**QUESTION BANK**

**DEPARTMENT: CIVIL** **SEMESTER: V**

**SUBJECT CODE / Name: 19CEB301 / SOIL MECHANICS**

## UNIT 1- INTRODUCTION

### PART - A (2 marks)

1. Distinguish between Residual and Transported soil.
2. Define i) Degree of saturation ii) Specific gravity
3. A compacted sample of soil with a bulk unit weight of 19.62 kN/$m^3$ has a water content of 15 per cent. What are its dry density, degree of saturation and air content? Assume G = 2.65.
4. What are all the Atterberg limits for soil and why it is necessary?
5. Define sieve analysis and sedimentation analysis and what is the necessity of these two analysis?
6. Two clays A and B have the following properties:

| Atterberg limits | Clay A | Clay B |
|---|---|---|
| Liquid limit | 44 % | 55% |
| Plastic limit | 29% | 35% |
| Natural water content | 30% | 50% |

Which of the clays A or B would experience larger settlement under identical loads? Why?

7. Determine the maximum possible voids ratio for a uniformly graded sand of perfectly spherical grains.

8. What is a zero air voids line? Draw a compaction curve and show the zero air voids line.
9. What is porosity of a given soil sample?
10. What is water content in given mass of soil?
11. Define :
    (a) Porosity
    (b) Void ratio.
12. Define effective size of particle in sieve analysis.
13. Write any two engineering classification system of soil.
14. List any one expression for finding dry density of soils.
15. Define water content and compaction.
16. What are the laboratory methods of determination of water content?
17. Define degree of saturation and shrinkage ratio.
18. Define specific gravity and density index.
19. What do understand from grain size distribution?
20. What are consistency limits of soil?
21. Define plasticity index, flow index and liquidity index.
22. What are the methods available for determination of in-situ density?
23. List the factors affecting compaction
24. Write the major soil classifications as per Indian Standard Classification System.
25. Differentiate standard proctor from modified proctor test.

**PART - B (16 marks)**

1. Explain BIS Classification system of Soil in Detail.

2. Sandy soil in a borrow pit has unit weight of solids as 25.8 kN/$m^3$, water content equal to 11% and bulk unit weight equal to 16.4 kN/$m^3$. How many cubic meter of compacted fill could be constructed of 3500 $m^3$ of sand excavated from borrow pit, if required value of porosity in the compacted fill is 30%. Also calculate the change in degree of saturation.

3. The following data on consistency limits are available for two soils A and B.

| Sl.No. | Index | Soil A | Soil B |
|---|---|---|---|
| 1 | Plastic limit | 16% | 19% |
| 2 | Liquid limit | 30% | 52% |
| 3 | Flow index | 11 | 06 |
| 4 | Natural water content | 32% | 40% |

Find which soil is

(i) More plastic.

(ii) Better foundation material on remoulding.

(iii) Better shear strength as function of water content.

**(iv)** Better shear strength at plastic limit.

Classify the soil as per IS classification system. Do those soils have organic matter?

4. By three phase soil system, prove that the degree of saturation S (as ratio) in terms of mass unit weight ($\gamma$), void ratio (e), specific gravity of soil grains (G) and unit weight of water ($\gamma_w$) is given by the expression

$$\gamma = \frac{(G + e\,S)\gamma_w}{1+e}$$

5. The mass of wet soil when compacted in a mould was 19.55 kN. The water content of the soil was 16%. If the volume of the mould was 0.95 $m^3$. Determine (i) dry unit weight, (ii) Void ratio, (iii) degree of saturation and (iv) percent air voids. Take G = 2.68.

6. A soil has a bulk unit weight of 20.22 $kN/m^3$ and water content of 15%. Estimate the water content if the soil partially dries to a unit weight of 19.42 KN/ $m^3$ and voids ratio remains unchanged.

7. An earthen embankment of $10^6$ $m^3$ volume is to be constructed with a soil having a void ratio of 0.80 after compaction. There are three borrow pits marked A, B and C having soils with voids ratios of 0.90, 0.50 and 1.80 respectively. The cost of excavation and transporting the soil is Rs

0.25, Rs 0.23 and Rs 0.18 per $m^3$ respectively. Calculate the volume of soil to be excavatedfrom each pit. Which borrow pit is the most economical? (Take G = 2.65). A laboratory compaction test on soil having specific gravity equal to 2.67 gave a maximum dryunit weight of 17.8 $kN/m^3$ and a water content of 15%. Determine the degree of saturation, aircontent and percentage air voids at the maximum dry unit weight. What would be theoretical maximum dry unit weight corresponding to zero air voids at the optimum water content?

8. A soil sample has a porosity of 40 per cent. The specific gravity of solids is 2.70. calculate
   i) Voids ratio
   ii) Dry density and
   iii) Unit weight if the soil is completely saturated.
9. A soil has a bulk unit weight of 20.11 $KN/m^3$ and water content of 15 percent. Calculate the water content of the soil partially dries to a unit weight of 19.42 $KN/m^3$ and the voids ratio remains unchanged.
10. Explain Standard Proctor Compaction test with neat sketches.
11. Soil is to be excavated from a barrow pit which has a density of 17.66$kN/m_3$ and water content of 12%. The specific gravity of soil particle is2.7. The soil is compacted so that water content is 18% and dry density is16.2 $kN/m_3$. For 1000 cum of soil in fill, estimate.
   (i) The quantity of soil to be excavated from the pit in cum and
   (ii) The amount of water to be added. Also determine the void ratios of the soil in borrow pit and fill.
12. Explain all the consistency limits and indices.
13. Explain in detail the procedure for determination of grain size distribution of soil by sieve analysis. **(8)**

14. An earth embankment is compacted at a water content of 18% to a bulk density of 1.92 $g/cm^3$. If the specific gravity of the sand is 2.7, find the void ratio and degree of saturation of the compacted embankment. **(8)**
15. Define compaction. Explain Standard Proctor compaction with neat sketch and also explain factors affecting compaction.