



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad-500043

CIVIL ENGINEERING

TUTORIAL QUESTION BANK

Course Title	GROUND IMPROVEMENT TECHNIQUES				
Course Code	ACE509				
Programme	B.Tech				
Semester	VII	CE			
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lectures	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Chief Coordinator	Mr. Ch. Balakrishna, Assistant Professor				
Course Faculty	Mr. Ch. Balakrishna, Assistant Professor Mr. S. Siva Ramakrishna, Assistant Professor				

COURSE OBJECTIVES:

The course should enable the students to:	
I	Identify the types of soils and categorize the problematic soils by in-situ laboratory tests.
II	Design dewatering systems to prevent significant groundwater seepage into the excavation and to ensure stability of excavation side slopes.
III	Modify the ground by different procedures such as admixtures, shot Crete, grouting and ground freezing.
IV	Apply different methods of soil reinforcement like soil anchors, rock bolts and soil nails in cohesive and granular soils.

COURSE OUTCOMES (COs):

CO 1	Describe different types of soils, In situ and laboratory tests to characterize soils.
CO 2	Describe various mechanical modification techniques like blasting, vibro compaction, dynamic tamping and compaction piles.
CO 3	Describe various dewatering methods, their choice and various hydraulic ground modification techniques.
CO 4	Explore the concept of soil modification by physical and chemical methods.
CO 5	Explain soil reinforcement technique, reinforcement with strip, in-situ ground reinforcement, ground anchors and soil nailing.

COURSE LEARNING OUTCOMES (CLOs):

ACE509.01	Understand the needs and objectives of ground improvement techniques.
ACE509.02	Identify soil types by performing In Situ and laboratory tests to characterize problematic soils.
ACE509.03	Analyze Mechanical, hydraulic, physic-chemical methods of ground improvement techniques.
ACE509.04	Understand Electrical, Thermal methods, and their applications of ground modification.
ACE509.05	Understand the need for mechanical modification
ACE509.06	Analyze Deep Compaction techniques
ACE509.07	Recognize the need for Blasting vibro compaction
ACE509.08	Understand the objectives and techniques of hydraulic modification.
ACE509.09	Identify traditional dewatering methods and their choice
ACE509.10	Design of dewatering system and understandingelectro-osmosis technique
ACE509.11	Understand Electro kinetic dewatering technique and Filtration technique used in geosynthetics.
ACE509.12	Analyze drainage and seepage control with geosynthetics.
ACE509.13	Identify preloading the vertical drains and understand Physical and Chemical Modification of admixtures.
ACE509.14	Analyze the importance of shotcreting and guniting Technology.
ACE509.15	Understand modification at depth by grouting, Crack grouting and compaction grouting
ACE509.16	Understand Jet grouting technique, Thermal modification, Ground freezing.
ACE509.17	Understand modification by inclusions and confinement
ACE509.18	Recognize the need for Soil reinforcement and grid reinforced soil.
ACE509.19	Analyze the importance of In-situ ground reinforcement.
ACE509.20	Understand ground anchors, Rock bolting and soil nailing.

