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First Semester M.Tech. Degree Examination, June/July 2016
Continuum Mechanics

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions.

- 1 a. The state of stress at a point is known by $\sigma_x = 100\text{MPa}$, $\sigma_y = 40\text{MPa}$, $\sigma_z = 80\text{MPa}$, $\tau_{xy} = \tau_{yx} = \tau_{xz} = 0$. Determine the extreme values of the shear stresses their associated normal stresses, the octahedral shear stress and its associated normal stress. (10 Marks)
- b. Explain: i) invariants of stress ii) octahedral stress. (10 Marks)
- 2 a. The displacement field is given by :
 $u = K(x^2 + 2z)$; $v = K(4x + 2y^2 + z)$ $w = 4Kz^2$ where 'K' is very small constant. What are the strains at (2, 2, 3) in directions.
 i) $\ell = 0$; $m = n = \frac{1}{\sqrt{2}}$ ii) $\ell = 1$; $m = n = 0$ iii) $\ell = 0.6$, $m = 0$, $n = 0.8$. (10 Marks)
- b. Derive the compatibility equation in terms of strains and displacements. (10 Marks)
- 3 a. The state of strain at a point is given by
 $\epsilon_x = 0.001$, $\epsilon_y = -0.003$; $\epsilon_z = \gamma_{xy} = 0$ $\gamma_{xz} = 0.004$; $\gamma_{yz} = -0.001$.
 Determine the stress tensor at this point. Take $E = 210 \times 10^6 \text{ kN/m}^2$, Poisson's ratio = 0.28 also find Lam's constant. (12 Marks)
- b. State and explain the following :
 i) St. Venant's principle
 ii) Principle of super position. (08 Marks)
- 4 a. Using Airy's stress function, determine bending stress of a rectangular beam of length ' ℓ ' width ' $2b$ ' depth ' b ' subjected to a pure couple ' M ' along its length. (14 Marks)
- b. Write a note on plane stress and plane strain problem. (06 Marks)
- 5 a. Derive the expression for radial and tangential stress in their cylinder subjected to a internal and external fluid pressure (Take only plane stress case). (14 Marks)
- b. Explain as symmetric problems with examples. (06 Marks)
- 6 a. Briefly explain the following :
 i) Von mises yield criteria ii) Tresca criteria (10 Marks)
- b. Write a note on :
 i) Strain hardening hypothesis ii) plastic potential theory. (10 Marks)
- 7 a. With a neat sketch, explain "Visco elastic modules". (10 Marks)
- b. With a neat sketch, explain creep and relaxation pertaining to viscodensity. (10 Marks)
- 8 Write a short notes on
 a. Viscous stress leister (06 Marks)
- b. Kelvin's theorem (06 Marks)
- c. Law of conservations of energy. (08 Marks)