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Question Paper Code : 73847

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Fourth Semester

Mechanical Engineering

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

(Common to Production Engineering and Automobile Engineering)

(Regulations 2008/2010)

(Also common to PTME 2254/10122 ME 405 – Strength of Materials for B.E. (Part-Time) Third Semester – Mechanical Engineering – Regulations 2009/2010)

Time : Three hours Maximum : 100 marks

(Missing data if any may suitably be assumed)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A load of 5 kN is to be lifted by a steel wire, what should be the minimum diameter of the wire so that, the stress in the wire may not exceed 100 N/mm^2.
2. Define Poisson's ratio.
3. Mention and sketch any two supports and beams.
4. Sketch the bending stress distribution and shear stress distribution for the beam of rectangular cross section.
5. Calculate the polar modulus for a solid circular section of diameter 150mm.
6. List the engineering uses of springs.
7. Draw the elastic curve (deflected shape) of a cantilever beam which carries of UDL throughout the span and indicate the slope and deflection at any section.
8. Determine the equivalent length of a column of height 10 m if the ends are
   (a) fixed
   (b) hinged.
9. The principal stresses at a point are 200 N/mm^2 and 100 N/mm^2 (Compressive). Determine the maximum shear stress at this point.
10. A thin pipe of 1 m diameter is carrying of fluid under a pressure of 10 N/mm^2.Calculate the necessary thickness of the pipe if the allowable stress in the pipe material is 10 N/mm^2.

PART B — (5 × 16 = 80 marks)

11. (a) Three bars made of copper; zinc and aluminium are of equal length and have cross section 50, 75 and 100 square mm respectively. They are rigidly connected at either ends. If this compound member is subjected to a longitudinal pull of 250 kN estimate the proportion of load carried on each rod, and the induced stresses. Assume E_{cu} = 130 kN/mm^2, E_{zinc} = 100 kN/mm^2 and E_{al} = 80 kN/mm^2.

Or

(b) A copper flat 500 mm long and 40 mm (width) × 60 mm (thickness) uniform section is acted upon by the following forces : 50 kN tensile in the direction of the length 300 kN compressive in the direction of the width and 250 kN tensile in the direction of the thickness. Determine change in dimension and hence change in volume of the flat. Assume the modulus of the elasticity and Poisson's ratio of copper as 120 KN/mm^2 and 0.25 respectively.

12. (a) A horizontal beam ABC 8 m long is supported at A and B. The beam supports a U.D.L. of 1.5 kN/m over its entire length and also concentrated loads of 3 kN and 1.5 kN at D and C respectively, D being 2 m from A. Draw the shear force and bending moment diagrams for the beam. Where does the maximum bending moment occur and what is its value? AB = 6 m.

Or

(b) A beam is simply supported and carries a uniformly distributed load of 30 kN/m run over the whole span. The section of the beam is rectangular having depth as 450 mm. If the maximum stress in the material of the beam is 120 N/mm^2 and moment of inertia of the section is 7 × 10^8 mm^4, find the span of the beam.

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 degree in 2 metres length of shaft, and shear stress is limited to 50 N/mm^2. Assume the modulus of rigidity of the material of the shaft as 100 kN/mm^2.

Or

(b) A close-coiled helical spring has mean diameter of 75 mm and spring constant of 90 kN/m. It has 8 coils. What is the suitable diameter of the spring wire if maximum shear stress is not to exceed 250 N/mm^2? Assume the modulus of rigidity of the material of the spring wire is 80 kN/mm^2. What is the maximum axial load the spring can carry?

14. (a) A beam of uniform section, 10 meters long, is simply supported at the ends. It carries point loads of 100 kN and 60 kN at distances of 2 m and 5 m respectively from the left end. Calculate :

(i) The slope at each support

(ii) The slope and deflection under 100 kN load.

Given : $E = 200$ kN/mm^2 and $I = 118 \times 10^{-4}$ m^4.

Or

(b) Compare the crippling loads given by Euler's and Rankine formulae for a pin-jointed tubular steel strut 2.5 m long, having outer and inner diameter 40 mm and 30 mm respectively. Pin-jointed at each end. Take the yield stress as 330 N/mm^2, the Rankine's constant = 1 / 7500, and Modulus of elasticity (E) = 200 kN/mm^2.

15. (a) At a certain point in a strained material the horizontal tensile stress is 80 N/mm^2 and the vertical tensile stress is 150 N/mm^2. The shear stress is 50 N/mm^2. Find the magnitude and nature of principal stresses and the directions of principal planes.

Or

(b) A cylindrical shell 5 m long which is closed at the ends has an internal diameter of 2 m and a wall thickness of 20 mm. Calculate the circumferential and longitudinal stresses induced and also change in the dimensions of the shell if it is subjected to an internal pressure of 1 N/mm^2. Assume the modulus of elasticity and Poisson's of the material of the shell as 200 kN/mm^2 and 0.3.
