Registration No. : | | | | | | | | | | |

Total number of printed pages – 6

B. Tech

PCME 4202

Third Semester Regular Examination – 2014

MECHANICS OF SOLIDS

BRANCH(S) : AUTO, CIVIL, MECH, MINERAL, MINING

QUESTION CODE : H 399

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2 ×10

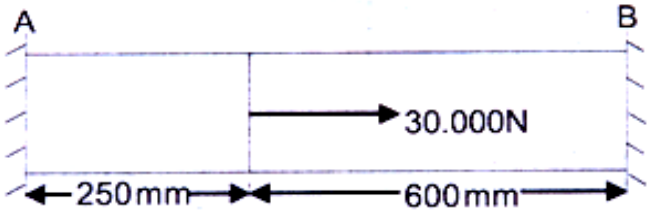
(a) Define term stress, true stress, Proof stress and Thermal Stress

(b) Draw the graph of stress versus strain diagram of mild steel and define Hooke's Law and Poisson's ratio.

(c) Define modulus of toughness, working stress factor of safety and proof resistance.

(d) Around bar of steel tapers uniformly from a diameter of 350mm to 250mm diameter in a length of 500mm. If an axial force of 60KN is applied at each end, determine the elongation of the bar. ($E=205KN/mm^2$)

(e) A steel bar of cross-section area of 300 mm^2 held firmly by end supports and loaded by an axial force of 30 kN as shown in the figure. Determine the reaction at A and B. Take $E= 2 \times 10^5$ kN/mm^2



(f) A material has modulus of rigidity 0.4×10^5 N/mm^2 and bulk modulus 0.75×10^5 N/mm^2. Find the modulus of elasticity and Poisson's ratio.

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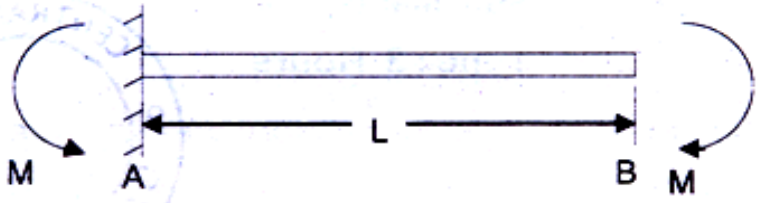
(g) Write different types of supports of the beam along with free body diagrams.

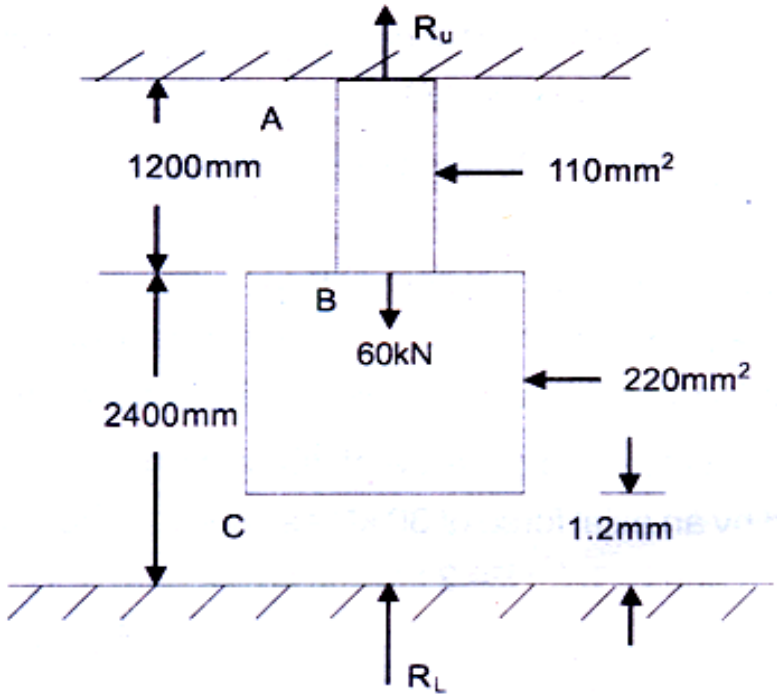
(h) Define the slenderness ratio and write the Euler's load equation for various end conditions.

