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SAINTGITS COLLEGE OF ENGINEERING
KOTTAYAM, KERALA

(AN AUTONOMOUS COLLEGE AFFILIATED TO
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH. DEGREE EXAMINATION(R), MARCH 2021
GEOMECHANICS AND STRUCTURES

Course Code: 20CEGST103

Course Name: THEORETICAL GEOMECHANICS

Max. Marks: **60** **Duration:** **3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Briefly differentiate Plane stress and plane strain condition
2. A concentrated load of 22.5 kN acts on the surface of a homogeneous soil mass of a large extent. Find the stress intensity at a depth of 15 meters and a horizontal distance of 7.5 meters using Boussinesq's Equation
3. List out at least three assumptions for Burmisters two-layer theory
4. Sketch the vertical stress distribution on a horizontal plane at depth z using Boussinesq Theory.
5. Explain different rheological models applicable for theoretical geomechanics
6. Define Tresca Failure criterion.
7. Differentiate Isotropic and Anisotropic models
8. How will you evaluate a constitutive model for soil mechanics

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. The state of stress at a point for a given reference axis xyz are σ_x=3, σ_y= 0, σ_z=2, τ_{xy}=2, τ_{yz}=-1, τ_{xz}=-2kPa. Determine the stress tensor relative to x'y'z' coordinates system obtained by a rotation through 30degrees about the z axis. (6)

OR

10. The state of stress at a point for a given reference axis xyz are σ_x=15, σ_y=10, σ_z=40, τ_{xy}=10, τ_{yz}=0, τ_{xz}=-10Mpa. Determine the normal stress and the magnitude and direction of the shear stress on a surface intersecting the point and parallel to the plane given by the equation 2x-y+3z=9. (6)

MODULE II

11. An overhead water tank is supported at a depth of 3 m by four isolated square footing of sides 2 m each placed in a square pattern with a centre-to-centre spacing

of 8 m. Compute the vertical stress at a level of 3m below ground (i) at the centre of the four footings and (ii) at the centre of one footing. Adopt Boussinesq's point load approximation. The load on each footing is 700 kN. (6)

OR

12. If it is required to find the vertical stress intensity at beneath a building, irregular in plan, which method would you propose? Explain the method. (6)

MODULE III

13. A rectangular raft of size 30x12m founded at a depth of 2.5m below the ground surface is subjected to a uniform pressure of 150 kPa. Assume the center of the area is the origin of coordinates (0, 0) and the corners have coordinates (6, 15). Calculate stresses at a depth of 20m below the foundation level by the methods of Westergaard at coordinates of (0, 0), (0, 15), (6, 0) (6, 15) and (10, 25). Neglect the effect of foundation depth on the stresses. (6)

OR

14. Explain with a neat sketch the stress distribution around tunnels. (6)

MODULE IV

15. Give a brief conceptual explanation of Rheology. Explain the procedure for the determination of rheological properties. (6)

OR

16. Estimate the immediate settlement of a concrete footing 1.5 x 1.5 m in size founded at a depth of 1m in silty soil whose modulus of elasticity is 90 kg/cm^2. The footing is expected to transmit a unit pressure of 200 kN/m^2. (6)

MODULE V

17. Describe Von Mises Yield criterion. (6)

OR

18. With a neat set of sketches, explain the Mohr-Coulomb Failure criterion based on Principal stress on a triaxial sample subjected to confining stress and deviatoric stress (6)

MODULE VI

19. Explain the Modified Cam clay model and list the parameters to define the model (6)

OR

20. Compared to the basic Mohr-Coulomb Model, explain how the Hardening soil model may be used to capture the behavior of soil better. Sketch a comparison for the stress-strain behavior. (6)

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