Techno India NJR Institute of Technology

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Course File

Subject Title/Subject Code: Geotechnical Engineering

(5CE4- 04)

Semester: V Year: III

Name of the Faculty: Mr. Jitendra Choubisa

E-mail id: jitendra.choubisa@technonjr.org

Class Schedule

Total Number of Lectures: 42

i) Course Objective

This course aims to provide a foundational understanding of geotechnical engineering, focusing on soil mechanics, properties, and classification. Students will learn to analyze soil stresses, permeability, and stability, and understand various soil testing methods. The course covers slope stability, earth pressure theories, bearing capacity, and site investigation techniques, equipping students with practical skills for design and construction in civil engineering. By the end, students will be able to evaluate soil behavior, address geotechnical challenges, and apply their knowledge to the development of safe and efficient structures.

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VISSION & MISSION OF INSTITUTE

Vision

Empowering student with recent and emerging technologies to create innovative technical leaders capable of contributing to industrial and societal needs for betterment of mankind across the globe.

Mission

M1: To provide dynamic learning environment to students by providing constant exposure to latest technologies by linking closely with the industries.

M2: To establish effective interface with industry to obtain live problems to enhance critical thinking and problem-solving skills among students and consultancy projects for faculty.

M3: To provide avenues and opportunities to faculty for domain specific trainings and qualification upgradation.

M4: To develop ethical leaders with strong communication skills.

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VISION & MISSION OF DEPARTMENT

Department Vision

To increase students learning of fundamentals for designing and planning of buildings and latest technologies through industry-aligned project-based learning which will help in transforming students to be good civil engineering professionals leading to innovation and incubation of new ideas.

Department Mission

M1: To create experimental learning through solving problems of Government, Society, Smart Cities, Industry and other entities.

M2: To teach the latest technologies to the students as beyond the syllabus activity so that they are updated and industry ready.

M3: To enable engineering students, understand industry-aligned technologies and learn to find solutions from their early engineering days and this is the only way to produce globally relevant engineers solving real-life problems applying current technologies.

M4: To enable students to generate projects through problem faced by and requirement of Smart cities, industry, Government and other entities whereby those outlined problem statements are to be studied deeply by a group of faculty members to convert them into real-time project format.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs 1: To provide an in-depth understanding of the fundamentals of Civil Engineering and create a foundation for lifelong learning to facilitate a progressive career in the construction Industry, as an entrepreneur and in pursuit of higher studies.

PEOs 2: To equip the students with technical and analytical skills to develop innovative solutions to complex real-life problems using existing and novel technologies. To equip the students with good communication and interpersonal skills, inter-disciplinary teamwork and leadership skills to enable them to fulfill professional responsibilities.

PEOs 3: To expose them to various contemporary issues which will enable them to become ethical and responsible towards themselves, co-workers, Society and the Nation.

PEOs 4: To make the student's industry ready by imparting education related to the latest technologies so that they can grab future industry jobs.

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PROGRAM SPECIFIC OUTCOMES (PSO's)

PSO1: To be aware of and initiate some-work on future technologies and new developments which may impact the future Industry 4.0.

PSO2: Hands on training on upcoming technologies and project-based learning.

PSO3: Get exposure to BIM (Building Information Modeling).

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PROGRAMME OUTCOMES (POs)

A student will develop:

PO01. ENGINEERING KNOWLEDGE: An ability to apply knowledge of Mathematics, Science and Engineering Fundamentals in Electronics and Communication Engineering.

PO02. PROBLEM ANALYSIS: Ability to analyze and interpret data by designing and conducting experiments. Develop the knowledge of developing algorithms, designing, implementation and testing applications in electronics and communication related areas.

PO03. DESIGN/ DEVELOPMENT OF SOLUTION: An ability to Design a system Component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

PO04. CONDUCTION OF INVESTIGATION OF COMPLEX PROBLEMS: Ability to Identify, formulate and solve engineering problems.

PO05. MODERN TOOL USAGE: An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

PO06. THE ENGINEERING AND SOCIETY: Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.

PO07. ENVIRONMENT & SUSTAINABILITY: Understand the impact of professional engineering solution in societal and environmental contexts, and demonstrate the knowledge of, and need of sustainable development.

PO08. ETHICS: An ability to understand the professional, social and ethical responsibility.

PO09. INDIVIDUAL AND TEAM WORK: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. COMMUNICATION: An ability to Communicate effectively in order to succeed in their profession such as, being able to write effective reports and design documentation, make effective presentations.

PO11. PROJECT MANAGEMENT & FINANCE: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in team, to manage projects and in multidisciplinary environment.

PO12. LIFE-LONG LEARNING: Recognize the need and an ability to engage in life-long learning.

