K.D.K College of Engineering, Nagpur
Civil Engineering Department
GEOTECHNICAL ENGINEERING-1
ASSIGNMENT NO. 1

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1. Establish the expression for bulk unit weight for soil in terms of specific gravity, void ratio and degree of saturation.
2. Explain what do you understand by bentonite and hardpan.
3. Briefly describe the process of soil formation. Differentiate between residual and transported soil.
4. Explain the term density index. What is its utility? For what type of soil, it is useful?
5. What are different methods of determining water content in laboratory and field?
6. Explain with the help of a sketch / graph Gap graded, poorly graded well graded and uniformly graded soil.
7. The following observation were obtained in field density test.
    a. Wt of core cutter: 1060 gm
    b. Volume of core cutter: 995 cm^3
    c. Wt of core cutter + wet soil: 3030 gm
    d. Water content of soil : 16%

    Determine dry unit weight, void ratio and degree of saturation of the soil in its field condition. (G=2.7).
8. Define the following terms
    a. Plasticity index (b). Flow index (c). Liquidity index.
9. Explain the use of plasticity chart for classification of soils.
10. Establish the relationship between discharge velocity (v) and seepage velocity (Vs) for sil with void ratio (e).
11. Write short note on
    a. Formation of soil.
    b. Uniformity coefficient and coefficient of curvature
    c. Grain size classification of soil.
    d. Sand replacement method.
    e. Relative density and its practical applications.
    f. Soil as a three phase system.
    g. IS classification soil.
    h. Uses of particle size distribution curve.
    i. Index properties.
    j. Thixoptropy
    k. Determination of liquid limit.
    l. Determination of plastic limit.
    m. Determination of shrinkage limit.
    n. Toughness index.
    o. Plasticity index
    p. Laboratory method for in-situ density in cohesive soil deposit.
    q. Sedimentation analysis of fine sand.
    r. Formation of soil giving names of soil basis of mode of deposition.
12. Discuss origin of soil.
13. Enumerate major deposit found in India.

14. Which are the agencies responsible for transportation and deposition of soil in the process of soil formation.
15. Name important clay minerals and represent them symbolically.
16. Enlist different methods of determination of water content. Explain in detail.
17. Discuss the importance of index properties of soil.
18. Define the i) Void ratio ii) Degree of saturation. (iii) Specific gravity.
19. Derive from first principle relationships for void ratio in terms of porosity and porosity in terms of void ratio.
20. A soil sample has a porosity of 40 %. The specific gravity of solids is 2.70. Calculate void ratio, dry unit weight, unit weight if the soil 50% saturated, unit weight if soil is completely saturated.
21. Derive relation between dry unit weight, bulk unit weight and water content.
22. In an earthen embankment under the bulk unit wt. of 17 kN/m^3 at water content of 12%. If the water content is to be raised to 15 %; compute the quantity of water required to be added per cubic meter of soil. Assume no. change in void ration.
23. What do you understand by term consistency of soil? Explain the different states of consistency in details.
24. A soil sample from field has a volume of 400 cm^3 and a weight of 450 gm. The water content of soil is 11% and G= 2.62. Find void ratio, degree of saturation and porosity.
25. Derive the relationship from first principles - $G, e,\ \eta_{a,}\gamma_{d,}\gamma_{sat,}\gamma_{w,}$ and $\gamma = \left(\frac{G+S_e}{1+e}\right)\gamma_w$, Se= WG
26. Explain the I.S. soil classification with the help of plasticity chart.
27. Derive relation between $G, e_{,and}\ \ \gamma_{sat,}\gamma_{w,}$
28. Derive relation $\gamma_d = \frac{(1-n_a)G\gamma_w}{1+wg}$. With the help of three phase diagram.
29. The following is the result of a liquid limit test: - Determine the liquid limit of a soil. If the plastic limit of the soil is 23 %. Find out the flow index. Natural water content were 18% Find CI and LI.

Number of blows	Water content
50	34.1
35	39
26	42
20	47
15	53
10	60

30. Explain the following abbreviation for IS classification of soil. CH, MI, OL, GW, SP.
31. An imaginary soil mass is contained in container 10 cm X 10 cm X 10 cm. The soild consist spherical grains of size 1 cm in diameter. Determine the maximum possible void ratio, Porosity and percent solids.
32. Explain formation of soil with the example of each type.
33. A saturated clay sample has a volume of 20 cm^3 and weight of 30 gm. On oven drying, the weight reduces to 18.00 gm, the volume of dry specimen is 9.9 cm^3. Determine shrinkage limit, specific gravity and shrinkage ratio.
34. Derive relation between $\gamma_{d,}\gamma_{,}w.$
35. A natural soil deposit has a bulk unit weight of 13.5 kN/m^3 and water content of 5%. Calculate the amount of water required to be added to 1 cubic meter of soil to raise the water content to 15%. Assume the void ratio to remain constant What will then be the degree of saturation? G=2.6

36. The plastic limit and liquid limit of a soil are 33 % and 45 % respectively. The % volume change from liquid limit to dry state is 36 % of the dry volume. Similarly, the % volume change from the plastic limit to the dry state is 24 % of the dry volume. Determine the shrinkage limit of shrinkage ratio.
37. A sample of saturated clay has volume of 97 ml and a weight of 202 gm when completely dried it has a volume of 87 ml and a weight of 167 gm. Find shrinkage limit and original water content.
38. Explain how both coarse and fine grained soil classified as per IS 1498 (1970).
39. Explain textural classification of a soil.