(i) Construct Mohr's circle for the case of biaxial stress of thin plate when $\sigma_y = -\sigma_x$ and $\sigma_x = \sigma_y$. What is the maximum shear stress ζ_{max} in such cases.

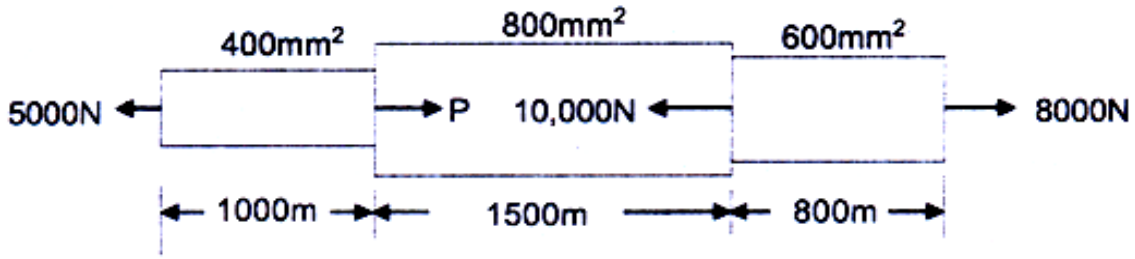
(j) Draw S.F and B.M diagram of cantilever beam subjected to a couple.



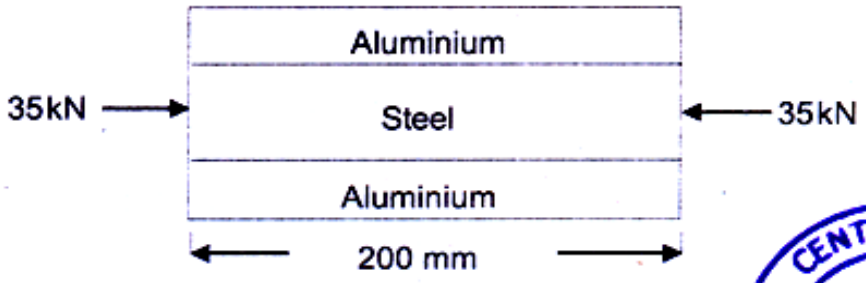
2. (a) Calculate the reactions produced by the lower support on the bar. Take $E = 2 \times 10^5$ kN/mm^2. 5



(b) A steel bar of ABCD of varying cross section is subjected to axial force as shown in figure. Find the value of 'P' for equilibrium. Assume $E = 2.1 \times 10^5$ kN/mm^2 determine the elongation. 5



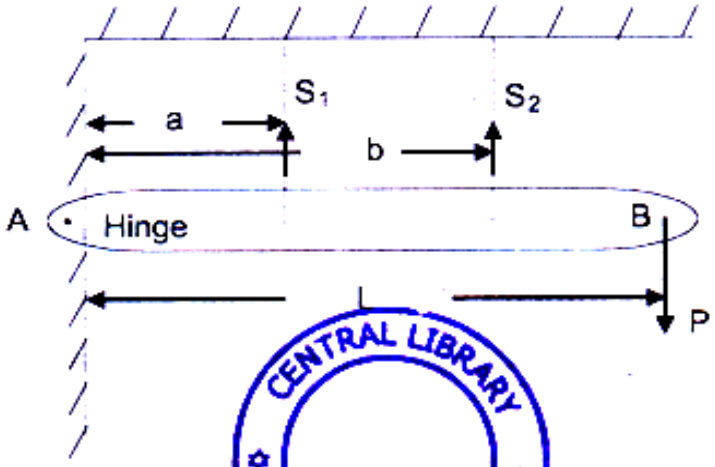
3. (a) Three bars, each 24mm × 6mm in cross section, two made of aluminum alloy and one of steel, are riveted together at each end to form a composite bar 24mm×18mm, the steel bar being in the centre. An axial compressive load of 35kN is applied to the composite bar as shown in figure. Find the stresses in two materials and the shortening on the gauge length of 200mm. if the ends were fastened together at 288°K. Find what temperature the bar must be raised so that the stresses in the material due to 35kN will be equalized. $E_s = 210 kN/mm^2$, $E_{AL} = 70 kN/mm^2$, $\alpha_s = 12 \times 10^{-6}$ per°K, $\alpha_{AL} = 23 \times 10^{-6}$ per°K. 7



