

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 5 – EXAMINATION – SUMMER 2026

Subject Code: 3150615

Date: 30/05/2026

Subject Name: Soil Mechanics

Time: 02:30 PM TO 05:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1**
- (a) Define subsoil exploration and state its objectives 03
 - (b) Write the importance of Shear strength in Civil Engineering. 04
 - (c) List out various stages of Sub soil exploration and explain in details anyone. 07

- Q.2**
- (a) Explain the working principle of wash boring. 03
 - (b) Draw split spoon sampler with its notations. 04
 - (c) Explain Boussinesq's theory and its assumptions in detail. 07

OR

- Q.2**
- (c) A strip footing of 3 m width is placed at 3.5 m depth below Ground Level. Determine ultimate bearing capacity using (i) Terzaghi's Equation ($N_c = 5.7$, $N_q = 1$, $N_\gamma = 0$) and (ii) IS Code method ($N_c = 5.14$, $N_q = 1$, $N_\gamma = 0$). Take $\gamma = 18 \text{ kN/m}^3$ and $c = 15 \text{ kN/m}^2$. $\phi = 0$. 07

- Q.3**
- (a) Write the limitation of Plate load test 03
 - (b) Differentiate between general shear and punching shear failure. 04
 - (c) A direct shear test was carried out on a soil sample and following results were obtained. 07

Normal stress kN/m^2	150	200
Shear stress kN/m^2	110	120

Compute deviator stress if a triaxial test is carried out on the same soil with cell pressure of 150 kN/m^2 .

OR

- Q.3**
- (a) Explain the concept of isobars and pressure bulb. 03
 - (b) Define adhesion factor. State its purpose in the design of piles in clay. 04
 - (c) A point load of 150 kN acting at ground surface. Compute the vertical stress at 4 m depth along axis using Boussinesq's equation and Westergaard's equation. 07

- Q.4**
- (a) Suggest methods to improve slope stability. 03
 - (b) A 25 kN weight pile is inserted using single acting steam hammer with a free fall of 1.2 m. The avg. penetration of last 20 blow is 20 mm. Find the safe load using the ENR formula. 04

(c) Describe lab vane shear test with neat sketch. 07

OR

Q.4 (a) Define drift and shaft for direct method of exploration. 03

(b) A vertical cut is made in a clay deposit having $c = 30 \text{ kN/m}^2$, $\phi = 0$, $\gamma = 17 \text{ kN/m}^3$. Determine the maximum depth of cut so that the cut is stable. Take $S_n = 0.26$ 04

(c) Write down the Procedure for Shear strength determination using Direct shear test with neat sketch. 07

Q.5 (a) Differentiate between End bearing pile and Friction pile. 03

(b) Explain types of slope failure with sketches. 04

(c) Describe Taylor's stability number and its use in slope analysis. 07

OR

Q.5 (a) Give characteristics of Black cotton soil. 03

(b) Enlist various pile driving hammers and explain any one. 04

(c) Explain various functions of geosynthetics with suitable applications. 07

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V EXAMINATION – SUMMER 2025****Subject Code:3150615****Date:20-05-2025****Subject Name:Soil Mechanics****Time:02:30 PM TO 05:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
Q.1	(a) List out the objectives of Soil Exploration.	03
	(b) Explain the difference between finite and infinite slope.	04
	(c) List out various boring method and Explain wash boring method with neat sketch in details.	07
Q.2	(a) Define the term (i) Ultimate bearing capacity (ii) Net safe bearing capacity	03
	(b) Discuss various methods to improve the stability of slope.	04
	(c) Explain in details Dynamic cone penetration test with neat sketch.	07
	OR	
	(c) The field N-value of Fully submerged Fine sand is 35 at 8 m depth. The avg. Saturated unit weight of sand is 19.5 kN/m^3 Calculated Corrected N-Value as per IS 2131-1981.	07
Q.3	(a) Draw a split spoon sampler with details.	03
	(b) Write short note on Friction circle method.	04
	(c) A strip footing of 3m wide and founded at 2.5m depth below GL, in a soil having cohesion is 35 kN/m^2 and angle of internal friction is 35° . The water table is at a depth of 5m below GL. The moist weight of soil above water table is 18.00 kN/m^3 . Determine Safe bearing capacity and safe load per m length. Take FOS= 3. Use terzaghi's theory and general shear failure. Take $N_c=57.8$, $N_q= 41.4$ and $N_\gamma=42.4$.	07
	OR	
Q.3	(a) Write short note on Floating foundation.	03
	(b) A pile is driven with a single acting steam hammer of weight 45 kN with a free fall of 1.5m. The average penetration of the last 20 blow is 30 mm. find the Safe load using ENR formula.	04
	(c) A drop hammer weighing 40 kN and having free fall of 75 cm drives an RCC pile of 30 kN. The average settlement per blow was 1.5 cm. The total temporary elastic compression is 2.0 cm. Assuming coefficient of restitution as 0.25 and FOS is 2.5, Determine ultimate bearing capacity and allowable load on pile.	07
Q.4	(a) Write advantages of Triaxial shear test.	03
	(b) Discuss merits and demerits of Plate load test.	04
	(c) Unconfined test is carried out on clay sample of 10 cm long and 5 cm in dia., fails under a load of 150 N at 10 % strain. Compute the shearing resistance also considers the effect of change in cross section of sample.	07

