d) The shaft in fig.4d consists of a 3-in-diameter aluminum segment that is rigidly joined to a 2-in-diameter steel segment. The ends of the shaft are attached to rigid supports. Calculate the maximum shear stress developed in each segment when the torque = 10 kip. In is applied. Use $G_{Al} = 4 \times 10^6$ psi and $G_S = 12 \times 10^6$ psi.

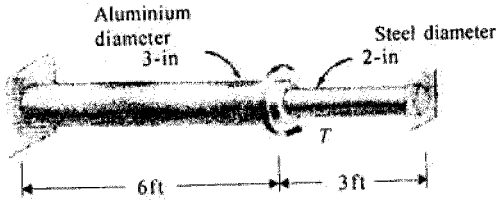

Fig. 4d

OR

Derive the expressions of stresses and deflection of helical spring of circular wire.

5. a) Define critical load in context of a column model with neat sketch.

b) The ultimate strength of a brittle material is 40 MPa in tension and 50 MPa in compression. Use Mohr's failure criterion to determine whether the plane state of stress in fig. 5b would result in failure of this material.

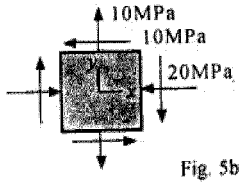

Fig. 5b

c) State Rankine's, Tresca's and von mises theories of failure.

d) Derive Euler's formula for column with pinned ends. .

OR

A 2-m-long pin-ended column of square cross section is to be made of wood. Assuming E = 13GPa, σ_{all} = 12MPa, and using a factor of safety of 2.5 in computing Euler's critical load for buckling ,determine the size of the cross section if the column is to safely support

i) a 100-kN load. ii) a 200-kN load.

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Roll No .....

AE/AU/IP/IEM/ME/PR - 303

B.E. III Semester

Examination, June 2015

Strength And Mechanics of Materials

Time : Three Hours

Maximum Marks : 70

Note: i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.

ii) All parts of each question are to be attempted at one place.

iii) All questions carry equal marks, out of which part A and B (Max. 50 words) carry 2 marks, part C (Max. 100 words) carry 3 marks, part D (Max. 400 words) carry 7 marks.

iv) Except numericals, Derivation, Design and Drawing etc.

1. a) Briefly explain true stress and true strain.

b) A specimen is originally 1 ft long, has a diameter of 0.5in., and is subjected to a force of 500 lb. when the force is increased from 500 lb to 1800 lb, the specimen elongates 0.009 in. Determine the modulus of elasticity for the material if it remains linear elastic.

c) The cross section of the 10-m-long flat steel bar AB has a constant thickness of 20 mm, but its width varies as shown in the fig.1c. Calculate the elongation of the bar due to the 100 -kN axial load. Use E = 200 GPa for steel.

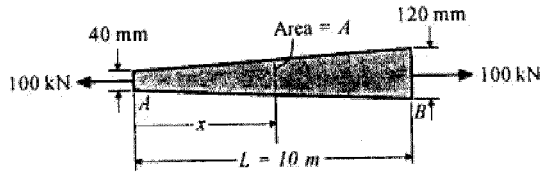

Fig. 1c

d) Determine the reactions at A and B for the steel bar and loading shown in fig.1d, assuming a close fit at both supports before the loads are applied.

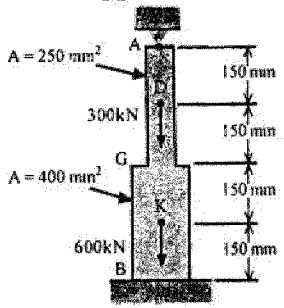

Fig. 1d

OR

Derive the relations amongst elastic constants.

2. a) What are principal planes and principal stresses?
   b) Explain strain rosette briefly.
   c) For the given state of stress (Fig.2c) construct Mohr's circle. Determine the principal stresses.

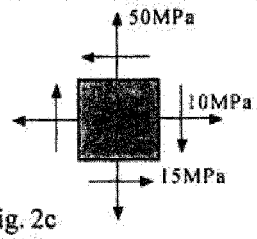

Fig. 2c

   d) The solid shaft is subjected to a torque, bending moment, and shear force as shown in fig.2d. Determine the principal stresses acting at point A.

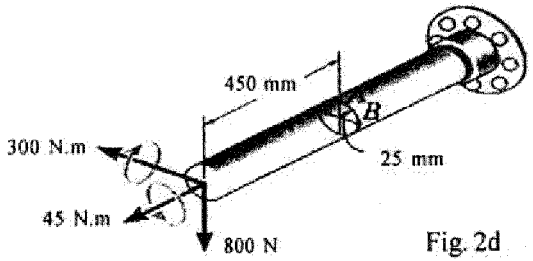

Fig. 2d

OR

Derive the stresses in thin walled pressure vessels supporting with neat sketches.

3. a) State the assumptions made in pure bending.
   b) What is anticlastic curvature?
   c) Briefly explain moment area theorem.
   d) For the beam and loading shown (fig.3d) and using singularity functions (Macaulay's method), express the slope and deflection as functions of the distance ×from the support at A and determine the deflection at the midpoint D. Use E = 200GPa and I = 6.87×10^{6} m^4.

OR

The simply supported beam in fig.3d has a rectangular cross section 120 mm wide and 200 mm high. Compute the maximum bending stress in the beam and the bending stress at a point on section E that is 25 mm below the top of the beam.

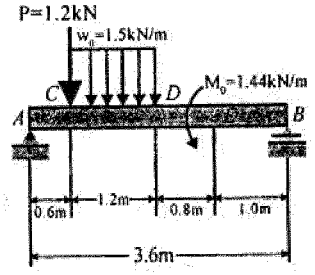

Fig. 3d

4. a) A close coiled helical compression spring of 12 active coils has a spring stiffness of k. It is cut into two springs having 5 and 7 turns. Determine the spring stiffness of resulting springs.
   b) Briefly describe the construction of leaf spring with neat sketch.
   c) A solid steel shaft in a rolling mill transmits 20kW of power at 2 Hz. Determine the smallest safe diameter of the shaft if the shear stress is not to exceed 40 MPa and the angle of twist is limited to 6°in a length of 3 m. Use G = 83 GPa.