Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH(GEOT.ENGG.)/SEM-2/GAM-201/2012

2012

THEORETICAL SOIL MECHANICS

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Attempt any *five* questions.

5 × 14 = 70

1. a) Determine the characteristic equation for the stress matrix [S] where [S] = $\begin{bmatrix} 2 & 2 & -2 \\ 2 & 3 & 3 \\ -2 & 3 & 4 \end{bmatrix}$

b) If the axis system is rotated about origin through 30° in clockwise direction so that *z* axis remains same, find the stress matrix [S'] for the given stress matrix [S] in Q.1 (a). 7 + 7

2. a) Prove that the principal stresses are mutually orthogonal.

   b) In three dimensions, prove that the value of maximum shear stress does not depend on the value of intermediate principal stress. 7 + 7

3. a) Derive the compatibility equation for plain strain condition.

   b) Develop the relationship between stress and strain in matrix form for plain strain condition.

   c) Find the geostatic stress ab initio. 4 + 5 + 5

4. a) Develop an expression for octahedral shear stress in terms of principal stresses σ_1, σ_2, σ_3.

   b) Prove that $0 \cdot 817 \leq \frac{\tau_{oct}}{\tau_{max}} \leq 0 \cdot 942$ 7 + 7

5. Develop the biharmonic equation in Cartesian coordinates and discuss method of finding stresses in soils with the above equation. Suggest method to find same equation in polar coordinate.

6. a) For an inclined point load acting at a point on the surface, find the vertical stress generated at a point at a depth, z, below the point of application of the load. Comment over the nature of such stress.

   b) For a dry sand sample, tested under normal stress of 1.5 kg/cm^2, the failure occurred under shear stress of 1.0 kg/cm^2 in a direct shear test. Draw the corresponding Mohr's circle at failure and show the locations of the principal planes. 8 + 6

7 a) Explain the term "slip lines". Give the differential form of the slip lines at a point.

   b) Develop the recurring relations for x, z, ξ and η for a soil body limited by horizontal boundary and subjected to uniform vertical distributed load. 6 + 8

8. Considering plastic state of soil, develop the governing equation for the stresses leading to Sokolovoski's solution.