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Question Paper Code : 10414

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2012.

Fourth Semester

Mechanical Engineering

ME 2254/113403/ME 45/CE 1259 T/10122 ME 405/080120018 — STRENGTH OF MATERIALS

(Common to Production Engineering and Automobile Engineering)

(Regulation 2008)

(Common to PTME 2254 – Strength of Materials for B.E. (Part-Time) Third Semester Mechanical Engineering, Regulation 2009)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define elasticity.
2. Give the relationship between modulus of Elasticity and modulus of Rigidity.
3. List out the types of beams.
4. What is point of contra flexure?
5. Write the expression for torsional rigidity of solid circular shaft.
6. State the differences between closed coil and open coil helical springs.
7. Give the expression for deflection of a simply supported beam carrying a point load at the centre.
8. State the limitations of Euler's formula.
9. List out the stresses induced in thin cylindrical shell due to internal pressure.
10. What are principal planes and stresses?

PART B — (5 × 16 = 80 marks)

11. (a) A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end. If, at a temperature of 10°C there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200°C. Take E for steel and copper as $2.1 \times 10^5 \text{ N/mm}^2$ and $1 \times 10^5 \text{ N/mm}^2$ respectively. The value of co-efficient of linear expansion for steel and copper is given as $11 \times 10^{-6} \text{ per}^\circ\text{C}$ and $18 \times 10^{-6} \text{ per}^\circ\text{C}$ respectively.

Or

- (b) A bar of cross section 8 mm × 8 mm is subjected to an axial pull of 7000 N. The lateral dimension of the bar is found to be changed to 7.9985 mm × 7.9985 mm. If the modulus of rigidity of the materials is $0.8 \times 10^5 \text{ N/mm}^2$, determine the Poisson's ratio and modulus of elasticity.
12. (a) A cantilever 1.5 m long is loaded with a uniformly distributed load of 2 kN/m run over a length of 1.25 m from the free end. It also carries a point load of 3 kN at a distance of 0.25 m from the free end. Draw the shear force and bending moment diagrams of the cantilever.

Or

- (b) A timber beam of rectangular section is to support a load of 20 kN uniformly distributed over a span of 3.6 m when beam is simply supported. If the depth of section is to be twice the breadth, and the stress in the timber is not to exceed 7 N/mm², find the dimensions of the cross section.
13. (a) A solid circular shaft transmits 75 kW power at 200 r.p.m. Calculate the shaft diameter, if the twist in the shaft is not to exceed 1° in 2 meters length of shaft, and shear stress is limited to 50 N/mm². Take modulus of rigidity, $C = 1 \times 10^5 \text{ N/mm}^2$.

Or

- (b) The stiffness of a close coiled helical spring is 15 N/mm of compression under a maximum load of 60 N. The maximum shearing stress produced in the wire of the spring is 125 N/mm². The solid length of the spring (when the coils are touching) is given as 5 cm. Find
- diameter of wire
 - mean diameter of the coils and
 - number of coils required. Take modulus of rigidity = $4.5 \times 10^4 \text{ N/mm}^2$.

14. (a) A beam of length 6 m is simply supported at its ends and carries two point loads of 48 kN and 40 kN at a distance of 1 m and 3 m respectively from the left support. Find :
- (i) deflection under each load,
 - (ii) maximum deflection, and
 - (iii) the point at which maximum deflection occurs.
- Given $E = 2 \times 10^5 \text{ N/mm}^2$ and $I = 85 \times 10^6 \text{ mm}^4$.

Or

- (b) A 1.5 m long column has a circular cross section of 5 cm diameter. One of the ends of the column is fixed in direction and position and the other end is free. Taking factor of safety as 3, calculate the safe load using :
- (i) Rankin's formula, take yield stress = 560 N/mm² and Rankine's constant $a = 1/1600$.
 - (ii) Euler's formula, Elastic modulus = $1.2 \times 10^5 \text{ N/mm}^2$.
15. (a) A cylindrical thin drum 80 cm in diameter and 3 m long has a shell thickness of 1 cm. If the drum is subjected to an internal pressure of 2.5 N/mm², determine
- (i) change in diameter,
 - (ii) change in length and
 - (iii) change in volume. Take $E = 2 \times 10^5 \text{ N/mm}^2$ and Poisson's ratio = 0.25.

Or

- (b) At a certain point in a strained material, the intensities of stresses on two planes at right angles to each other are 20 N/mm² and 10 N/mm² both tensile. They are accompanied by a shear stress of magnitude 10 N/mm². Find graphically or otherwise, the orientation of principal planes and evaluate the principal stresses.
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