(b) Obtain the total elongation of the bar due to its own weight of solid uniform bar of diameter 'D' and length 'L' having vertically from its upper end. 3

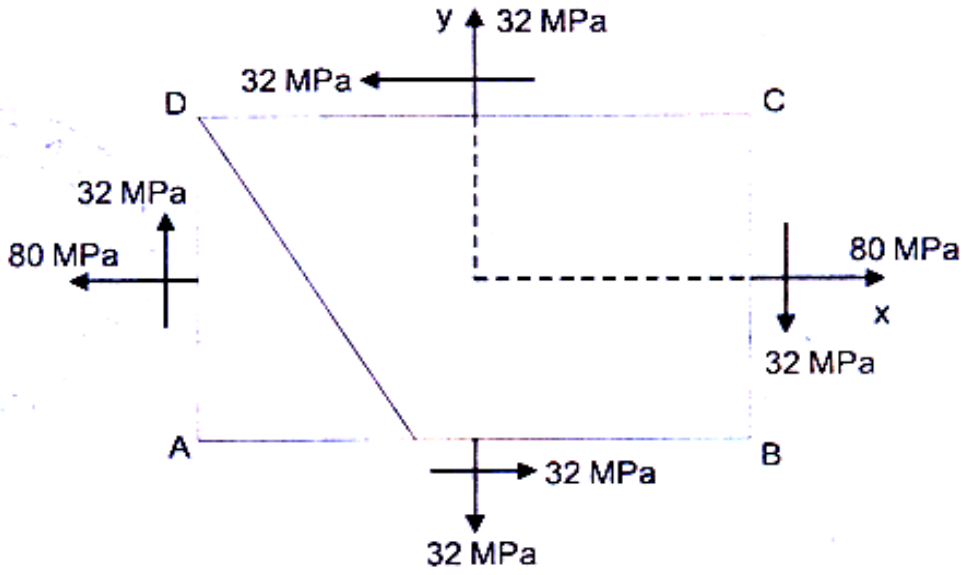
4. (a) A thin cylindrical shell of 2000mm length has 200mm diameter and thickness of metal 10mm. It is completely filled with a fluid at atmospheric pressure. If a additional volume 30,000mm³ fluid is pumped in, find the pressure developed and the hoop stress developed. Also find the changes in the diameter and length. Assume $E = 2 \times 10^5$ kN/mm² and Poisson's ratio $\mu = 0.3$. 6

(b) A rigid bar AB hinged at A and supported in horizontal position by two identical vertical steel wires. Find the tensile forces S_1 and S_2 induced in these wires by a vertical load 'P' applied at B. 4



5. (a) Define principal planes and principal stresses. 4

(b) At certain point in a strained material the values of normal stresses across two planes at right angles to each other are 80 μ Pa and 32 MPa, both tensile and there is a shear stress of 32MPa clockwise on the plane carrying 80 μPa stress across the planes as shown in the figure.

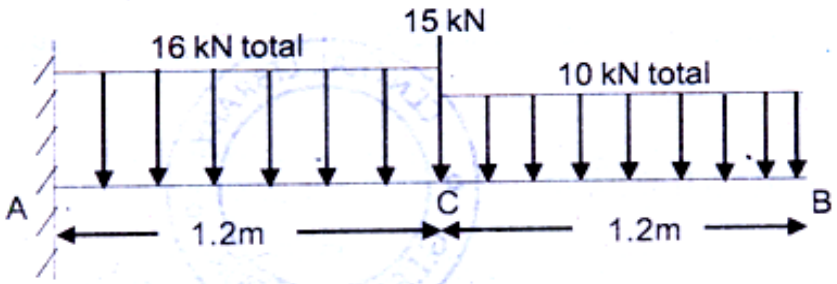


(i) Locate the principal planes and evaluate the principal stresses.