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COURSE OUTCOMES (COs) OF THE SUBJECT

CO No.	Mapping	Statement
CO35404.1	**Remembering**	Student will be able to Explain different types of soil present on Earth crust.
CO35404.2	**Understanding**	Student will be able to Explain different types of soil properties And their use in engineering fields
CO35404.3	**Applying**	Students will be able to Analyze engineering properties of soil Like compaction, permeability, and shear strength.
CO35404.4	**Analyzing**	Students will be able to Analyze engineering properties of soil Like compaction, permeability, shear strength.
CO35404.5	**Evaluating**	Students will be able to Compute the lateral thrust due to backfill On the retaining walls

COS MAPPING WITH POs AND PSOs

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO35404.1	3	2	2	2	0	0	0	0	0	0	0	2	2	1	1
CO35404.2	2	2	1	1	0	0	0	0	0	0	0	1	1	1	1
CO35404.3	3	2	2	2	0	0	0	0	0	0	0	2	2	1	1
CO35404.4	2	2	2	1	0	0	0	0	0	0	0	1	1	1	1
CO35404.5	2	2	2	2	0	0	0	0	0	0	0	0	1	1	1
CO35404 (AVG)	2.4	2	1.8	1.6	0	0	0	0	0	0	0	1.2	1.4	1	1

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UNIVERSITY ACADEMIC CALENDAR

Academic Calendar for Odd Semester for Session

RAJASTHAN TECHNICAL UNIVERSITY KOTA				
Course: Bachelor of Technology (B.TECH.) for Odd Semester				
Semester	I	III	V	VII
Induction Program	17.08.2023			
Commencement of Classes	11.09.2023	24.08.2023	04.09.2023	04.09.2023
Commencement of First Mid Term	02.11.2023	03.10.2023	05.10.2023	05.10.2023
Commencement of Second Mid Term	07.12.2023	16.11.2023	20.11.2023	20.11.2023
Last Working Day	23.12.2023	02.12.2023	02.12.2023	30.11.2023
Commencement of Practical Exams	02.01.2024	04.12.2023	23.12.2023	14.12.2023
Commencement of Theory Exams	18.01.2024	14.12.2023	08.12.2023	07.12.2023
Winter Break				

Academic Calendar of Institute

Academic Calendar for Odd semester for session 2023-24

Academic Calendar

Academic Calendar for Odd Semester for Session 2023-24 (Odd Semester)

Course: Bachelor of Technology (B.TECH.)				
Semester	**I**	**III**	**V**	**VII**
Induction Program	10-08-2023			
Commencement of Classes	20-08-2023	11-09-2023	30-08-2023	22-08-2023
Commencement of First Mid Term	04-11.2023	02-11.2023	02-11.2023	27-09-2023
Commencement of Second Mid Term	15-01-2024	27-12-2023	27-12-2023	05-12-2023
Last Working Day	20-01-2024	12-01-2024	12-01-2024	20-12-2023
Commencement of Practical Exams	29-01-2024	15-01-2024	15-01-2024	31-12-2023
Commencement of Theory Exams	15-02-2024	30-01-2024	29-01-2024	27-12-2023

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Evaluation Scheme

FACULTY DETAILS:

Name of the Faculty	:	Gourav Purbia
Designation	:	Technical Assistant
Department	:	Civil Engineering

1. TARGET

a) Percentage Pass: 100%
b) Percentage I class: 60 %

2. METHOD OF EVALUATION

- [x] Continuous Assessment Examinations (Mid-Term 1, Mid-Term 2)
- [x] Assignments / Seminars
- [ ] Mini Projects
- [x] Quiz
- [x] Semester Examination

Others_____

3. List out any new topic(s) or any innovation you would like to introduce in teaching the subject in this Semester.
4. Take the help of creative tools to stimulate creativity. Include slide presentations, demonstration or forms of visual exercises that will excite the young minds and capture their interest.

Signature of Faculty: **Signature of HOD**

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UNIVERSITY SYLLABUS

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. (Civil Engineering)

5CE4-04: GEOTECHNICAL ENGINEERING

Credit: 3 **Max. Marks: 100(IA:30, ETE:70)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Soil and soil-mass constituents, water content, specific gravity, void ratio, porosity, degree of saturation, air void and air content, unit weights, density index etc. Inter-relationships of the above. Determination of index properties of soil: water content, specific gravity, particle size distribution, sieve and sedimentation analysis, consistency limits, void ratio and density index. Mineral structures, structures of Illite Montmorillonites and kaolinite and their characteristics. Darcy's law of permeability of soil and its determination in laboratory. Stresses in soil mass: total, effective and neutral pressure, calculation of stresses, influence of water table on effective stress, quicksand phenomenon. Classification of soil for general engineering purposes: particle size and I.S. Classification systems.	8
3	Mohr's circle of stress, shearing strength of soil, parameters of shear strength, Coulomb's failure envelope, determination of shear parameters by Direct Shear Box. Tri-axial and unconfined compression test apparatuses. Principles of soil compaction, laboratory compaction tests; Proctor's test, Stresses in Soil under surface loading: Bossinesq's and Westergaard's analysis for vertical pressure and its distribution in a soil mass. Vertical stresses due to concentrated loads, Isobar diagram, Vertical stress distribution on a horizontal plane. Influence diagram, Vertical stresses at a point under circular and rectangular loaded area. Approximate methods of obtaining vertical pressure due to surface loading. Newmark's chart,	8