TUTORIAL QUESTION BANK

UNIT- I				
INTRODUCTION TO GROUND MODIFICATION				
Part - A (Short Answer Questions)				
S No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes (CLOs)
1	What is the need for ground improvement?	Remember	CO 1	ACE509.01
2	What are the objectives of ground improvement?	Understand	CO 1	ACE509.01
3	What is expansive soil? Give one example.	Remember	CO 1	ACE509.01
4	What are the major problematic soils?	Understand	CO 1	ACE509.01
5	What are the difficulties faced with soft clay?	Understand	CO 1	ACE509.02
6	What is a collapsible soil?	Understand	CO 1	ACE509.02
7	Name various soil deposits found in India.	Remember	CO 1	ACE509.02
8	What is the need for improving the ground?	Remember	CO 1	ACE509.02
9	Name any four ground improvement techniques.	Remember	CO 1	ACE509.02
10	Define ground improvement.	Understand	CO 1	ACE509.03
11	Classify ground modification techniques?	Understand	CO 1	ACE509.03
12	What are the tests to identify the problematic soils?	Understand	CO 1	ACE509.03
13	Explain in brief mechanical modification?	Understand	CO 1	ACE509.03
14	Define hydraulic modification?	Understand	CO 1	ACE509.03
15	Explain in brief physical and chemical modification?	Remember	CO 1	ACE509.03
16	Define Electrical modification?	Remember	CO 1	ACE509.03
17	Explain in brief thermal ground improvement technique?	Understand	CO 1	ACE509.03
18	Differentiate between mechanical and hydraulic modification techniques?	Remember	CO 1	ACE509.03
19	What are the applications of physical and chemical ground modification techniques?	Remember	CO 1	ACE509.03
20	Differentiate between electrical and thermal modification techniques?	Understand	CO 1	ACE509.03
Part - B (Long Answer Questions)				
1	Explain in detail the role of ground improvement in foundation engineering.	Remember	CO 1	ACE509.02
2	What are the objectives of ground improvement Technique?	Remember	CO 1	ACE509.02
3	What are the various geotechnical problems faced with black cotton soil, laterite soil and alluvial soil deposits?	Understand	CO 1	ACE509.02
4	Explain in detail thermal modification techniques along with their merits and demerits?	Understand	CO 1	ACE509.02
5	What are the factors influencing the selection of ground improvement techniques?	Remember	CO 1	ACE509.02
6	Classify ground improvement Technique and explain them in detail?	Remember	CO 1	ACE509.03
7	Explain in detail mechanical modification techniques along with their merits and demerits?	Understand	CO 1	ACE509.03
8	Explain in detail hydraulic modification techniques along with their merits and demerits?	Remember	CO 1	ACE509.03
9	Explain in detail physical and chemical modification techniques along with their applications?	Understand	CO 1	ACE509.03
10	What are the various laboratory and field tests to characterise problematic soils? Explain them in detail?	Remember	CO 1	ACE509.03
11	Explain in detail various methods used to determine the water content in the soil.	Remember	CO 1	ACE509.03
12	Discuss the importance of plastic limit of the Soil?	Understand	CO 1	ACE509.03
13	Discuss the importance of liquid limit of the soil?	Remember	CO 1	ACE509.03
14	What are the applications of mechanical and hydraulic modifications techniques?	Understand	CO 1	ACE509.03
15	Differentiate between electrical and thermal modification techniques?	Remember	CO 1	ACE509.03
Part - C (Problem Solving and Critical Thinking Questions)				
1	Discuss the practical situations which necessitate the ground modification.	Understand	CO 1	ACE509.02
2	Explain in detail various field compaction tests and its applicable soil types?	Remember	CO 1	ACE509.02

3	What are the objectives of various soil improvement methods? Give an outline of various available techniques.	Remember	CO 1	ACE509.02
4	What are the major geotechnical problems in black cotton soils and discuss on the basic principles of each identified problem.	Understand	CO 1	ACE509.03
5	Discuss the appropriate techniques that can be used for controlling the problems in black cotton soils?	Remember	CO 1	ACE509.03
6	Discuss in detail the laboratory test for problematic soils?	Understand	CO 1	ACE509.03
7	Discuss the problems associated with expansive soils on building foundations?	Understand	CO 1	ACE509.03
8	Discuss the field conditions that favour the swelling of soils and write its consequences?	Understand	CO 1	ACE509.03

UNIT-II

MECHANICAL MODIFICATION

Part – A (Short Answer Questions)

