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Question Paper Code: ACE001



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

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

Regulation: IARE – R16

STRENGTH OF MATERIALS - I

(Civil 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) A steel bolt 12 mm diameter passes through a brass tube of 16 mm internal diameter, 250 mm long and 20 mm external diameter. The bolt is tightened by a nut at 15° so as to exert a compressive force 1500 kN on the tube. Calculate the stress in each at [7M]

 - 15°C
 - when the temperature of the tube and bolt is raised to 50°C .
- (b) A point is subjected to a tensile stress of 250 MPa in the horizontal direction and another tensile stress of 100 MPa in the vertical direction. The point is also subjected to a simple shear stress of 25 MPa, such that when it is associated with the major tensile stress. It tends to rotate the element in the clockwise direction. What is the magnitude of the normal and shear stresses inclined on a section at an angle of 20° with the major tensile stress? [7M]
- (a) Determine the stresses when a member subjected to direct stresses in two mutually perpendicular directions accompanied by a simple shear stress. [7M]

(b) According to the theory of maximum shear stress, determine the diameter of a bolt which is subjected to an axial pull of 9 kN together with a transverse shear force of 4.5 kN. Elastic limit tension is 225 N/mm^2 , factor of safety = 3 and Poisson's ratio = 0.3. [7M]

UNIT – II

- (a) Define point of contraflexure. Is the point of contraflexure and point of inflection different? [7M]

(b) A simply supported beam of length 6 m, carries point load of 3 kN and 6 kN at distances of 2 m and 4 m from the left end. Draw the shear force and bending moment diagrams for the beam. [7M]
- (a) Define shear force and bending moment. What are the types of beams and define them with neat sketches. [7M]

(b) Draw the shear force diagram for a cantilever of length 'L' fixed at A and carrying a gradually varying load from zero at free end to w per unit length at the fixed end. [7M]

UNIT – III

5. (a) Two beams are simply supported over the same span and have the same flexural strength. Compare the weights of these two beams. If one of them is solid and the other is hollow circular with internal diameter half of the external diameter. [7M]
- (b) Derive the distribution of shearing stress for an symmetrical I-Section. [7M]
6. (a) List the assumptions made in simple bending. [7M]
- (b) A beam of square section is used as a beam with one diagonal horizontal. Find the maximum shear stress in the cross section of the beam. Also sketch the shear stress distribution across the depth of the section. [7M]

UNIT – IV

7. (a) A railway wagon weighing 65kN and moving with a speed of 18 kmph has to be stopped by four buffer springs. The maximum compression allowed in each spring is 200 mm. Calculate the number of turns required in each spring if the diameter of the wire of the spring is 20 mm. The mean diameter of the each coil is 200 mm. Take shear modulus of the material as $0.84 \times 10^4 \text{ N/mm}^2$ and $g = 9.8 \text{ m/s}^2$. [7M]
- (b) Find the diameter of the shaft required to transmit 160 kW at 250 r.p.m., if the maximum torque is not to exceed the mean torque by 35% with a maximum permissible shear stress of 50 N/mm^2 . [7M]
8. (a) A weight of 2600 N is dropped on a closely coiled helical spring consisting of 16 turns. Find the height by which the weight is dropped before striking the spring so the spring may be compressed by 220 mm. The coil has a mean radius of 120 mm and the diameter of the wire of the spring is 30 mm. The modulus of rigidity of material is $9 \times 10^4 \text{ N/mm}^2$. [7M]
- (b) Draw the shear stress distribution across a hollow circular shaft of external diameter 200 mm and wall thickness 20 mm, subjected to a torque of 500 kNm. [7M]

UNIT – V

9. (a) Determine the crippling stress in terms of effective length and radius of gyration. [7M]
- (b) Calculate the safe compressive load on a hollow cast iron column (1 end rigidly fixed and other hinged) of 15 cm external diameter, 10 cm internal diameter and 10 m in length. Use Euler's formula with a factor of safety = 5 and $E = 95 \text{ kN/mm}^2$. [7M]
10. (a) Find the maximum length of a steel rod of 50mm diameter, used as a column with both ends fixed and carrying a load of 25kN. Allow factor of safety 3, Take $\alpha = 1/7500$ and $f_c = 320 \text{ N/mm}^2$. [7M]
- (b) Compare the strength of solid circular column of diameter 200 mm and hollow circular column of same cross-sectional area and thickness 30 mm. The other parameters are same for both the sections. [7M]