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Rajasthan Technical University, Kota

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. (Civil Engineering)

4	Compressibility and Consolidation: Introduction to consolidation, comparison of compaction and consolidation, Spring Analogy Terzaghis one dimensional consolidation theory, Degree of consolidation, consolidation test, Compressibility parameters, co-efficient of consolidation. Pre-consolidation pressure and its determination. Normally, over and under consolidated soils. Methods of predicting Settlement and its rate. Total and differential Settlement.	8
5	Stability of Slopes: Classifications of slopes, Stability analysis of infinite slopes. Stability of finite slopes by Swedish and Friction circle method. Stability analysis by Taylor's stability number , Taylor's stability number curves. . Bishop's method of stability analysis. Earth Pressure: Active, passive and earth pressure at rest. Rankine's and Coulomb's theories. Rebhann's and Culman's graphical methods for active earth pressure for vertical and inclined back retaining walls, horizontal and inclined cohesion less back fill.	8
6	Bearing Capacity of Soils: Terminology related to bearing capacity, Common types of foundations. Terzaghi and Meyehoff's theory for bearing capacity. Rankine's method for minimum depth of foundation. Skempton's method. Effect of eccentricity and water table on bearing capacity. IS code method, Plate load and penetration tests for determining bearing capacity. Introduction to pile, Site Investigations: Methods of explorations. Planning of Investigations, Depth of exploration, Number of boreholes, Undisturbed and Disturbed samples. Types of samplers. Brief description of procedures of sampling, Transportation and Storage of samples.	9
	TOTAL	**42**

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PRESCRIBED BOOKS

1. Basic and applied Civil Mechanics by Ranjan & Rao, NewAge International Publishers.
2. Soil Mechanics & Foundation Engineering by Arora K.R, StandardPublishers and Distributers, Delhi.
3. Soil Engineering in Theory & Practice by Alam Singh, CBS Publishersand Distributers, Delhi.

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WEEKLY TIME TABLE OF THE TEACHER

First Time Table: with effect from (Date):

Day	1	2	3	4	5	6	7
Monday	Geotech						
Tuesday	Geotech						
Wednesday	Geotech						
Thursday	Geotech						
Friday	Geotech						
Saturday							

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COURSE-PLAN

Lecture No.	Unit	Topic
1	1	INTRODUCTION: Objective, scope and outcome of the course
2	2	Student should be able to understand about SOIL AND SOIL-MASS CONSTITUENTS, water content
3	2	Student should be able to understand about Specific gravity, void ratio, porosity, degree of saturation
4	2	Student should be able to understand about Air void and air content, unit weights, density index
5	2	Student should be able to compute Inter-relationships between different properties of soil.
6	2	Student should be able to Determine of index properties of soil: water content, specific gravity
7	2	Student should be able to understand Particle size distribution, sieve and sedimentation analysis, consistency limits, voidratio and density index
8	2	Student should be able to understand Mineral structures, structures of Illite Montmorillonites and kaolinite and theircharacteristics
9	2	Student should be able to understand about Darcy's law of permeability of soil and its determination in laboratory
10	2	Student should be able to understand about Stresses in soil mass: total, effective and neutral pressure, calculation of stresses, influence of water table on effective stress

11	2	Student should be able to understand about Quicksand phenomenon. Classification of soil for general engineering purposes
12	3	Student should be able to understand about MOHR'S CIRCLE OF STRESS, shearing strength of soil, parameters of shearStrength, Coulomb's failure envelope
13	3	Student should be able to Determine shear parameters by Direct Shear Box
14	3	Student should be able to understand about Tri-axial and unconfined compression test apparatuses
15	3	Student should be able to understand Principles of soil compaction, laboratory compaction tests; Proctor's test
16	3	Student should be able to understand about Stresses in Soil under surface loading: Bossinesq's and Westergaard's analysis for vertical pressure and its distribution in a soil mass
17	3	Student should be able to understand about Vertical stresses due to concentrated loads, Isobar diagram
18	3	Student should be able to understand about Vertical stress distribution on a horizontal plane. Influence diagram
19	3	Student should be able to understand about Vertical stresses at a point under circular and rectangular loaded area
20	3	Student should be able to understand about Approximate methods of obtaining vertical pressure due to surface loading. Newmark's chart
21	4	Student should be able to understand

