Code: ME3T5

II B.Tech - I Semester – Regular/Supplementary Examinations November 2018

MECHANICS OF SOLIDS - I
(MECHANICAL ENGINEERING)

Duration: 3 hours   Max. Marks: 70

PART – A

Answer **all** the questions.   All questions carry equal marks
$$11x\ 2 = 22\ M$$

1. a) Draw typical stress-strain diagram for mild steel.

   b) Why nominal breaking stress is less than the ultimate strength as obtained from uniaxial tensile test of a ductile material?

   c) Differentiate Shear Strain and Shear stress.

   d) In a plane stress problem, under what conditions Mohr's circle becomes a point?

   e) Define Principal Stresses and Principal Planes.

   f) Define proof resilience and modulus of resilience

   g) Write the relationship between the three elastic constants of an isotropic material.

   h) What are the different types of Beam loadings?

   i) What is point of inflection?

   j) Write the Assumptions for theory of Simple Bending.

   k) Sketch the Shear stress distribution for a beam of rectangular cross section.

PART – B

Answer any ***THREE*** questions.   All questions carry equal marks.   3 x 16 = 48 M

2. a) A square steel bar of 50 mm on a side and 1 m long is subjected to an axial tensile force of 250 kN. Determine the decrease in lateral dimension due to this load. Take E=200 GPa and v =0.3.   6 M

   b) A tensile test was conducted on a mild steel bar. The following data was obtained from the test: 10 M
   Diameter of the steel bar = 20 mm;
   Gauge length of a bar =150 mm;
   Load at the elastic limit = 200 kN;
   Extension at a load of 100kN=0.2 mm;
   Maximum load = 300 kN;Total extension = 50 mm;
   Diameter of the rod at the failure = 12.5 mm;
   Determine i) Young's modulus, ii) Stress at the elastic limit, iii) Ultimate stress, iv) Percentage elongation and v) Percentage decrease in area

3. a) Briefly explain Hooke's law for plane stress.   6 M

   b) The stresses on two mutually perpendicular planes through a point in a body are 120MPa and 30 MPa both tensile along with a shear stress of 60 MPa. Determine   10 M

i) The magnitude and direction of principal stresses stating whether the stress condition is uniaxial or biaxial

ii) The plane of maximum shear stress.

iii) The normal and shear stress on the plane of maximum shearing stress.

4. a) Three bars of aluminium, steel and copper support a rigid bar which is centrally placed. All the bars have the same cross-sectional area. The aluminium bar is 1 m long. Find the lengths of the steel and copper bars and the stresses in the bars if the rigid bar remains horizontal when the temperature rises by 40°C. The E values are 70 GPa for aluminium, 200 GPa for steel and 120 GPa for copper. Also α values are 23 x $10^{-6}/^\circ$C for aluminium, 12 x $10^{-6}/^\circ$C for steel and 16 x $10^{-6}/^\circ$C for copper.   10 M
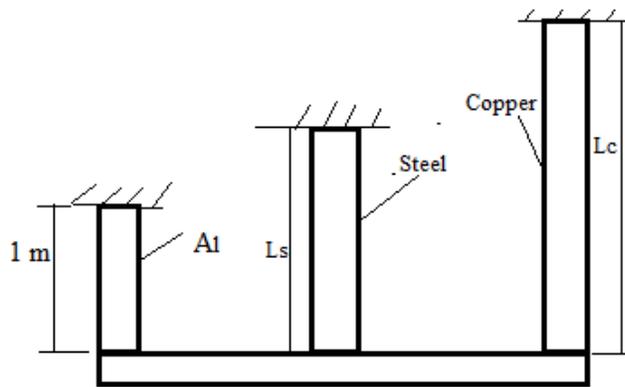
b) Derive the relation between E and K.   6 M

5. A beam of uniform section 10 meters long carries a uniformly distributed load of 10kN per meter over the whole length and a concentrated load of 10kN at the right end. If the beam is

freely supported at the left end, find the position of the second support so that maximum bending moment for the beam shall be as small as possible. Find also the maximum bending moment for the case. Draw also SF and BM diagrams.   16 M

6. A beam of rectangular cross-section 160 mm wide and 300 mm deep is of 4 meters span and is loaded with a central point load of 50 kN. Determine the bending and shear stresses at the top, 100 mm and 40 mm from the neutral axis of the section and at the neutral axis and plot the variations along the section. Consider the bending moment at the mid cross-section of the beam.   16 M