1	What are the various methods of in-situ densification of soil?	Understand	CO 2	ACE509.05
2	What is vibrocompaction.	Remember	CO 2	ACE509.07
3	What do you understand from the term in-situ densification?	Understand	CO 2	ACE509.05
4	What is vibro-displacement?	Understand	CO 2	ACE509.05
5	Define Dynamic Tamping.	Understand	CO 2	ACE509.05
6	Define mechanical modification.	Understand	CO 2	ACE509.05
7	What is compaction?	Remember	CO 2	ACE509.05
8	What is compaction pile and where it is used?	Understand	CO 2	ACE509.05
9	What is stone column?	Understand	CO 2	ACE509.06
10	How is blasting a ground improvement technique?	Remember	CO 2	ACE509.06
11	Write the advantages of compaction piles.	Understand	CO 2	ACE509.06
12	What are the applications of stone column?	Understand	CO 2	ACE509.05
13	What are the methods of installing a stone column?	Remember	CO 2	ACE509.05
14	Write the advantages and disadvantages of compaction piles.	Remember	CO 2	ACE509.05
15	Define dynamic compaction?	Remember	CO 2	ACE509.05
16	What are the various deep compaction techniques?	Understand	CO 2	ACE509.06
17	What is vibro-flotation?	Understand	CO 2	ACE509.06
18	What are the applications of vibro-flotation?	Remember	CO 2	ACE509.05
19	What is dynamic consolidation?	Remember	CO 2	ACE509.05
20	Write the advantages of dynamic consolidation?	Remember	CO 2	ACE509.05

Part - B (Long Answer Questions)

1	What are the equipments used in vibro compaction method?	Understand	CO 2	ACE509.05
2	Discuss with a neat diagram installation of explosives for ground improvement techniques	Understand	CO 2	ACE509.07
3	Explain in detail the method dynamic consolidation of cohesive soil.	Understand	CO 2	ACE509.07
4	How is a rammed stone column installed?	Understand	CO 2	ACE509.07
5	Explain in detail vibro-compaction? In which soils it is adopted?	Understand	CO 2	ACE509.09
6	What are compaction piles? Discuss the installation procedure of compaction piles.	Understand	CO 2	ACE509.09
7	What is stone column? What are the methods of installing a stone column?	Understand	CO 2	ACE509.05
8	Explain in detail the method of dynamic compaction of cohesion less soil.	Remember	CO 2	ACE509.09
9	Explain in detail with a neat diagram the method of dynamic tamping?	Understand	CO 2	ACE509.09
10	Discuss in detail the procedure of the vibro compaction?	Understand	CO 2	ACE509.09
11	What is in-situ densification of soil? Explain in detail.	Understand	CO 2	ACE509.05
12	How dynamic tamping is helpful in compaction of the soil.	Remember	CO 2	ACE509.07
13	Write the advantages and Disadvantages of sand blasting Techniques.	Remember	CO 2	ACE509.07
14	Write short notes on: a) Heavy Tamping b) Impact rollers c) Plate vibrators.	Understand	CO 2	ACE509.09
15	How does a sand compaction pile improve the soil? Write a detailed note on its installation and functioning.	Understand	CO 2	ACE509.07

Part - C (Problem Solving and Critical Thinking Questions)

1	Compare and contrast the various methods of in-situ densification techniques.	Understand	CO 2	ACE509.07
2	Differentiate between vibro compaction and vibro Replacement? Explain them in detail.	Understand	CO 2	ACE509.07
3	What are the merits and demerits of dynamic compaction?	Understand	CO 2	ACE509.09
4	Explain in brief about the installation and working of a vibro-replacement stone column.	Understand	CO 2	ACE509.09