		about COMPRESSIBILITY AND CONSOLIDATION: Introduction to consolidation, comparison of compaction and consolidation,
22	4	Student should be able to understand about Spring Analogy Terzaghis one dimensional consolidation theory
23	4	Student should be able to understand about Degree of consolidation, consolidation test, Compressibility parameters
24	4	Student should be able to understand about Degree of consolidation, consolidationtest, Compressibility parameters
25	4	Student should be able to understand about Coefficient of consolidation. Preconsolidation pressure and its determination
26	4	Student should be able to understand about Normally, over and under consolidated soils
27	4	Student should be able to understand about Methods of predicting Settlement and its rate
28	4	Student should be able to understand about Total and differential Settlement
29	5	Student should be able to understand about STABILITY OF SLOPES: Classifications of slopes
30	5	Student should be able to understand about Stability of infinite slopes. Stability of finite slopes by Swedish and Friction circle method
31	5	Student should be able to understand Stability analysis of infinite slopes. Stability of finite slopes by Swedish and

		Friction circle method
32	5	Student should be able to understand about Stability analysis by Taylor's stability number , Taylor's stability number curves
33	5	Student should be able to understand about Stability analysis by Taylor's stability number , Taylor's stability number curves
34	5	Student should be able to understand about Bishop's method of stability analysis
35	5	Student should be able to understand about Earth Pressure: Active, passive and earth pressure at rest
36	5	Student should be able to understand about Rankine's and Coulomb's theories
37	5	Student should be able to understand about Rebhann's and Culman's graphical methods For active earth pressure for vertical and inclined back retaining Walls, horizontal and inclined cohesion less back fill
38	5	Student should be able to understand about Rebhann's and Culman's graphical methods For active earth pressure for vertical and inclined back retaining Walls, horizontal and inclined cohesion less back fill
39	6	Student should be able to understand about BEARING CAPACITY OF SOILS: Terminology related to bearing capacity, Common types of foundations
40	6	Student should be able to understand about Terzaghi and Meyehoff's theory for bearing capacity. Rankine's method for minimum depth of foundation. Skempton's method

41	6	Student should be able to understand about Effect of eccentricity and water table on bearing capacity
42	6	Student should be able to study on IS code method, Plate load and penetration tests for determining bearing capacity

Signature of Faculty: **Signature of HOD**

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Assignment – 1
B. TECH 3rd – YEAR (V SEM.)
Subject: - *Geotechnical Engineering(5CE4- 04)*

1. Explain the significance of the degree of saturation in soil mechanics and how it affects soil behavior.

2. Describe the process and importance of sieve analysis in determining the particle size distribution of soil.

3. A soil sample has a bulk density of 1.85 g/cm³, a specific gravity of 2.65, and a moisture content of 10%. Calculate the void ratio and the degree of saturation of the soil.

4. A soil layer is subjected to a total vertical stress of 150 kN/m², and the pore water pressure in the same layer is 50 kN/m². Calculate the effective stress in the soil layer.

5. Discuss the factors that influence soil compaction and the significance of Proctor's compaction test in ensuring adequate soil density for construction.

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Assignment – 2
B. TECH 3rd – YEAR (V SEM.)
Subject: - *Geotechnical Engineering(5CE4- 04)*

1. Given a soil sample with a moisture content of 12%, specific gravity of 2.70, and a bulk density of 1.80 g/cm³, calculate the void ratio and the dry density of the soil.

2. A soil has a specific gravity of 2.68, a water content of 14%, and a dry density of 1.85 g/cm³. Determine the porosity of the soil.

3. In a laboratory test, a soil sample has a length of 30 cm and a cross-sectional area of 10 cm². The hydraulic head difference across the sample is 15 cm, and the discharge rate is 5 cm³/min. Calculate the coefficient of permeability.

4. Describe the procedure for conducting a standard Proctor compaction test and explain how the results are used to determine the optimum moisture content and maximum dry density of the soil.

5. Outline the steps involved in performing a sieve analysis for soil classification. What information can be obtained from the results of this test?

6. Explain the difference between primary and secondary consolidation in soil. How does Terzaghi's theory apply to the analysis of one-dimensional consolidation?

7. A soil sample has a coefficient of consolidation of 0.005 cm²/min and a compression index of 0.25. If the thickness of the soil layer is 10 meters, estimate the time required for 50% primary consolidation.

8. Discuss the factors affecting the bearing capacity of soils and describe the methods used to determine it in the field. Provide a detailed explanation and example.

9. Describe the process of slope stability analysis using the Swedish circle method. How do you apply this method to determine the safety factor of a slope?

10. Classify a soil sample with the following characteristics: particle size distribution shows 40% sand, 30% silt, and 30% clay. Use the Unified Soil Classification System (USCS) to determine the soil classification.