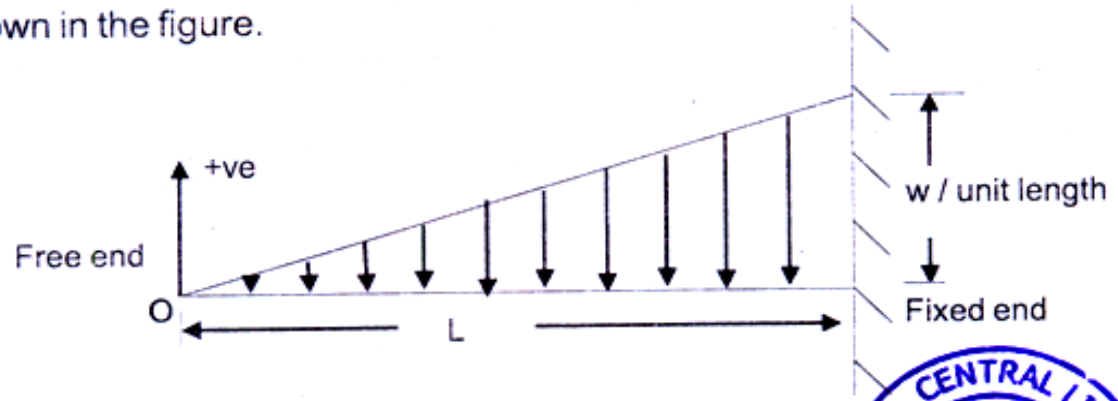
(ii) Calculate the maximum shear stress and specify its planes.

(iii) Derive the formula used from the 1st principle. 6

6. (a) Draw the S.F and B.M diagram for the cantilever beam as shown in the figure. 5

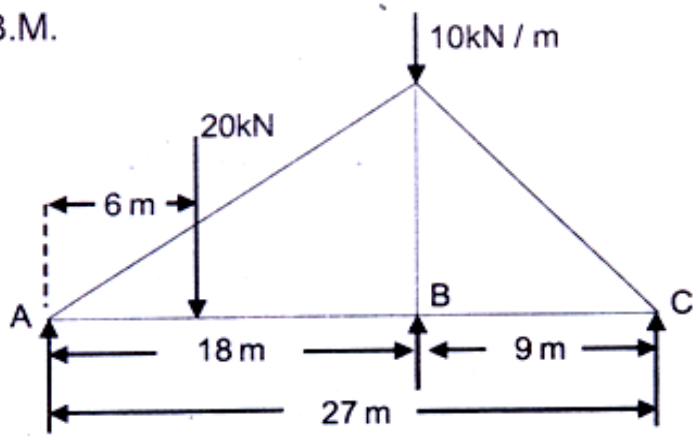


(b) Determine the slope and deflection at the free end of a cantilever beam as shown in the figure. 5



7. (a) Compare the moment of resistance of a beam of square section placed with two sides horizontal to that with a diagonal horizontal for same stress in each case. 3

(b) A beam ABC, 27m long is simply supported at A and B, 18m apart, and carries a load of 20kN at 6m from A together with distributed load whose intensity varies in linear fashion from zero at A and C to 10kN/m at B. Draw the S.F and B.M diagrams and calculate the position and magnitude of maximum B.M. 6



(c) Define the point of centraflexure. 1

8. (a) Derive the Bernoulli-Euler bending equation along with assumptions. 4

(b) Derive the differential equation of flexure of the beam and define flexural rigidity. 2

(c) Prove that a hollow shaft is stronger and stiffer than the solid shaft of the same material, length and weight. Define torsional rigidity. 4