Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 91297

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Fourth Semester

Civil Engineering

CE 6405 – SOIL MECHANICS

(Regulations 2013)

(Common to PTCE 6405 – Soil Mechanics for B.E. (Part-Time) for Third Semester – Civil Engineering Regulations – 2014)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. What do you understand by CL, CI and CH clays ?
2. Show the effect of compactive energy on γd_{max} and OMC.
3. How do you know that the flow through a soil obeys Darcy's law ?
4. What is capillary stress ? How does it vary for sand and clay ?
5. State the Boussinesq formula for Vertical Stress Distribution in soil under a point load.
6. What is the effect of single and double drainage on the rate of consolidation ?
7. A purely cohesive soil sample of cohesion 40 kPa is subjected to a cell pressure of 100 kPa in a triaxial compression test. Will the sample fail by shear ? Justify your answer.
8. The diameter of all the Mohr circles drawn at incipient failure condition for the results of a triaxial test performed on a soil is the same and equal to 150 kPa to a scale. Find the shear strength parameters of the soil.
9. A cutting is to be made in clay for which the cohesion is 350 kN/m^2 ; bulk unit weight is 20 kN/m^3. Find the maximum depth for a cutting of side slope 1.5 : 1. Factor of safety to be 1.5. Take the stability number as 0.17.
10. Mention different modes of slope failure.

PART – B (5×13=65 Marks)

11. a) i) A soil sample has a diameter of 38.1 mm and a length of 76.2 mm. Its wet weight is 1.843 N and its dry weight is 1.647 N. If specific gravity of the solids is 2.7, find dry unit weight, bulk unit weight, void ratio, water content and degree of saturation. (7)

ii) Explain IS soil classification system for classifying coarse grained soil. (6)

(OR)

b) i) Discuss various factors influencing compaction behaviour of soils. (7)

ii) The sieve analysis of a soil gave the following results : % passing 75 μ sieve = 8 ; % retained on 4.75 mm sieve = 35. Coefficient of curvature = 2.5; uniformity coefficient = 7. The fine fraction gave the following results : Plasticity index = 3% ; Liquid limit = 15%. Classify the soil as per IS soil classification system. (6)

12. a) i) A clay layer 3 m thick is having water content 45% and specific gravity of solids 2.7. This clay layer is lying below another layer which is 5 m thick sand layer. The sand layer lying at the top is having void ratio 0.6 and with degree of saturation 40% and Gs = 2.65. The water table is at a depth of 3 m below. Determine the Total Stress, Pore Pressure and Effective Stress at various levels and draw the corresponding diagrams. (7)

ii) Define Quicksand Condition and Critical Hydraulic Gradient. (6)

(OR)

b) i) What are the different types of water exist in soil ? State their importance. (6)

ii) Describe the laboratory procedure involved in the determination of coefficient of permeability of fine grained soil. (7)

13. a) i) A water tank has supported by a circular foundation of diameter 10.5 m is resting on a soil stratum. The total weight of the tank including the foundation is 17,700 kN. Estimate the stress due to the above load at 0.5 m and 2.5 m depth at the center of the water tank.

ii) Explain in details the determination of coefficient of consolidation using log t method.

(OR)

b) i) For a single concentrated load 1,000 kN acting on the ground surface construct an isobar for $\sigma_z = 40 kN/m^2$. (6)

ii) A 8m thick clay layer with single drainage settles by 120 mm in 2 years. The co-efficient of consolidation of this clay was found to be 6×10^{-3} cm^2/sec. Calculate the likely ultimate consolidation settlement and find how long it will take to undergo 90% of this settlement. (7)

91297

14. a) i) In direct shear test, find the angle made by failure plane and major principal plane respectively with respect to horizontal, if the angle of internal friction is 30°. **(3)**

ii) Describe the state of soil samples A to D when the Mohr circles describing their state of stresses are as follows : for A, the Mohr circle is a dot on the normal stress axis, for B, the Mohr circle is too small to touch the strength envelope, for C, the Mohr circle is tangential to strength envelope and for D, the Mohr circle is so large that part of the circle is above the strength envelope. Also for the sample C, find the angle made by the failure plane with respect to minor principal plane. **(10)**

(OR)

b) Following are the results of a triaxial test conducted on two specimens of the same soil. Find the shear strength parameters of the soil. If another specimen of the same soil is subjected to a cell pressure of 400 kPa, find the deviator stress at which it is likely to fail. Also for this specimen, find the normal stress and shear stress on the failure plane and locate the plane of maximum shear stress with respect to major principal plane and find the magnitude of maximum shear stress.

Cell pressure , kPa	100	200
Deviator stress at failure, kPa	300	585

15. a) i) A slope of very large extent of soil with properties $c' = 0$ and $\phi = 32°$ is likely to be subjected to seepage parallel to the slope with water level at the surface. Determine the maximum angle of slope for a factor of safety of 1.5 treating it as an infinite slope. For this angle of slope what will be the factor of safety if the water level were to come down well below the surface ? The saturated unit weight of soil is 20 kN/m^3. **(8)**

ii) Discuss about various slope protection measures. **(5)**

(OR)

b) i) An embankment 10 m high is inclined at 35° to the horizontal. A stability analysis by the method of slices gave the following forces :

Total normal force = 900 kN ; Total tangential force = 420 kN ; Total neutral force = 200 kN. If the length of the failure arc is 23 m, find the factor of safety with respect to shear strength. The soil has c = 20 kN/m^2 and $\phi = 15°$. **(8)**

ii) Explain friction circle method of slope stability analysis. **(5)**

PART – C (1×15=15 Marks)

16. a) The unit weight of a soil at 50% and 80% saturation is 17.60 kN/m^3 and 18.81 kN/m^3 respectively. Find

i) Specific gravity of solids
ii) Void ratio
iii) Porosity
iv) Dry unit weight
v) Saturated unit weight
vi) Submerged unit weight
vii) Water content corresponding to 100% saturation. When a disturbed sample of the same soil was subjected to classification tests, the following results were obtained :

Percentage finer than 4.75 mm	: 80
Percentage finer than 0.075 mm	: 9
Liquid limit	: 23%
Plastic limit	: 15%
Size corresponding to 10 % finer	: 0.09 mm
Size corresponding to 30% finer	: 1.2 mm
Size corresponding to 60% finer	: 3.4 mm

Classify the soil as per IS 1498.

(OR)

b) A soil profile consists of 4-m thick sand underlain by 3-m thick clay. The clay layer overlies hard rock. A square foundation of size 2 m carrying a load of 800 kN is founded at a depth of 1.5m from the ground level. The ground water table is at the base of the foundation. The specific gravity of solids and void ratio of the sand are 2.7 and 0.7 respectively. The degree of saturation above the water table can be assumed as 30%. The liquid limit, water content and specific gravity of solids of the clay are 40%, 27% and 2.66 respectively. Estimate the probable consolidation settlement of the clay layer, assuming the clay to be normally consolidated. For calculation of additional vertical stress, equivalent point load approach shall be adopted (dividing the total area into four area units).