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SAMPLE QUIZ QUESTIONS

1. What are the primary constituents of a soil mass?

a) Water, air, and organic material

b) Water, air, and mineral particles

c) Air, organic material, and mineral particles

d) Organic material, water, and mineral particles

Answer: b) Water, air, and mineral particles

2. Which of the following describes the degree of saturation?

a) The ratio of water content to the weight of dry soil

b) The ratio of the volume of water to the volume of voids

c) The ratio of air content to the total volume

d) The ratio of void ratio to the specific gravity

Answer: b) The ratio of the volume of water to the volume of voids

3. What does Darcy's law primarily relate to?

a) Soil compaction

b) Soil permeability

c) Soil consolidation

d) Soil stability

Answer: b) Soil permeability

4. Which mineral structure is characterized by a 2:1 layer ratio?

a) Kaolinite

b) Montmorillonite

c) Illite

d) Calcite

Answer: b) Montmorillonite

5. What is the purpose of a sieve analysis?

a) To determine soil permeability

b) To determine particle size distribution

c) To measure soil compaction

d) To measure shear strength

Answer: b) To determine particle size distribution

6. What is effective stress in soil mechanics?

a) Total stress minus pore water pressure

b) Total stress plus pore water pressure

c) Pore water pressure minus total stress

d) Neutral stress minus pore water pressure

Answer: a) Total stress minus pore water pressure

7. Which phenomenon occurs when the upward seepage force exceeds the weight of soil particles?

a) Compaction

b) Consolidation

c) Quicksand condition

d) Shear failure

Answer: c) Quicksand condition

8. What is represented by the Mohr’s circle in soil mechanics?

a) Soil permeability

b) Shear strength of soil

c) Compaction curves

d) Consolidation rate

Answer: b) Shear strength of soil

9. Which test is used to determine the shear parameters of soil?

a) Proctor's compaction test

b) Unconfined compression test

c) Plate load test

d) Direct shear test

Answer: d) Direct shear test

10. Which soil classification system is based on particle size?

a) Unified Soil Classification System (USCS)

b) AASHTO Soil Classification

c) Indian Standard (IS) Classification System

d) All of the above

Answer: d) All of the above

11. What is the main difference between compaction and consolidation?

a) Compaction is an increase in soil density by removing water, while consolidation is an increase by air expulsion.

b) Compaction is a rapid process by mechanical means, while consolidation is a slow process due to expulsion of water.

c) Compaction occurs due to surface loading, while consolidation occurs due to groundwater.

d) Both processes are the same.

Answer: b) Compaction is a rapid process by mechanical means, while consolidation is a slow process due to expulsion of water.

12. Which theory is used for analyzing one-dimensional consolidation in soils?

a) Darcy’s theory

b) Terzaghi’s theory

c) Rankine’s theory

d) Coulomb’s theory

Answer: b) Terzaghi’s theory

13. Which method is commonly used for analyzing the stability of finite slopes?

a) Taylor’s stability number method

b) Newmark’s chart method

c) Plate load test

d) Mohr’s circle method

Answer: a) Taylor’s stability number method

14. What is Rankine's theory used to determine in soil mechanics?

a) Bearing capacity of soil

b) Active and passive earth pressure

c) Soil consolidation rate

d) Soil compaction characteristics

Answer: b) Active and passive earth pressure

15. What does Bishop's method analyze in geotechnical engineering?

a) Compaction characteristics of soil

b) Stability of slopes

c) Consolidation rate

d) Permeability of soil

Answer: b) Stability of slopes

16. Which factor does not affect the bearing capacity of soil?

a) Soil type and structure

b) Depth of foundation

c) Water table location

d) Surface vegetation

Answer: d) Surface vegetation

17. Which test is used to determine the bearing capacity of soil on-site?

a) Proctor's compaction test

b) Plate load test

c) Triaxial compression test

d) Direct shear test

Answer: b) Plate load test

18. Which method is used to determine the minimum depth of a foundation according to soil conditions?

a) Terzaghi’s method

b) Rankine's method

c) Skempton’s method

d) Coulomb’s method

Answer: b) Rankine's method

19. What is the primary purpose of site investigation in geotechnical engineering?

a) To determine soil color and texture

b) To assess the groundwater level only

c) To collect data for safe and economical design

d) To ensure vegetation growth

Answer: c) To collect data for safe and economical design

20. What type of sample is required for accurate soil property analysis in the laboratory?

a) Disturbed sample

b) Undisturbed sample

c) Water sample

d) Mixed sample

Answer: b) Undisturbed sample

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TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR

B. TECH III YEAR (V SEM.) – MT-I

Geotechnical Engineering (5CE4-04)

Time: 3 Hr **Max. Marks:** 70

Note:

1. The paper is divided into 2 parts: Part-A and, Part-B.
2. Part-A contains 10 questions and carries 2 mark each.
3. Part-B contains 5 questions. Each question is having two options and carries 10 marks each.

