

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-3 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

Subject Name & Code: Geotechnical Engineering (3130606)

Unit 1: Type of Soils, Index Properties, Inter-relationships and Soil Characterization

Repeated Questions:

1. **Define the following terms: Void ratio, Degree of saturation, Water content.**
o Appeared in: S24 (Q1a, 03 marks), W24 (Q1a, 03 marks), S22 (Q1c, 07 marks)
2. **Derive the relationship between $\gamma_d = \frac{(G+se)}{(1+e)} \gamma_w$.**
o Appeared in: S24 (Q1b), W23 (Q1b, 04 marks)
3. **Explain the Geological Cycle with a diagram.**
o Appeared in: S23 (Q1a, 03 marks), S22 (Q1a, 03 marks)
4. **Classify soil based on sieve analysis and Atterberg limits (IS Classification).**
o Appeared in: S24 (Q2a, 03 marks), W23 (Q2a, 03 marks), W22 (Q2a)

Other Important Questions:

1. **Differentiate between coarse-grained and fine-grained soil.**
o Appeared in: W24 (Q1b, 04 marks)
 2. **List methods of water content determination and explain any one in detail.**
o Appeared in: W24 (Q1c, 07 marks)
 3. **Describe the liquid limit test by Casagrande's method.**
o Appeared in: S22 (Q1c, 07 marks)
 4. **Describe Atterberg limits with sketches. Define PI, CI, LI.**
o Appeared in: W22 (Q2c, 07 marks)
 5. **Explain the purpose of soil classification.**
o Appeared in: S23 (Q2a, 03 marks)
 6. **Draw the phase diagram for dry soil and state the equation for relative density.**
o Appeared in: W22 (Q1a, 03 marks)
 7. **Define: Water content, Void ratio, Porosity, Unit weight of solids, Air content, Bulk unit weight, Specific gravity.**
o Appeared in: S23 (Q1c, 07 marks)
 8. **Explain flocculated and honeycombed soil structures.**
o Appeared in: S22 (Q1b, 04 marks), S24 (Q3b, 04 marks)
 9. **Explain the scope of geotechnical engineering in civil engineering.**
o Appeared in: S23 (Q1b, 04 marks)
 10. **Draw the textural classification chart and describe the classification process.**
o Appeared in: W22 (Q3c OR, 07 marks)
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Unit 2: Permeability and Seepage

Repeated Questions:

1. **Explain Darcy's law and its limitations.**
o Appeared in: W24 (Q2a, 03 marks)
2. **Describe the laboratory falling head permeability test.**
o Appeared in: S24 (Q2c, 07 marks)
3. **Define a flow net. Explain its characteristics and applications.**
o Appeared in: S23 (Q3c, 07 marks), S22 (Q3c, 07 marks)

Other Important Questions:

1. **List factors affecting permeability and illustrate any two in detail.**
o Appeared in: W23 (Q2c OR, 07 marks), S22 (Q3a, 03 marks)
 2. **Calculate permeability from constant head test data.**
o Appeared in: W23 (Q2b, 04 marks)
 3. **Calculate effective permeability for stratified soil (horizontal & vertical flow).**
o Appeared in: W22 (Q3c, 07 marks)
 4. **Explain Newmark's influence chart and its application.**
o Appeared in: S24 (Q4b, 04 marks), S23 (Q4c, 07 marks), S22 (Q4b, 04 marks)
 5. **Explain Boussinesq's theory for point load and calculate vertical stress.**
o Appeared in: W24 (Q5b, 04 marks)
 6. **Calculate vertical stress due to line loads or concentrated loads.**
o Appeared in: W23 (Q4c, 07 marks), W22 (Q4c, 07 marks)
 7. **Give the application of flow net.**
o Appeared in: W24 (Q5a, 03 marks)
 8. **Calculate time for falling head permeability test.**
o Appeared in: W22 (Q3c, 07 marks)
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Unit 3: Compaction & Consolidation of Soil

Repeated Questions:

1. **Differentiate between compaction and consolidation.**
o Appeared in: W24 (Q2b, 04 marks), S23 (Q3b OR, 03 marks)
 2. **Describe the Standard Proctor compaction test.**
o Appeared in: S24 (Q2c OR, 07 marks), W23 (Q2c, 07 marks)
 3. **Explain the factors affecting compaction.**
o Appeared in: S23 (Q2b, 04 marks), S22 (Q2b, 04 marks)
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Other Important Questions:

1. **Differentiate between light and heavy compaction.**
o Appeared in: S22 (Q2a, 03 marks)
 2. **Explain MDD and OMC. Draw compaction curve from given data.**
o Appeared in: W24 (Q3b, 04 marks), S23 (Q3c, 07 marks)
 3. **Describe the spring analogy method for consolidation.**
o Appeared in: S24 (Q5c, 07 marks), W23 (Q3a, 03 marks), W22 (Q3b, 04 marks)
 4. **List assumptions in Terzaghi's consolidation theory.**
o Appeared in: S24 (Q5c, 07 marks), W23 (Q5b, 04 marks)
 5. **Define: Compression index, Coefficient of volume change, Coefficient of compressibility.**
o Appeared in: S22 (Q5b, 04 marks), W24 (Q3a, 03 marks)
 6. **Calculate m_v , a_v , C_c from consolidation test data.**
o Appeared in: W24 (Q4c, 07 marks)
 7. **Calculate time for consolidation in lab vs field.**
o Appeared in: S22 (Q5c, 07 marks)
 8. **Describe field compaction methods.**
o Appeared in: W22 (Q3a, 03 marks)
 9. **Explain square root of time fitting method for consolidation.**
o Appeared in: W22 (Q3b, 04 marks)
 10. **How to determine pre-consolidation pressure?**
o Appeared in: W24 (Q3a, 03 marks)
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Unit 4: Stress Distribution

Repeated Questions:

1. **Explain Newmark's influence chart and its application.**
o Appeared in: S24 (Q4b, 04 marks), S23 (Q4c, 07 marks), S22 (Q4b, 04 marks)
2. **Calculate vertical stress due to point/line loads using Boussinesq's theory.**
o Appeared in: W24 (Q5b, 04 marks), W23 (Q4c, 07 marks), W22 (Q4c, 07 marks)

Other Important Questions:

1. **Draw isobar diagram.**
o Appeared in: S24 (Q4b, 04 marks)
 2. **Calculate stress distribution under concentrated load and plot curve.**
o Appeared in: W23 (Q4c, 07 marks)
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Unit 5: Shear Strength of Soil

Repeated Questions:

1. **Differentiate between UU and CU tests.**
o Appeared in: S24 (Q3a, 03 marks)
2. **Explain Mohr–Coulomb failure theory and draw failure envelopes for different soils.**
o Appeared in: S23 (Q4b, 04 marks), S22 (Q4a, 03 marks)
3. **Describe the direct shear test with advantages and limitations.**
o Appeared in: S22 (Q4c, 07 marks), W24 (Q3c, 07 marks)

Other Important Questions:

1. **Calculate deviator stress from triaxial test (cohesionless soil).**
o Appeared in: S24 (Q3c, 07 marks)
 2. **Determine c and ϕ from unconfined compression test.**
o Appeared in: S24 (Q3c OR, 07 marks), W22 (Q4c, 07 marks)
 3. **Determine c and ϕ from triaxial test data.**
o Appeared in: W24 (Q3c, 07 marks)
 4. **Explain the three standard triaxial tests (drainage conditions) and their applications.**
o Appeared in: S23 (Q4c, 07 marks)
 5. **Differentiate between consolidated drained and undrained tests.**
o Appeared in: W23 (Q3b, 04 marks)
 6. **Describe various drainage conditions in shear tests.**
o Appeared in: W24 (Q5a, 03 marks)
 7. **Draw neat diagram of triaxial test and label parts.**
o Appeared in: W23 (Q3b, 04 marks)
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Unit 6: Earth Pressure & Stability of Slopes

Repeated Questions:

1. **Differentiate between active and passive earth pressure.**
o Appeared in: S23 (Q4a, 03 marks), W24 (Q4b, 04 marks), S22 (Q4a, 03 marks)
2. **Explain types of slope failures.**
o Appeared in: S23 (Q5a, 03 marks), S22 (Q3b, 04 marks), W23 (Q4a, 03 marks)
3. **Describe Culmann's graphical method for earth pressure.**
o Appeared in: S22 (Q4c, 07 marks), W22 (Q4b, 04 marks)

Other Important Questions:

