

**B. TECH.**  
**(SEM III) THEORY EXAMINATION 2018-19**  
**MECHANICS OF SOLIDS**

*Time: 3 Hours**Total Marks: 100***Note:** Attempt all Sections. If require any missing data; then choose suitably.**SECTION A****1. Attempt all questions in brief. 2 x 10 = 20**

- a. Briefly explain about types of stresses?
- b. What is Hooke's law?
- c. Define the term obliquity.
- d. What is flitched beam?
- e. Draw Shear stress distribution for rectangular section.
- f. What do you mean by effective length?
- g. Write the difference between strut and column.
- h. What is Hoop stress?
- i. Define shear centre.
- j. What is difference between pure bending and unsymmetrical bending?

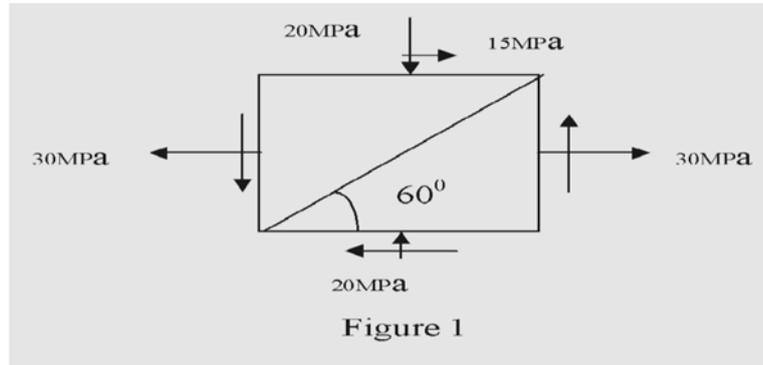
**SECTION B****2. Attempt any three of the following: 10 x 3 = 30**

- a. An element in a strained body is subjected to tensile stress of 150MPa and a shear stress of 50 MPa tending to rotate the element in an anti clockwise direction. Find out the magnitude of normal and shear stresses on a section inclined at 40° with the tensile stress. Also calculate magnitude and direction of maximum shear stress that can exist on the element. Use Mohr's circle graphical method to solve this.
- b. A water main of 500 mm internal diameter and 20 mm thick is running full. The water main is of cast iron and is supported at two points 10 m apart. Find the maximum stress in the metal. The cast iron and water weigh 72000 N/m<sup>3</sup> and 10000 N/m<sup>3</sup> respectively.
- c. A closely coiled helical spring is made of 12.5 mm diameter steel wire and its 10 coils have a mean diameter of 250 mm. Find the elongation, intensity of torsional and total shearing stresses and strain energy per cubic cm when the spring carries an axial load of 180 N. ( $G = 80 \text{ GPa}$ ).
- d. A steel cylinder 240 mm internal diameter is to withstand an internal pressure of 5N/mm<sup>2</sup>. The increase in area of the bore due to the resulting radial expansion is limited to 0.1% of the nominal area. Calculate the necessary thickness of the cylinder and the circumferential stress induced in the section. Take  $E = 2 \times 10^5 \text{ N/mm}^2$ ,  $\mu = 0.3$ .
- e. A curved bar of square section 4 cm sides and mean radius of curvature 5 cm is initially unstressed. If a bending moment of 300 Nm is applied to bar to straighten it, find the stresses at the inner and outer faces.

## SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

- (a) At a point in a strained material stresses are applied as shown in figure. Find out the normal and shear stress on the oblique plane, principal stress and principal strain.



- (b) The strain measurements from a rectangular strain rosette were  $e_{\theta} = 600 \times 10^{-6}$ ,  $e_{45} = 500 \times 10^{-6}$  and  $e_{90} = 200 \times 10^{-6}$ . Find the magnitude and direction of the principal strains. If  $E = 200 \text{ KN/mm}^2$  and  $\mu = 0.3$ , find the principal stresses.

4. Attempt any *one* part of the following: 10 x 1 = 10

- (a) A timber beam 80 mm wide and 160 mm deep is reinforced with two steel plates 5 mm thick and 60 mm wide on top and bottom. If bending moment of 800 N m acts at section of this beam, calculate the magnitude of maximum fiber stresses in tensions and compression in wood and steel. Assume  $E_s / E_w = 15$ .

- (b) A hollow steel shaft 10 cm external diameter, 5 cm internal diameter, transmits 600 KN at 500 rpm and is subjected to an end thrust of 60 KN. Find what bending moment may be safely applied to the shaft if the greater principal stress is not to exceed  $100 \text{ N/mm}^2$ .

5. Attempt any *one* part of the following: 10 x 1 = 10

- (a) A cantilever leaf spring has a clear span of 800 mm and carries a load of 10 KN at the free end. The bending stress in strip and deflection at free end not exceed respectively 320 MPa and 80 mm. Find the number of plates if width of a plate is 8 times the thickness.

- (b) A short column of rectangular cross section 200 mm by 150 mm carries a load of 400 KN at a point 50 mm from longer side and 87.5 mm from the shorter side. What are the maximum compressive and tensile stresses?

6. Attempt any *one* part of the following: 10 x 1 = 10

- (a) Find the expression for stresses induced in a long cylinder rotating with angular speed  $\omega$ .

- (b) A steel disc of uniform thickness and of diameter 900 mm is rotating about its axis at 3000 r.p.m. Determine the radial and circumferential stresses at the centre and outer radius. The density of material is  $7800 \text{ Kg/m}^3$  and Poisson's ratio = 0.3

7. Attempt any *one* part of the following: 10 x 1 = 10

- (a) The cantilever of length 1 m carries a point load of 2000 N at the free end. The cross section of the cantilever is an unequal angle of dimensions 100 mm by 60 mm and 10 mm thick. The small leg of angle is horizontal. The load passes through the centroid of the cross section. Determine :

i. Position of neutral axis

ii. The magnitude of maximum stress set up, at the fixed section of the cantilever.

- (b) Discuss unsymmetrical bending slope of neutral axis and stresses induced.