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B.Tech. III Semester (Main/Back) Examination - 2014

Mechanical Engg.

3ME1A Mechanics of Solids - I

(Common to 3AN1, 3PI1A and 3AE1A)

Time : 3 Hours **Maximum Marks : 80**

Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any **five** questions, selecting **one** question from each **unit**. All questions carry **equal** marks. Solutions should be followed by neat diagrams, every step and units of quantities.*

Unit - I

1. a) The following results were obtained in a tensile test on a mild steel specimen of original diameter 2cm and gauge length 4cm. At the limit of proportionality the load was 80kN and extension 0.048 mm. The specimen yielded at a load of 85 kN and the maximum load with stand was 150kN

When the two parts were fitted together after being broken, the length between gauge points was found to be 5.56cm and diameter at the neck was 1.58cm.

Calculate Young's modulus and stress at the limit of proportionality, the yield stress, and the ultimate stress, also the percentage elongation and percentage contraction in area. **(8)**

b) Find the extension of a bar uniformly tapering from diameter 'd_1' at one end to diameter 'd_2' at other end subjected to an axial tensile load P at both ends. Length of bar is taken as L.

What will be equivalent diameter 'd' of the bar of the same length and material, for the same extension? **(8)**

OR

1. a) A bar of 25mm diameter is subjected to a pull of 40 kN. The measured extension on gauge length of 200mm is 0.085mm and the change in diameter is 0.003mm. Calculate the Poisson's ratio and the values of three elastic module. **(8)**

   b) A piece of material is subjected to three perpendicular tensile stresses $\sigma_1, \sigma_2 \& \sigma_3$. The normal strains in the three directions are in the ratio 3:4:5. If Poisson's ratio is 0.286 find the ratio of stresses, and their values if the greatest is $60 N/mm^2$. **(8)**

Unit - II

2. a) At a section in a beam the tensile stress due to bending is 50 N/mm^2 and there is a shear stress of 20 N/mm^2. Determine from first principles the magnitude and direction of the principal stresses and calculate the maximum shear stress. **(10)**

   b) Derive an expression for equivalent bending and torsional moment of a circular rod. What is its significance? **(6)**

OR

2. a) Why failure theories are needed? Name them. Discuss these about their use. **(6)**

   b) If the principal stresses at a point in an elastic material are 2f tensile, f tensile and $\frac{1}{2}$ f compressive, calculate the value of 'f' at failure according to five different theories, for failure to just take place.

   The elastic limit in simple tension is 200 N/mm^2 and Poisson's ratio = 0.3 **(10)**

Unit - III

3. a) A cantilever of 14m span carries loads of 6kN, 4kN, 6kN and 4kN at 2m, 4m, 7m and 14m respectively from the fixed end. It also has a uniformly distributed load of 2kN/m run for the length between 4m and 10m from the fixed end. Draw the shear force and bending moment diagrams and write down the important values on it. **(10)**

   b) Draw maximum bending moment diagram for a moving load 'W' on a simply supported beam of length '*l*' **(6)**

OR

3. a) Derive relation between load, shear force and bending moment. **(6)**

b) A beam 25m long is supported at A and B and loaded as shown in Fig.1. Sketch the S.F. and B.M. diagrams and find

i) the Position and magnitude of maximum B.M. and

ii) the position if the point of contraflexure. **(10)**

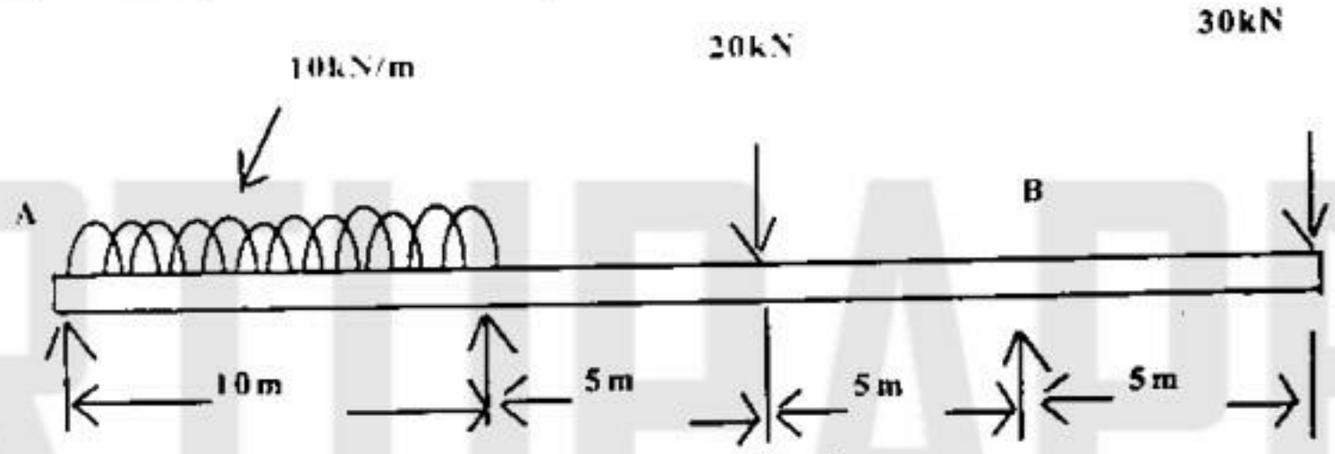

Fig.1

Unit - IV

4. a) A simply supported square beam of 800mm length and 15mm×15mm in section is just safe on applying a load of 360N at the mid span. Find the maximum uniformly distributed load that can be applied safely to a 40mm wide, 75mm deep and 1.6m long cantilever made of the same material. **(10)**

b) A boiler of 1.6m diameter is made of 20mm thick steel plates. Determine the permissible steam pressure in the boiler if the efficiency of the longitudinal joint of boiler is 80% and the maximum tensile stress in the steel plates is not to exceed 80MPa. Calculate the longitudinal stress of the circumferential joint if the efficiency of the joint is 70%. **(6)**

OR

4. a) What are the two types of stresses produced in beams? Which one is predominant and why? **(4)**

b) A simply supported beam of 2m span carries a uniformly distributed load of 140KN per m over the whole span. The cross-section of the beam is a T - section with a flange width of 120mm, web and flange thickness of 20mm and overall depth of 160mm. Determine the maximum shear stress in the beam and draw the shear stress distribution for the section. **(12)**

Unit - V

5. a) A solid shaft of 250mm diameter has the same cross sectional area as the hallow shaft of the same material with inside diameter 150mm.

   i) Find the ratio of power transmitted by the two shafts for the same angular velocity.

   ii) Compare the angle of twist in equal lengths of these shafts when subjected to the same torque. **(10)**

   b) Discuss Euler's theory of buckling failure. What is the significance of slenderness ratio? Draw columns with different end conditions and give its equivalent length. **(6)**

OR

5. a) How the power transmission by a given solid shaft to be calculated? In what way hallow shafts are better. **(6)**

   b) A 4m long hallow alloy tube inside and outside diameters as 36mm and 48mm elongates by 3mm under a tensile force of 50kN. Determine the safe buckling load for the tube when it is used as a column with both ends pinned with a factor of safety of 5. **(10)**