Hall Ticket No | | | | | | | | | | | Question Paper Code: ACE001

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech III Semester End Examinations (Supplementary) - January, 2019

Regulation: IARE – R16

STRENGTH OF MATERIALS - I

Time: 3 Hours **(CE)** **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

1. (a) Explain with illustrations and stress-strain diagram for mild steel, the phenomenon of strain-hardening and necking. **[7M]**

   (b) A tensile load of 60kN is gradually applied to a circular bar of 4cm diameter and 5m long. If the value of E = $2x10^5 N/mm^2$, determine **[7M]**

   (i) Stretch in the rod

   (ii) Stress in the rod

   (iii) Strain energy absorbed by the rod.

2. (a) Write and demonstrate the strain energy expressions for the following cases: **[7M]**

   i. Bending

   ii. Shear

   iii. Torsion

   (b) Determine the Poisson's ratio and bulk modulus of a material, for which Young's modulus is $1.2x10^5$ N/mm^2 and modulus of rigidity is $4.5x10^4$ N/mm^2. **[7M]**

UNIT – II

3. (a) Enumerate the relation between rate of loading, shear force and bending moment for a beam carrying a uniformly distributed load of w per unit length over whole span. **[7M]**

   (b) Draw the shear force and bending moment diagram for the beam shown in Figure. 1 **[7M]**

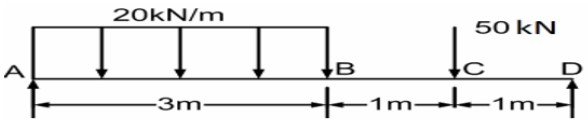

Figure 1

4. (a) Compare **[7M]**

   i. A simply supported beam and a cantilever beam

   ii. A fixed beam and a cantilever beam

   (b) A simply supported beam is loaded as shown in the below Figure 2. What is the maximum shear force in the beam? **[7M]**

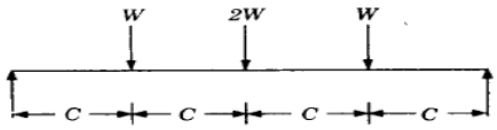

Figure 2

UNIT – III

5. (a) Explain the concept of complimentary shear in longitudinal section of a beam which is transversely loaded. From the rectangular, circular, triangular, I and T sections, which is most efficient for section withstanding shear stress in beams? Why? **[7M]**

   (b) A rectangular section made of timber is simply supported at the ends and carries a point load at the centre of the beam. The maximum bending stress is $12\text{N}/mm^2$ and the maximum shearing stress is $1\text{N}/mm^2$. Find the span to depth ratio. **[7M]**

6. (a) A horizontal beam with square cross-section is simply supported with sides of the square horizontal and vertical and carries a uniformly distributed load that produces maximum bending stress 'a' in the beam. When the beam is placed with one of the diagonals horizontal the what is the maximum bending stress? **[7M]**

   (b) The cross-section of an I-beam is shown in Figure 3. The bending moment at the section is 20 kN-m. Plot the distribution of bending stress in the beam. **[7M]**

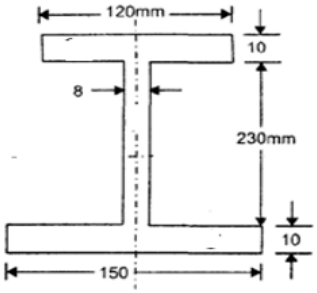

Figure 3

UNIT – IV

7. (a) Distinguish between close and open helical coil springs. What is the value (i) maximum shear stress (ii) deflection in a closely coiled helical spring subjected to an axial force? **[7M]**

   (b) A hollow shaft of external diameter 120mm transmits 300kW power at 200 rpm. Determine the maximum internal diameter if the maximum stress in the shaft is not to exceed 60N/mm^2. **[7M]**

8. (a) State and explain the significance of the assumptions made in deriving the torsion equation. Also state the torsion equation, and explain what each term signifies. Provide a consistent set of units for each term. **[7M]**

   (b) In a torsion test, the specimen is a hollow shaft with 50 mm external and 30 mm internal diameter. An applied torque of 1.6 kN-m is found to produce an angular twist of 0.4^0 measured on a length of 0.2 m of the shaft. The Young's modulus of elasticity obtained from a tensile test has been found to be 200 GPa. Find the values of (i) Modulus of rigidity (ii) Poisson's ratio **[7M]**

UNIT – V

9. (a) Define column and effective length of a column. Distinguish between a column and a strut & between short column and long column. **[7M]**

   (b) A 1.5m long cast iron column has a circular cross section of 50mm diameter. One end of the column is fixed in direction and position and the other is free. Taking factor of safety as 3, calculate the safe load using Rankine-Gordon formula. Take yield stress as 560 MPa and Rankine constant $\alpha = 1/1600$. **[7M]**

10. (a) State the secant formula and explain each of the terms in it. Why is it necessary to use the minimum radius of gyration of a section to calculate the crippling load? **[7M]**

    (b) A hollow cylinder CI column, 3 m long its internal and external diameters as 80 mm and 100 mm respectively. Calculate the safe load using Rankine formula: if **[7M]**

    i. Both ends are hinged and

    ii. Both ends are fixed.

    Take crushing strength of material as 600 N/mm^2, Rankine constant 1/1600 and factor of safety = 3.

– ∘ ∘ ◯ ∘ ∘ –