5	Explain in detail with neat sketch stone column construction methods?	Understand	CO 2	ACE509.09
6	Describe the vibroflotation technique of identifying granular soil.	Understand	CO 2	ACE509.05
7	Explain impact at depth method of soil densification.	Understand	CO 2	ACE509.05
UNIT - III				
HYDRAULIC MODIFICATION				
Part - A (Short Answer Questions)				
1	When are deep wells used for dewatering?	Understand	CO 3	ACE509.10
2	Define dewatering?	Understand	CO 3	ACE509.12
3	What is the need for drainage and dewatering?	Remember	CO 3	ACE509.12
4	What are the objectives used in dewatering?	Understand	CO 3	ACE509.11
5	What are the various methods of dewatering?	Remember	CO 3	ACE509.11
6	Explain about well point system.	Understand	CO 3	ACE509.10
7	What is hydraulic modification?	Understand	CO 3	ACE509.13
8	What is electro kinetic dewatering?	Understand	CO 3	ACE509.10
9	How are sumps and ditches used in dewatering?	Understand	CO 3	ACE509.12
10	What are the different types of well point systems?	Remember	CO 3	ACE509.11
11	What are the different types of drains?	Understand	CO 3	ACE509.10
12	Define geosynthetics in ground improvement techniques?	Understand	CO 3	ACE509.12
13	How seepage control is done with geosynthetics?	Understand	CO 3	ACE509.11
14	What is the role of geosynthetics in separation work?	Understand	CO 3	ACE509.11
15	What are the types of drainages?	Understand	CO 3	ACE509.09
16	What is preloading and when it is adopted as a ground improvement technique?	Remember	CO 3	ACE509.11
17	Explain the role of geosynthetics in filtration work?	Remember	CO 3	ACE509.09
18	Define Vertical drains	Understand	CO 3	ACE509.12
19	Define Pre-fabricated vertical drains	Understand	CO 3	ACE509.12
20	What is advantage of using vertical drains along with pre-loading?	Remember	CO 3	ACE509.10
Part – B (Long Answer Questions)				
1	Explain in detail with a neat sketch the method of dewatering using sumps and ditches stating its advantages and disadvantages.	Remember	CO 3	ACE509.13
2	Explain in detail various types of geosynthetics & their applications?	Understand	CO 3	ACE509.13
3	Explain in detail the well point system of dewatering?	Remember	CO 3	ACE509.13
4	What is a deep well? When is it adopted? What are its merits and demerits?	Understand	CO 3	ACE509.13
5	Explain in brief the principle, equipment used, installation and operation adopted in electro-osmotic dewatering.	Remember	CO 3	ACE509.13
6	Explain in brief the various steps for designing a dewatering system.	Understand	CO 3	ACE509.13
7	Compare the various dewatering systems suitability, uses, merits and demerit.	Understand	CO 3	ACE509.13
8	Explain in detail single stage well point with neat sketch.	Understand	CO 3	ACE509.13
9	Write the various methods of preloading adopted in ground improvement technique.	Understand	CO 3	ACE509.13
10	What are vertical drains and when it is adopted?	Remember	CO 3	ACE509.13
11	Discuss in detail electro-kinetic dewatering technique with neat sketch?	Remember	CO 3	ACE509.12
12	Explain in detail multi stage well points with neat sketch?	Understand	CO 3	ACE509.11
13	Discuss the advantages and disadvantages of dewatering system.	Understand	CO 3	ACE509.10
14	Discuss the consideration taken to design a proper dewatering system.	Remember	CO 3	ACE509.12
15	Explain in detail with the help of neat sketches, application of geosynthetics as separator?	Understand	CO 3	ACE509.11
16	How do geosynthetics function as a filter? How does it differ in its function for drainage? Explain in detail with sketches.	Remember	CO 3	ACE509.12
17	Explain in detail application of geosynthetics as a drainage material?	Understand	CO 3	ACE509.11
Part – C (Problem Solving and Critical Thinking)				
1	Explain in brief various traditional dewatering systems and their choice.	Understand	CO 3	ACE509.13
2	What are the advantages of sumps and ditches in dewatering?	Understand	CO 3	ACE509.13
3	How do geosynthetics function as a filter? How does it differ in its function for drainage? Explain in detail with sketches.	Understand	CO 3	ACE509.13
4	Explain the design of dewatering system in hydraulic modification of the ground.	Understand	CO 3	ACE509.13
5	Explain drainage prevention after construction of structure on a ground.	Remember	CO 3	ACE509.13