Part- A (20 Marks)

A. Explain the process of Soil formation	CO1
B. Explain the Alluvial, Lacustrine, Marine & Aeoline Soil.	CO1
C. Explain what water content is & Void Ratio.	CO1
D. Explain Degree of Saturation & Air Content.	CO1
E. Derive the Inter-relationship between e, w, G, S.	CO2
F. Describe what Radiation method is?	CO2
G. Explain what is core cutter instrument?	CO2
H. Explain the three-phase system of Soil.	CO2
I. Explain Stoke's Law.	CO3
J. What do you understand by Calcium Carbide method?	CO3

Part- B (50 Marks)

1. Explain in detail the oven drying method for determining the water content.	CO1
OR	
1. Explain in detail the Pycnometer method for determining the water content.	CO1

2. Explain what Sieve Analysis is for particle size distribution.	CO1
OR	
2. Explain in detail Density Index and write the range of Density Index with respective Description of soil.	CO1

3. The moist unit weight of a soil is 16.5 kN/m^3. Given that the w = 15% and G = 2.70, find: (1) Dry unit weight γ_d, (2) The porosity n, (3) The degree of saturation S.	CO2
OR	
3. The dry density of a sand with porosity of 0.387 is 1600 kg/m^3. Find the void ratio of the soil and the specific gravity of the soil solids. Take Unit weight of water = 1000 kg/m^3, n = 0.387, Υ_d= 1600 kg/m^3.	CO2

4. A contractor has compacted the base course for a new road and found that the mean value of the test samples shows w = 14.6%, GS = 2.81, and γ = 18.2 kN/m^3. The specifications require that e $\leq$ 0.80. Has the contractor complied with the specifications?	CO2
OR	
4. A saturated soil sample has a unit weight of 12.5 Kn/m^3 and G=2.70. Find dry γ , e, n, and w.	CO2

5. Derive the relationship between Υ, G, e, S, Υ_w	CO3
OR	
5. Describe the Soil formation cycle and types of soil in detail.	CO3

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Marks and Gap Analysis of Mid-Term I

S.No.	University Roll No.	Name of Student	Mid-Term 1 MM-70	Remark (Remedial Class need or not – Y/N)
1.	21ETCCE001	Dev vaishnav	50	N
2.	21ETCCE002	Hitesh Sutradhar	45	N
3.	21ETCCE004	Naved khan	47	N
4.	21ETCCE006	Pushpendra gehlot	54	N
5.	21ETCCE007	Shalin Dak	45	N
6.	21ETCCE009	Tamanna kumawat	61	N
7.	21ETCCE300	Muniraj Sharma	58	N
8.	22ETCCE200	Moiz Udaipurwala	50	N
9.	22ETCCE201	Vikas Suthar	58	N

(Y, if obtained marks are <50%)

Signature of Faculty: **Signature of HOD**

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Remedial Action Taken to Remove the Gaps (After Mid-Term 1)

S.no.	University Roll no.	Name of Student	Topics to be discussed in Remedial Class	Schedule Date of Remedial Class	Outcome Achieved
1.	NIL				
2.					

Signature of Faculty: **Signature of HOD**

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Mid Term Paper-II

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR

B. TECH III YEAR (V SEM.) – MT-II

Geotechnical Engineering (5CE4-04)

Time: 3 Hr **Max. Marks:**70

Note:

1. The paper is divided into 3 parts: Part-A Part-B & Part-C.
2. Part-A contains 10 questions and carries 2 mark each.
3. Part-B contains 7 questions. Attempt any 4 questions. Each question is having two options and carries 5 marks each.
4. Part-C contains 5 questions. Attempt any 3 questions. Each question is having two options and carries 10 marks each

Part- A (20 Marks)

A. Explain what water content is?	CO1
B. Explain the phases of soil.	CO1
C. Explain what is active earth pressure and Passive Earth Pressure.	CO2
D. Explain the finite & infinite slope.	CO2
E. Explain Compaction.	CO3
F. Explain Consolidation.	CO3
G. Explain Darcy's law of permeability.	CO4
H. Explain the three-phase system of Soil.	CO4
I. Explain bearing capacity of a soil.	CO5
J. Write any two assumption of terzaghi's theory.	CO5

Part- B (50 Marks)

1. What do you understand by Darcy's law of permeability, Explain with diagram?	CO1
2. Explain the procedure of obtaining pressure under any uniform loaded area by Newmark's Influence chart. Draw the chart neatly and show the used formula.	CO2
3. Describe what Taylor's number is, Explain failures of slope.	CO3
4. What are the common type of foundations used in construction?	CO4
5. Explain Plate load test in detail.	CO4