OR

- Q.4** (a) Explain the concept of pressure bulb. **03**
(b) Explain merits and demerits of Box Shear test. **04**
(c) An Road embankment is inclined on sides at angle of 30° to the horizontal. If the shear strength parameters are as $c=20 \text{ kN/m}^2$ and $\phi=10^\circ$, Find factor of safety available against slope failure for 12m and 15m height . The unit weight of soil is 18 kN/m^3 . Take $S_n=0.07$. **07**

- Q.5** (a) Define (i) Free swell index (ii) Swelling pressure **03**
(b) Write short note on Under reamed pile in expansive soil. **04**
(c) Explain procedure of direct shear test. Also explain its limitations. **07**

OR

- Q.5** (a) Enlist various application area of Geosynthetics. **03**
(b) Write a short note on Newmark's influence chart. **04**
(c) Derive the Equation for Vertical stress under a line load using Baussinesq theory. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V (NEW) EXAMINATION – SUMMER 2024****Subject Code:3150615****Date:23-05-2024****Subject Name:Soil Mechanics****Time:02:30 PM TO 05:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS								
Q.1	(a) Explain the concept of 'Pressure Bulb' in soils.	03								
	(b) Explain shear tests based on drainage condition.	04								
	(c) A circular footing 1.5 m radius transmits a uniform pressure of 100 kN/m ² . Calculate vertical stress at point 3 m directly below its centre.	07								
Q.2	(a) What are the assumptions made in Terzaghi's analysis of bearing capacity of a strip footing?	03								
	(b) Write brief critical notes on the Engineering News formula.	04								
	(c) A standard penetration test is conducted at a depth of 5 m in saturated fine sand having unit weight 20kN/m ³ . If observed N value is 25, then find the corrected N value.	07								
OR										
	(c) Three specimens of clay having a small air void content were tested in the shear box. Shear loading was started immediately after the application of normal load and was completed in 10 minutes. The results obtained were as follows:	07								
<table><tr><td>Normal stress (kPa)</td><td>145</td><td>241</td><td>337</td></tr><tr><td>Shear stress at failure (kPa)</td><td>103</td><td>117</td><td>132</td></tr></table>			Normal stress (kPa)	145	241	337	Shear stress at failure (kPa)	103	117	132
Normal stress (kPa)	145	241	337							
Shear stress at failure (kPa)	103	117	132							
Find the apparent cohesion and angle of shearing resistance of the clay.										
Q.3	(a) Write brief critical notes on unconfined compression test.	03								
	(b) Write a short note on Mohr-Coulomb strength theory.	04								
	(c) Compute the area ratio of a thin-walled tube sampler having an external diameter of 100 mm and wall thickness of 2 mm. Do you recommend this sampler for obtaining undisturbed soil sample?	07								
OR										
Q.3	(a) What is the different application of geotextile, and geocell.	03								
	(b) Write brief critical notes on standard penetration test.	04								
	(c) A 6 meter deep cut is to be made in cohesive soil with a slope of 1:1. The soil has C _u = 30 kPa, φ _u = 10° & γ = 18 kN/m ³ . Find the factor of safety with respect to cohesion. Take stability number, S _n = 0.108.	07								
Q.4	(a) Write a short note on types of slope failure according to extent of slip surface.	03								
	(b) Write a short note on Geophysical exploration using electrical resistivity method.	04								
	(c) Two identical specimens of a soil were tested in triaxial apparatus. First specimen failed at a deviator stress of 770 kN/m ² when the cell pressure was 200 kN/m ² . While the second specimen failed at a deviator stress of 1400 kN/m ² under a cell pressure of 400 kN/m ² . Determine the shear parameters of the soil.	07								
OR										
Q.4	(a) Differentiate between general shear failure and local shear failure.	03								

