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Question Paper Code: AME004



INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)

B.Tech III Semester End Examinations (Supplementary) - February, 2018

Regulation: IARE – R16

MECHANICS OF SOLIDS
(Mechanical Engineering)

Time: 3 Hours

Max Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT – I

- (a) What is a bulk modulus ? Derive an expression for Young's Modulus in terms of bulk modulus and Poisson's ratio. [7M]
(b) Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 50 cm apart. Diameters and lengths of each rod are 2 cm and 4 m respectively. A cross bar fixed to the rods at the lower ends carries a load of 5000 N such that the crossbar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. Take E for steel = $2 \times 10^5 \text{ N/mm}^2$ and E for copper = $1 \times 10^5 \text{ N/mm}^2$. [7M]
- (a) Derive an expression for strain energy for the gradually applied load and impact load. [7M]
(b) A bar 3.2 m long and 160 mm in diameter, hangs vertically and has a collar attached at the lower end. Determine the maximum stress induced when a weight of 80 kg falls from a height of 32 mm on the collar. If the bar is turned down to half the diameter along half of its length, what will be the value of the maximum stress and the extension ? (Take $E = 205 \text{ GPa}$.) [7M]

UNIT – II

- (a) Derive the equations of Shear force and Bending moment for the simply supported beam, which is subjected to uniformly distributed load throughout the length. [7M]
(b) A cantilever of 14 m span carries loads of 6 kN, 4 kN, 6 kN at 2 m, 4 m, 7 m and 14 m respectively from the fixed end. It also has a uniformly distributed load of 2 kN/m run for the length between 4 m and 8 m from the fixed end. Draw the S.F and B.M diagrams. [7M]

4. (a) Derive the relationship between shear force and bending moment. [7M]
 (b) A simply supported beam AB 6 m span loaded shown in Figure 1. Draw shear force and bending moment diagrams. Also indicate point of contraflexure [7M]

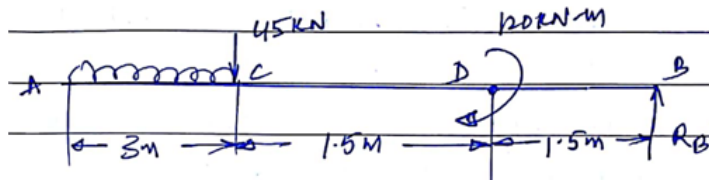


Figure 1

UNIT – III

5. (a) Derive the bending equation from the first principles. [7M]
 (b) A simply supported beam of span 5m has a cross section 150mm X 250mm. If the permissible stress is 10 N/mm^2 . Find [7M]
 i. Maximum intensity of uniformly distributed load it can carry.
 ii. Maximum concentrated load P applied at 2m from one end it can carry.
6. (a) A simply supported beam carrying UDL of $w \text{ kN/m}$ is subjected to a maximum bending stress of 45 MPa and maximum shear stress of 4.5 MPa. The beam has rectangular cross section of width 50 mm and depth 100mm. Determine length of beam and maximum intensity of uniformly distributed load it can carry. [7M]
 (b) A cantilever beam of square section $200\text{mm} \times 200\text{mm}$, 2 m long just fails in bending when a load of 20kN is placed at its free end. A beam of same material having rectangular bar of $150\text{mm} \times 300\text{mm}$ simply supported over a span of 3m. Calculate the minimum central concentrated load required to break the beam. [7M]

UNIT – IV

7. (a) Write a note on Mohr's circle of stresses. [7M]
 (b) The stresses on two perpendicular planes through a point in a body are 120 MPa and 30 MPa, both tensile along with a shear stress of 60 MPa. Determine [7M]
 (i) The magnitude and direction of principal stresses stating whether the stress condition is uniaxial or biaxial.
 (ii) The planes of maximum shear stress
 (iii) The normal and shear stresses on the planes of maximum shearing stresses.
8. (a) Explain briefly about maximum shear stress theory and maximum principal strain theory. [7M]
 (b) A mild steel shaft of 100 mm diameter is subjected to a maximum torque of 12 kNm and a maximum bending moment of 8 kNm at a particular section. Determine the factor of safety according to maximum shear stress theory if the elastic limit of mild steel in simple tension is 240 MPa. [7M]

UNIT – V

9. (a) State the difference between thick and thin cylinders. [7M]
(b) A spherical shell of internal diameter 1m and thickness 10mm is subjected to internal pressure of 2 N/mm^2 . Determine the increase in diameter and volume. [7M]
10. (a) A closed cylindrical vessel made of steel plates 4 mm thick with plane ends, carries fluid under a pressure of 3 N/mm^2 . The dia. of cylinder is 25 cm and length is 75 cm. Calculate the longitudinal and hoop stresses in the cylinder wall and determine the change in diameter, length and volume of the cylinder. Take $E = 2.1 \times 10^5 \text{ N/mm}^2$ and Poisson's ratio = 0.286. [7M]
(b) A spherical shell of internal diameter 0.9 m and of thickness 10 mm is subjected to internal pressure of 1.4 N/mm^2 . Determine the increase in diameter and increase in volume. Take $E = 2 \times 10^5 \text{ N/mm}^2$ and Poisson's ratio = $1/3$. [7M]