6	Explain in detail about the dewatering techniques used in cohesive soils.	Remember	CO 3	ACE509.12
7	Explain in detail the advantage of using vertical drains along with preloading?	Understand	CO 3	ACE509.11
UNIT -IV				
PHYSICAL AND CHEMICAL MODIFICATION				
Part – A (Short Answer Questions)				
1	Define grouting as a ground improvement techniques.	Understand	CO 4	ACE509.14
2	Write the applications of grouting.	Understand	CO 4	ACE509.13
3	What are the various methods of grouting?	Understand	CO 4	ACE509.14
4	What are the different types of grouts?	Remember	CO 4	ACE509.15
5	Name the different methods of grout injection.	Understand	CO 4	ACE509.16
6	What are the two methods of mechanical stabilization?	Remember	CO 4	ACE509.13
7	How is stabilization of soil achieved by cement?	Understand	CO 4	ACE509.16
8	How ground modification is done by grouting?	Remember	CO 4	ACE509.14
9	Explain stabilization by heating in thermal methods of ground improvement techniques.	Understand	CO 4	ACE509.16
10	Explain in brief Jet Grouting.	Understand	CO 4	ACE509.16
11	Explain about compaction Grouting.	Understand	CO 4	ACE509.13
12	Discuss dry mix Vs wet mix.	Understand	CO 4	ACE509.16
13	Differentiate between Shotcreting and Guniting.	Understand	CO 4	ACE509.15
14	What is crack grouting?	Understand	CO 4	ACE509.17
15	What is low mobility Grouting?	Remember	CO 4	ACE509.16
16	Explain freezing of ground.	Understand	CO 4	ACE509.14
17	Explain heating of ground.	Understand	CO 4	ACE509.16
18	Define shotcreting technology.	Understand	CO 4	ACE509.13
19	Define Guniting technology.	Understand	CO 4	ACE509.16
20	Define thermal modification?	Understand	CO 4	ACE509.14
Part – B (Long Answer Questions)				
1	Describe in detail various methods of grouting with neat sketches.	Understand	CO 4	ACE509.16
2	Write short notes on: (a) Pre-grout investigation (b) Grout holes pattern (c) Selection of grout characteristics	Remember	CO 4	ACE509.16
3	How are heating and freezing used to improve ground?	Remember	CO 4	ACE509.16
4	Discuss in detail compaction grouting and jet grouting	Remember	CO 4	ACE509.16
5	What are the various methods of jet grouting?	Understand	CO 4	ACE509.15
6	Define Grouting. What are the materials used in grouting?	Remember	CO 4	ACE509.16
7	Discuss in detail the grouting procedure.	Understand	CO 4	ACE509.15
8	Explain about the jet grouting with neat sketch.	Remember	CO 4	ACE509.15
9	What do you understand from the term chemical stabilization?	Understand	CO 4	ACE509.16
10	What is the procedure for cement grouting of cracks in concrete structures?	Understand	CO 4	ACE509.16
11	Discuss the application of Grouting?	Remember	CO 4	ACE509.14
12	Discuss various methods of Shotcreting?	Understand	CO 4	ACE509.15
13	Discuss shotcrete vs gunite in detail.	Understand	CO 4	ACE509.13
14	Describe in detail the various applications of grouting?	Understand	CO 4	ACE509.14
15	Describe in detail chemical stabilization of the soil with the help of an example.	Understand	CO 4	ACE509.13
Part – C (Problem Solving and Critical Thinking)				
1	Explain in detail how expansive soils are stabilized.	Understand	CO 4	ACE509.16
2	Explain in detail cement stabilization?	Understand	CO 4	ACE509.16
3	How thermal methods are helpful in soil stabilization.	Remember	CO 4	ACE509.16
4	Explain in detail difference between compaction and jet grouting?	Understand	CO 4	ACE509.16
5	Explain in detail principle of ground modification at depth by grouting?	Remember	CO 4	ACE509.16
UNIT-V				
MODIFICATION BY INCLUSIONS AND CONFINEMENT				
Part - A (Short Answer Questions)				
1	What is soil reinforcement?	Understand	CO 5	ACE509.17
2	Define grid reinforced soil.	Understand	CO 5	ACE509.18
3	Define soil nailing.	Understand	CO 5	ACE509.18
4	Discuss about ground anchors.	Understand	CO 5	ACE509.18