40. A soil sample consisting of particles of size ranging from0.5 mm to 0.01 mm, is put on surface of still water tank 5 meters deep. Calculate the time of settlement of the coarsest and the finest particles of sample to the bottom of the tank. Assume average specific gravity of soil particles as 2.66 and viscosity of water as 0.01 poise.
41. A partially saturated soil from an earth fill has a natural water content of 19 % and bulk unit weight of 19.33 kN/m^3. Assuming the specific gravity of soil solids as 2.6, compute the degree of saturation and void ratio. If subsequently the soil gets saturated, determine the dry unit weight and saturated unit weight.
42. The soil of an embankment is to be compacted void ratio of 0.7. the void ratio of borrow pit soil is 1.2. How much will be compacted volume embankment per 1000 m^3 of volume taking from borrow pit.
43. The atterberg limits of a clay soil are: liquid limit 52%, plastic limit 30% and shrinkage limit 18%. If the specimen of this soil shrinks from a volume of 39.5 cm^3 at liquid limit to a volume of 24.2 cm^3 at shrinkage limit, calculate true specific gravity.
44. A sample of soil from field had a volume of 300cm^3 and weighed 600 gm. Moisture content of soil samples was found to be 12% and specific gravity of soil solid as 2.6. determine void ratio, degree of saturation and porosity of sample. Also determine the moisture content at which the sample will get fully saturated.
45. One cubic meter of wet soil weighs 19.8 kN; if the specific gravity of soil particles is 2.6 and water content 12%, find void ratio, dry density and degree of saturation.
46. A granular sand was tested in laboratory and found to have maximum and minimum void ratios of 0.84 and 0.38 respectively. The value of specific gravity was determined to be 2.65. A natural soil deposit of same sand has 9 % water content, and its unit weight is 18.64 kN/m^3. Determine the relative density of soil in the field.
47. The values of liquid limit, plastic limit and shrinkage limit are 60%, 30%,20% respectively. If a sample of this soil at liquid limit has a volume of 40cm^3 and its volume measured at shrinkage limits was 23.5 cm^3, determine the specific gravity of the solids. Percentage of particles less than 2μ = 25% What is the shrinkage ratio and volumetric shrinkage? I_f =25%. Also find liquidity index, activity number, toughness index.
48. During soil investigation, the following observation were taken for the insitu. Weight measurement by sand replacement method:
    a. Wt. of excavated soil = 761.25gm
    b. Wt of sand + cylinder (w1)= 10500g
    c. Wt of sand + cylinder after pouring in the excavated hole and cone(w2) =9450gm
    d. Wt of sand + cylinder after pouring for the cone only (w3).
    e. Volume of calibrating container – 1000 cc weight of sand in calibrating after pouring from cylinder= 1500gm.

    Calculate the in situ unit weight of soil.

49. A soil in its natural state has, when fully saturated, a water content of 32.5%. Determine the void ratio, dry and total unit weight. Calculate the total weight of water required to saturate a soil mass of volume $10m^3$. G=2.6.
50. The plastic limit of a soil is 25 % and its plasticity index is 8%. When the soil is dried from its state to plastic limit, the volume change is 25% of its volume at plastic limit. Similarly, the corresponding volume change from the liquid limit to dry state is 34% of its volume at liquid limit. Determine the shrinkage limit and shrinkage ratio.
51. If D_{10} = 0.20 mm, D30=0.23 mm, D60=0.26mm. Calculate; (I)Cc (II) Cu and classify type of soil.
52. Can porosity exceed unity? Disscuss.
53. Determination the maximum possible void ratio for uniformly grade sand of spherical grains.
54. An undisturbed sample of soil has a volume of 100 cm^3 and a weight 2 N. On oven drying for 24 hours the weight is reduced to 1.5 N. If the specific gravity of grains is 2.68. Determine the water content, Void ratio and degree of saturation of the soil.
55. The result of sieve analysis are given below :-

I.S. Sieve	Wt of soil Retained (gm)	% mass retained	Cumulative % mss retained	% finer
4.75 mm	32.34			
2.40 mm	41.60			
1.20 mm	47.29			
600 µ	58.14			
425 µ	71.23			
300 µ	74.99			
212 µ	46.24			
150 µ	58.14			
75 µ	38.17			

The total wt. of dry soil taken was 500 gms.

a) Plot particle size distribution curve.
b) Determine Cc and Cu.
c) Comment on type of soil.