- (b) Explain in brief about any two types of geosynthetics. **04**
- (c) Determine the safe bearing capacity of a strip footing 1.5 m wide & 1.5 m depth, resting on a deep sand bed, consider, $\gamma = 18 \text{ kN/m}^3$, and bearing capacity factors $N_C = 35.5$, $N_q = 23.2$, $N_\gamma = 22$ corresponding to $\phi = 38^\circ$ and factor of safety = 3. **07**
- Q.5** (a) Describe with a neat sketch how will you carry out the wash boring method of soil exploration. **03**
- (b) Explain with figure about contact pressure & settlement distribution beneath rigid & flexible footing. **04**
- (c) A concentrated load of 50 kN acts on the surface of a homogeneous soil mass of large extent. Find the stress intensity at a depth of 5m; (a) Directly under the load, and (b) At a horizontal distance of 5m. Use Boussinesq's equation. **07**
- OR**
- Q.5** (a) What are the basic assumptions in Boussinesq's theory of stress distribution in soils? **03**
- (b) Write a short note on different types of shallow foundation. **04**
- (c) A 30 cm diameter pile is driven into a homogeneous clay ($C = 40 \text{ kPa}$, $\alpha = 0.7$). If the embedded length is 10 m, estimate the safe load ($FS = 2.5$). **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE – SEMESTER- V EXAMINATION-SUMMER 2023****Subject Code: 3150615****Date: 28/06/2023****Subject Name: Soil Mechanics****Time: 02:30 PM TO 05:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		Marks
Q.1	(a) Define types of foundation. Explain various steps in selection of type of foundation for different structures.	03
	(b) Explain working principle of SPT test and its application.	04
	(c) Define subsurface investigation. Give various objectives and Planning for carrying out subsurface exploration. Explain any one type of geophysical exploration method used in field along with its applications.	07
Q.2	(a) Write critically note on Pile classification	03
	(b) Explain the functions of (i) Batter pile (ii) Fender pile (iii) End bearing pile (iv) Friction pile	04
	(c) Explain Negative skin friction for Cohesive Soil and Cohesion less Soil	07
	OR	
	(c) Explain in detail plate load test	07
Q.3	(a) Explain Newmark's influence Chart and its application.	03
	(b) Enlist theories regarding distribution of stresses in soil. Derive equation for stress distribution of soil under a point load as per Boussinesq's theory.	04
	(c) Explain causes of stress in soil. What is geostatic stress? What are different factors of safety used in the stability of slopes? Discuss briefly.	07
	OR	
Q.3	(a) Discuss briefly, different types of slope failures.	03
	(b) Explain Taylor's Stability Number in relevant terms.	04
	(c) How is a slope analyzed using a Swedish circle method (method of slices)? Discuss the method and derive an expression for the factor of safety.	07
Q.4	(a) Explain the principle of the Direct shear test. What are the advantages of this test?	03
	(b) Enlist factor affecting the bearing capacity and explain any two in detail.	04

- (c) Define Safe, Allowable, Ultimate and net bearing capacity of soil. Write down Terzaghi's bearing capacity equation in detail, its assumption and limitation of analysis **07**
- OR**
- Q.4** (a) What is the effect of increase in width of a footing on bearing capacity of a footing resting on (a) sand and (b) clay? **03**
- (b) Critically explain effect of G.W.T. on bearing capacity of soil. **04**
- (c) A square footing has dimensions of 2mx2m and depth 2m. Determine its ultimate bearing capacity in pure clay with UCS of 0.15 N/mm^2 , $\phi = 0^\circ$, $\gamma = 1.7 \text{ g/cm}^3$. Assume Terzaghi's factor for $\phi = 0^\circ$ as $N_c = 5.7$, $N_q = 1.0$, $N_\gamma = 0$. **07**
- Q.5** (a) Discuss the UU, CU, and CD triaxial shear test conditions **03**
- (b) Explain the principle of the Direct shear test. What are the advantages of this test? **04**
- (c) Following are the results obtained from box shear test on soil: **07**
 Normal Stress (kN/m^2) : 25, 75, 150, 250
 Shear Stress (kN/m^2) : 60, 80, 105, 145
 Plot graph and determine the shear values C and ϕ of soil. If a specimen of same soil is tested in triaxial test, estimate the deviator stress (σ_d) at which the sample will fail when cell pressure (σ_3) is 100 kN/m^2
- OR**
- Q.5** (a) Different between shallow foundation and deep foundation. **03**
- (b) Explain the concept of 'Pressure bulb' and its use in soil engineering practice. Draw contact pressure distribution diagram for flexible and rigid footings on sand and clayey soil. **04**
- (c) Define 'GEOSYNTHETICS'. Classify the geosynthetic materials and explain any two of them with neat sketch. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-V(NEW) EXAMINATION – SUMMER 2022