5	What is soil reinforcement?	Understand	CO 5	ACE509.17
6	What is the application of geosynthetics?	Remember	CO 5	ACE509.18
7	What is in-situ reinforcement?	Remember	CO 5	ACE509.18
8	Define soil or fill material.	Remember	CO 5	ACE509.18
9	Define Grouted nails.	Remember	CO 5	ACE509.18
10	Define facing in reinforcement.	Remember	CO 5	ACE509.19
11	Define geogrids in ground improvement.	Remember	CO 5	ACE509.19
12	Define rock bolting.	Remember	CO 5	ACE509.19
13	Define driven nails.	Remember	CO 5	ACE509.19
14	Write a brief note on geosynthetics as reinforcement.	Remember	CO 5	ACE509.18
15	What is reinforced soil wall?	Understand	CO 5	ACE509.19
16	Define geomembrane.	Understand	CO 5	ACE509.19
17	What are the advantages of soil nailing.	Understand	CO 5	ACE509.20
18	Define Grouted nails.	Remember	CO 5	ACE509.20
19	What is meant by reinforced soil?	Understand	CO 5	ACE509.20
20	What are the advantages of soil nailing	Understand	CO 5	ACE509.20
Part - B (Long Answer Questions)				
1	What are the various types of geosynthetics & explain in detail four major applications of geosynthetics?	Understand	CO 5	ACE509.18
2	Describe in detail about soil nailing and when is it adopted?	Remember	CO 5	ACE509.18
3	Describe in detail rock bolting.	Understand	CO 5	ACE509.17
4	Explain "Geosynthetics can be used as soil reinforcement Justify in detail with supporting sketches.	Understand	CO 5	ACE509.18
5	Why soil nails are called passive inclusion?	Remember	CO 5	ACE509.20
6	Discuss the following terms in detail Soil nailing, Rock bolting, Ground Anchor and Reinforced Earth.	Remember	CO 5	ACE509.20
7	What are the three basic material composites required in the construction of any reinforced soil structure?	Understand	CO 5	ACE509.18
8	What are the applications of earth reinforcement?	Understand	CO 5	ACE509.17
9	What are the applications of soil nailing?	Understand	CO 5	ACE509.18
10	What are the applications of ground anchors?	Understand	CO 5	ACE509.19
11	Define ground anchors. What are the different types of ground anchors?	Remember	CO 5	ACE509.19
12	With neat sketches explain in detail the various applications of reinforced earth for ground improvement?	Understand	CO 5	ACE509.19
13	Write the applications of rock bolting.	Understand	CO 5	ACE509.20
14	Describe in detail about soil nailing and when is it adopted?	Understand	CO 5	ACE509.20
15	Explain in details various in-situ ground reinforcement techniques?	Understand	CO 5	ACE509.20
Part – C (Problem Solving and Critical Thinking)				
1	Explain in detail the use of geosynthetics as reinforcement?	Understand	CO 5	ACE509.19
2	Explain the design principles of reinforced earth walls?	Understand	CO 5	ACE509.19
3	What do you understand by reinforced earth? Enumerate various applications of reinforced earth.	Remember	CO 5	ACE509.20
4	Explain the procedure of soil nailing and rock bolting?	Understand	CO 5	ACE509.19
5	Explain the difference between ground anchor and soil nailing?	Understand	CO 5	ACE509.20

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