6. Explain with neat sketch Active Earth Pressure and Passive Earth Pressure	CO5
7. Explain falling head permeability test of soil.	CO5

Part- C (30 Marks)

1. Explain any two tests in detail for finding water content of a sample.	CO1
2. Explain what you understand by Clay minerals and also explain their basic building blocks.	CO2
3. What is the basis of construction of Newmark's Influence Chart? Explain.	CO3
4. A concentrated load of 2000kN is applied at the ground surface. Determine the vertical stress at a point P, which is 6m directly below the load. Also, calculate the vertical stress at a point R, which is at a depth of 6m but at a horizontal distance of 5m from the axis of the load. Solve using Boussinesq's equation.	CO4
5. A smooth backed vertical wall is 6.3m high and retains a soil with bulk unit weight of 18kN/m^3 and angle of internal friction 18 degrees. The top of the soil is level with the top of the wall and is horizontal. If the soil surface carries a uniformly distributed load of 45kN/m^2. Determine the total active thrust on the wall per unit length and its point of application.	CO5

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Marks and Gap Analysis of Mid-Term II

S.No.	University Roll No.	Name of Student	Mid-Term 2 MM-70	Remark (Remedial Class need or not – Y/N)
1.	21ETCCE001	Dev vaishnav	49	N
2.	21ETCCE002	Hitesh Sutradhar	44	N
3.	21ETCCE004	Naved khan	46	N
4.	21ETCCE006	Pushpendra gehlot	53	N
5.	21ETCCE007	Shalin Dak	44	N
6.	21ETCCE009	Tamanna kumawat	60	N
7.	21ETCCE300	Muniraj Sharma	57	N
8.	22ETCCE200	Moiz Udaipurwala	49	N
9.	22ETCCE201	Vikas Suthar	57	N

(Y, if obtained marks are <50%)

Signature of Faculty: **Signature of HOD**

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Remedial Action Taken to Remove the Gaps (After Mid- Term 1I)

S.no.	University Roll no.	Name of Student	Topics to be discussed in Remedial Class	Schedule Date of Remedial Class	Outcome Achieved
1.	NIL				
2.					

Signature of Faculty: **Signature of HOD**

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Model Question Paper

5E1344

Roll No. _____ Total No of Pages: 3

5E1344

B. Tech. V - Sem. (Main / Back) Exam., Feb.-March – 2021

PCC/PEC Civil Engineering

5CE4 – 04 Geotechnical Engineering

Time: 2 Hours **[To be converted as per scheme]**

Max. Marks: 82

Min. Marks: 29

Instructions to Candidates:

Attempt all ten questions from Part A, four questions out of seven questions from Part B and two questions out of five from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only) **[10×2=20]**

All questions are compulsory

Q.1 What do you mean by the term Thixotropy of soil?

Q.2 What is normally consolidated soil?

Q.3 What do you understand by the term sensitivity of soil?

Q.4 Define the terms –

(a) Net ultimate bearing capacity

(b) Allowable bearing pressure

Q.5 What is normally consolidated and over consolidated soil?

Q.6 Define the term permeability.

Q.7 What is pre-consolidation ratio?

Q.8 What do you mean by disturbed and undisturbed sample of soil?

Q.9 What is an Isobar Diagram?

Q.10 Give any four differences between compaction and consolidation.

PART – B

(Analytical/Problem solving questions) **[4×8=32]**

Attempt any four questions

Q.1 A partially saturated sample from a borrow pit has a natural moisture content of 15 percent and bulk unit weight of 1.9 g/cc, the specific gravity of solids is 2.70. Determine the degree of saturation and void ratio.

Q.2 What is quick sand condition? Derive the relation for critical hydraulic gradient, $i_{cr} = \frac{G-1}{1+e}$

Q.3 What are the factors affecting permeability of soil?

Q.4 What are the disadvantages of direct shear test?

Q.5 Find the intensity of vertical pressure at a point 4 m directly below a 20 kN point load acting at a horizontal surface. What will be the vertical pressure 2 m horizontally away from the axis of loading? Solve according to Bossinesq theory.

Q.6 Derive relation for vertical stress under a circular loading.

Q.7 Derive relation for permeability for falling head method.

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PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) *[2×15=3*

Attempt any two questions

Q.1 Write soil IS soil classification system with symbol and their names.

Q.2 Determine the ultimate bearing capacity of a strip footing 2 m in width with its base at a depth of 1.5 m below ground surface and resting on a dry sand stratum with the following properties:

$\Phi = 38°$, $N_q = 60$; $N_\gamma = 75$. Use Terzaghi's theory. Determine the change in bearing capacity of soil when water table is at the base of footing.

