Paper Code: MME-205	Roll No.										

M.Tech.

(SEM II) EVEN SEMESTER EXAMINATION, 2015-16

ADVANCED MECHANICS OF SOLID

[Time: 3 hrs.] **[Max. Marks: 100]**

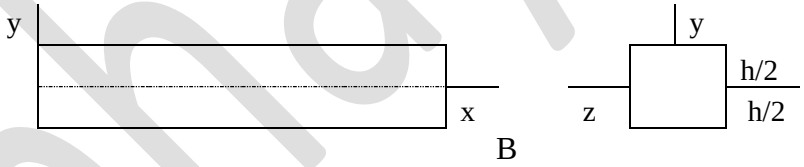
Note:- (i) Attempt any five questions.
(ii) All questions carry equal marks.

1. (a) Write a note on Octahedral stresses.
(b) The state of stress at appoint is characterized by the components: $\sigma_x = 12.31$, $\sigma_y = 8.96$, $\sigma_z = 4.34$, $\tau_{xy} = 4.20$, $\tau_{xz} = 5.27$, $\tau_{xx} = 0.84$. Find the values of principal stresses and their directions. **[8+12]**

2. (a) The displacement field for a body is given by: $\mathbf{u} = (x^2 + y)\mathbf{i} + (3 + z)\mathbf{j} + (x^2 + 2y)\mathbf{k}$. Write down the displacement gradient matrix at point (2, 3, 1).
(b) Develop relation between E, G & B. **[14+6]**

3. (a) For the following plane strain distribution, verify whether the compatibility condition is satisfied: $\epsilon_{xx} = 3x^2y$, $\epsilon_{yy} = 4y^2x + 10^{-2}$, $\Upsilon_{xy} = 2xy + 2x^3$.
(b) What are the two approaches used in solving a fracture mechanics problem. **[10+10]**

4. Calculate the rectangular beam shown in the fig. According to the elementary theory of bending, the 'fiber stress' in the elastic range due to bending is given by: $\sigma_x = -My/I = -12My/bh^3$ where M is the bending moment which is a function of x. Assume that $\sigma_z = \tau_{xz} = \tau_{xy} = 0$ and the top and bottom, and further, that $\sigma_y = 0$ at the bottom. Using the differential equations of equilibrium, determine τ_{xy} and σ_y. Compare these with the values given in the elementary strength of materials. **[20]**



5. (a) Find torsion in bars with thin rectangular sections.
(b) A solid alloy shaft 5 cm diameter is to be coupled in series with a hollow steel shaft of same external diameter. Find the internal diameter of the steel shaft if the angle of twist per unit length is 75% of the alloy shaft. Determine the speed at which the shafts are to be driven to transmit 200 kW, if the limits of shearing stress are to be 55 N/mm^2 and 75 N/mm^2 respectively. $G_{steel} = 2.2G_{alloy}$. **[10+10]**

6. (a) Consider a graphical-epoxy laminate whose elastic constants along and perpendicular to the fibers is as follows: $E_{xx} = 181$ GPa, $E_{yy} = 10.3$ GPa, $G_{xy} = 7.17$ GPa, $\nu_{yx} = 0.28$, $\nu_{xy} = 0.01594$. Obtain the compliance coefficients appropriate to x'y' axes which are at $+30^0$ counter-clockwise to xy.
(b) Discuss Stress Invariants. **[12+8]**

7. Write a short note on any four of the following: **[5x4=20]**
   (a) Multi-directional Laminates.
   (b) State of plain stress and strain.
   (c) Failure theories for fiber composites.
   (d) Discuss the limitation of Euler's theory for columns.
   (e) State and prove the first theorem of moment-area method.
   (f) Briefly discuss deflection due to shear, in beams.