1. **Calculate earth pressure for cohesionless soil with/without surcharge.**
o Appeared in: S24 (Q4c, 07 marks), W24 (Q5c, 07 marks), W23 (Q3c, 07 marks), W22 (Q5c, 07 marks)
 2. **Calculate earth pressure for cohesive soil, depth of tension crack, unsupported height.**
o Appeared in: S24 (Q4c OR, 07 marks), W23 (Q3c, 07 marks), S22 (Q4b, 04 marks)
 3. **Derive factor of safety for infinite slope in cohesionless soil.**
o Appeared in: S22 (Q3c OR, 07 marks), W23 (Q4b, 04 marks)
 4. **Explain Taylor's stability number and its uses.**
o Appeared in: W24 (Q4b, 04 marks)
 5. **Describe friction circle method.**
o Appeared in: S24 (Q4a, 03 marks)
 6. **Describe Swedish circle method.**
o Appeared in: S24 (Q4a OR, 03 marks)
 7. **Explain method to locate center of critical slip circle.**
o Appeared in: W23 (Q4b, 04 marks), W22 (Q4a, 03 marks)
 8. **Derive equations for active/passive pressure at base for cohesionless soil.**
o Appeared in: W22 (Q5a, 03 marks)
 9. **Derive equation for depth of tension crack in cohesive soil.**
o Appeared in: W22 (Q5a, 03 marks)
 10. **Calculate factor of safety for canal slope with and without water.**
o Appeared in: W22 (Q5c, 07 marks)
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Unit 7: Introduction to Foundations and Bearing Capacity

Repeated Questions:

1. **Differentiate between general and local shear failure.**
o Appeared in: S24 (Q5a, 03 marks), S23 (Q4b, 04 marks), W23 (Q5a, 03 marks)
2. **Explain Terzaghi's bearing capacity equation, assumptions, and limitations.**
o Appeared in: S23 (Q5c, 07 marks), S22 (Q5c, 07 marks), W23 (Q5b, 04 marks)
3. **Classify piles in detail.**
o Appeared in: S24 (Q5b, 04 marks), W23 (Q5b, 04 marks)

Other Important Questions:

1. **Explain effects of water table on bearing capacity.**
o Appeared in: S24 (Q5a OR, 03 marks), W23 (Q5c, 07 marks)
2. **Differentiate between end-bearing and friction piles.**
o Appeared in: S24 (Q5b OR, 04 marks), W23 (Q5a, 03 marks)
3. **Describe plate load test with sketch and applications.**
o Appeared in: S23 (Q5b, 04 marks), W24 (Q5c, 07 marks)
4. **Define safe, allowable, and ultimate bearing capacity.**
o Appeared in: S23 (Q5c, 07 marks), S22 (Q5c, 07 marks)
5. **Explain factors affecting bearing capacity.**
o Appeared in: S23 (Q5b, 04 marks), S22 (Q5a, 03 marks)
6. **Suggest suitable pile foundations for soft clay and stiff clay.**
o Appeared in: W22 (Q5b, 04 marks)
7. **Describe under-ream pile foundation.**
o Appeared in: W23 (Q5c, 07 marks)
8. **Explain factors affecting selection of foundation type.**
o Appeared in: W24 (Q5b, 04 marks)

Numerical Problems List (From All Papers)

1. **Void ratio, porosity, dry density, saturated unit weight calculations** – S24 (Q1c), W24 (Q2c), W23 (Q1c), W22 (Q1c)
2. **Sieve analysis and soil classification** – S24 (Q2a), W23 (Q2a), W22 (Q2a)
3. **Permeability calculations (constant head, falling head)** – W23 (Q2b), W22 (Q3c)
4. **Compaction curve plotting (MDD, OMC)** – S23 (Q3c)
5. **Consolidation parameters (m_v , a_v , C_c)** – W24 (Q4c)
6. **Time factor in consolidation** – S22 (Q5c)
7. **Shear strength parameters from triaxial/unconfined tests** – S24 (Q3c), W24 (Q3c), W22 (Q4c)
8. **Earth pressure calculations (cohesive/cohesionless)** – S24 (Q4c), W24 (Q5c), W23 (Q3c), W22 (Q5c)
9. **Slope stability factor of safety** – W22 (Q5c)
10. **Stress distribution (Boussinesq, line loads)** – W24 (Q5b), W23 (Q4c), W22 (Q4c)