Q.3 An infinite slope is to be constructed of clay soil at a slope angle of 30°. The ground water table is at ground itself, with seepage parallel to the ground. The soil properties are:

$C = 15kN/m^3$; $\Phi = 22°$, $\gamma_{sat} = 20kN/m^3$

What is the factor of safety against movement along a parallel to the ground surface at depth of 4m and 5.5m?

Q.4 A clay soil, tested in a consolidometer, showed decrease in void ratio from 1.20 to 1.10 when pressure was increased from 0.25 to 0.50 kgf/cm^2. Calculate coefficient of compressibility (a_v) and coefficient of volume compressibility (m_v). If coefficient of consolidation (C_v)=$10m^2$/year, calculate coefficient of permeability in cm/s.

Q.5 Explain the procedure to calculate vertical stress under a given loading using Newmarks influence chart.

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STUDENT PERFORMANCE REPORT

Roll No.	Name of Student	I Mid-Term	II Mid-Term	Average
21ETCCE001	Dev vaishnav	50	49	49.5
21ETCCE002	Hitesh Sutradhar	45	44	44.5
21ETCCE004	Naved khan	47	46	46.5
21ETCCE006	Pushpendra gehlot	54	53	53.5
21ETCCE007	Shalin Dak	45	44	44.5
21ETCCE009	Tamanna kumawat	61	60	60.5
21ETCCE300	Muniraj Sharma	58	57	57.5
22ETCCE200	Moiz Udaipurwala	50	49	49.5
22ETCCE201	Vikas Suthar	58	57	57.5

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RESULT ANALYSIS

S.NO.	RTU ROLL NUMBER	NAME OF STUDENT	END TERM MARKS	SESSIONAL MARKS	TOTAL
		MAX MARKS	**70**	**30**	**100**
1.	21ETCCE001	Dev vaishnav	21	22	43
2.	21ETCCE002	Hitesh Sutradhar	16	20	36
3.	21ETCCE004	Naved khan	25	21	46
4.	21ETCCE006	Pushpendra gehlot	14	24	38
5.	21ETCCE007	Shalin Dak	21	20	41
6.	21ETCCE009	Tamanna kumawat	32	27	59
7.	21ETCCE300	Muniraj Sharma	36	26	62
8.	22ETCCE200	Moiz Udaipurwala	19	22	41
9.	22ETCCE201	Vikas Suthar	28	26	54

TOTAL	PASS	FAIL	ABSENT	PASS %
9	9	0	0	100 %

Indirect Assessment:

Overall Teacher Self-Assessment (at the completion of course) in terms of course objective and outcomes

Course Objectives:

The Geotechnical Engineering course provides students with essential knowledge of soil behaviour and its civil engineering applications. Students will understand key soil properties and their relationships, apply principles like Darcy's law and stress analysis, conduct and interpret laboratory tests such as Proctor compaction and sieve analysis, evaluate soil behaviour for consolidation and bearing capacity, and use soil classification to design foundations and assess site investigations.

Course Outcomes:

At the end of this course students will be able to:

CO1: Student will be able to Explain different types of soil present on Earth crust.

CO2: Student will be able to Explain different types of soil properties And their use in engineering fields.

CO3: Students will be able to Analyze engineering properties of soil Like compaction, permeability, and shear strength.

CO4: Students will be able to Analyze engineering properties of soil Like compaction, permeability, shear strength.

CO5: Students will be able to Compute the lateral thrust due to backfill On the retaining walls.

Methodology to identify bright student

It is done by considering a range of criteria, including academic performance, creativity, critical thinking, problem-solving skills, and enthusiasm for learning. Bright students often excel in multiple areas. Observed how students perform in the classroom. In terms of active participation, engagement in discussions, leadership, and the ability to grasp complex concepts.

Efforts to keep students engaged

1. **Active Learning**: Incorporate active learning strategies, such as group discussions, problem-solving activities, and hands-on projects. Active participation keeps students engaged and encourages critical thinking.
2. **Varied Teaching Methods**: Use a variety of teaching methods, including lectures, group work, multimedia presentations, and interactive activities to cater to different learning preferences.
3. **Technology Integration**: Leverage technology, such as online platforms, educational apps, and interactive software, to make lessons more engaging and interactive.

Methodology to identify weak student

It is done by considering a range of criteria, including classroom observation, formative assessment, summative assessment, assignment review etc. Weak students are struggling students with sensitivity and a desire to support their learning. Some measures, such as additional tutoring, personalized assignments, or alternative assessment methods, to help students succeed.

Targeted inventions for weak student

1. Additional Resources

Offer supplementary learning materials, such as textbooks, online resources, or multimedia content, to provide alternative explanations and reinforce key concepts.

2. Remedial classes

Establish a tutoring program where students can receive extra help from teachers.

3. Flipped classroom

Students are assigned pre-class learning materials, often in the form of videos, readings, or online modules, to cover the foundational concepts before coming to class.