Subject Code:3150615**Date:13/06/2022****Subject Name:Soil Mechanics****Time:02:30 PM TO 05:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
Q.1	(a) Describe Various types of Failure with sketch.	03
	(b) What do you mean by site investigation? What are the different purposes of site investigation?	04
	(c) Write step by step procedure to perform standard penetration test in the field. Also explain corrections for SPT value?	07
Q.2	(a) Enlist different types of factor of safety used in stability of slopes.	03
	(b) Define following terms in relation to tri-axial test	04
	(i) Confining pressure	
	(ii) Deviator stress	
	(iii) major and minor principal stress	
	(c) An Embankment 13 m high is inclined at 30° to the horizontal. A stability analysis by the method of slice gives the following forces per running meter.	07
	Sum of shearing forces = 600 kN.	
	Sum of Normal forces = 1000 kN.	
	Sum of neutral forces= 200 kN.	
	The length of arc is 35 m. the value of effective stress parameter are 30 kN/m^2 and 25° resp. Determine the FOS w.r.t. (a) shearing strength (b) Cohesion.	
	OR	
	(c) How a slope is analyzed using Swedish circle method? Derive an expression for factor of safety.	07
Q.3	(a) What are the advantages and disadvantages of Tri-axial Compression Test?	03
	(b) Define negative skin friction. What is its effect on the pile?	04
	(c) Two identical specimens 3.8 cm in dia. and 7.6 cm height were tested in tri-axial test under un-drained conditions. The first specimen failed at an axial load of 75 kg under a cell pressure of 1 kg/cm^2 . The second specimen failed at on axial load of 95 kg under a cell pressure of 2 kg/cm^2 . Determine the value of cohesion and angle of shearing resistance.	07
	OR	
	(a) Write short note on Newmark's influence chart.	03
	(b) Describe Terzaghi's theory of bearing capacity of foundation soil under strip footing. What are the assumptions and its limitations?	04
	(c) What is Unconfined compression test? Explain the procedure with neat sketch and write its advantages over a tri-axial test.	07

- Q.4** (a) Write short note on Floating Foundation. **03**
 (b) Enumerate factor affecting bearing capacity of soil . **04**
 (c) A 2.5 m wide strip footing is founded at a depth of 2.0 m below the ground level in a homogeneous bed of sand , having the following properties: $\Phi = 35^\circ$, $\gamma = 18.0 \text{ kN/m}^3$. Determine the ultimate, net ultimate and net safe bearing capacity of the footing. For $\Phi = 35^\circ$ $N_c = 57.8$, $N_q = 41.4$, $N_\gamma = 42.4$. Assume a factor of safety of 3.0 Use Terzaghi's analysis. Water table is at 2 m from G.L. **07**

OR

- Q.4** (a) Differentiate between general shear failure and local shear failure. **03**
 (b) Explain how expansive soil can be identified in the laboratory? **04**
 (c) Determine the safe bearing capacity of a square footing 2.0 m x 2.0 m located at a depth of 1 m below ground level in a soil of density 17.5 kN/m^3 , $\Phi = 30^\circ$ ($N_c = 30.4$, $N_q = 18.4$, $N_\gamma = 22.4$) if the water table rises upto G.L. what is reduction in SBC. Take FOS=3. **07**

- Q.5** (a) Enlist different pile driving hammers. Explain any two in detail. **03**
 (b) Write Short note on Under reamed pile. **04**
 (c) A group of 16 piles of 0.45 m diameter is arranged in a square pattern with centre to centre spacing of 1.5 m. The piles are 10 m long and embedded in soft clay with cohesion 30 kN/m^2 . Bearing resistance may be neglected for the piles. Adhesion factor is 0.6. Determine the ultimate load capacity of pile group. **07**

OR

- Q.5** (a) Write dynamic formulae to estimate pile capacity. **03**
 (b) Classify geo-textile materials. What are the basic functions performed by geotextiles? **04**
 (c) A concrete pile, 35 cm diameter, 15 m long is driven through a 6 m thick layer of silty sand ($\phi = 25^\circ$, $\gamma = 18 \text{ kN/m}^3$) overlaying a dense layer of sand ($\phi = 40^\circ$, $\gamma = 16.5 \text{ kN/m}^3$). If the water table is at great depth, estimate the safe load the pile can carry Take F.S. =3, $k = 1.0$, and $\delta = 0.75\phi$. ($N_q = 140$ for $\phi = 40^\circ$) **07**
