Total No. of Questions—**12**] [Total No. of Printed Pages—**8+1**

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S.E. (Production & Production Sandwich)

(First Semester) EXAMINATION, 2010

STRENGTH ANALYSIS OF MACHINE ELEMENTS

(2008 COURSE)

Time : Three Hours **Maximum Marks : 100**

***N.B.* :—** (*i*) Attempt *one* question form each Unit of Section I and Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Figures to the right indicate full marks.

(*iv*) Neat diagrams must be drawn wherever necessary.

(*v*) Use of non-programmable electronic pocket calculator is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

UNIT I

1. (*a*) Explain with neat sketches tensile, compressive and shear stresses and strains. [6]

(*b*) A member ABCD is subjected to point loads P_1, P_2, P_3, and P_4 as shown in Fig. 1. Calculate the force P_3 necessary for the equilibrium if P_1 = 120 kN, P_2 = 220 kN and

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P_4 = 160 kN. Also determine the net change in the length of the member. Take E = 2 × 10^5 N/mm^2. [10]

Or

2. (*a*) Comment on the bars of composite sections. Derive the relation for total load on composite bar and modular ratio. [6]

(*b*) A weight of 200 kN is supported by three short pillars, each 500 mm^2 in section. The central pillar is of steel and the outer pillars are of copper. The pillars are so adjusted that at a tempreature of 15ºC each carries equal load. The temperature is then raised to 115ºC. Estimate the stress in each pillar at 15ºC and 115ºC.

Take E_s = 2.0 × 10^5 N/mm^2 and E_c = 0.8 × 10^5 N/mm^2.

α_s = 1.2 × 10^{-5} per ºC, α_c = 1.85 × 10^{-5} per ºC. [10]

UNIT II

3. (*a*) A simply supported beam AB of span 8 m carrying concentrated loads of 4 kN, 10 kN and 7 kN at distances of 1.5 m, 4 m and 6 m from the left support as shown in Fig. 2. Draw the shear force diagram and bending moment diagram for the beam AB. [6]

(*b*) Find the reaction at the fixed end of the cantilever loaded as shown in Fig. 3. Also draw the shear force diagram and bending moment diagram for the beam. [12]

Or

4. (*a*) Draw the bending moment diagram for the cantilever shown in Fig. 4. [6]

(*b*) The diagram shown in Fig. 5 is the shear force diagram for a beam which rests on two supports one being the left hand end. Deduce directly from the shear force diagram.

(*i*) Loading on the beam

(*ii*) Determine the magnitude of maximum bending moment and draw the bending moment diagram. [12]

UNIT III

5. (*a*) Prove the relations :

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

Where,

M = Total moment of resistance offered by the beam section in N-mm

I = Moment of Inertia of the section about the neutral axis in mm^4

σ = Stress intensity in the fiber N/mm^2

y = Distance of the fiber from the neutral axis in mm

E = Modulus of Elasticity in N/mm^2

R = Radius of Neutral surface in mm. [6]

(*b*) A cast iron bracket as shown in Fig. 6 is subjected to bending and has cross-section of I-form with unequal flanges. The total depth of the section is 280 mm and the metal is 40 mm thick throughout. The top flange is 200 mm wide. Find the position of neutral axis and the moment of inertia of the section about the neutral axis and determine the maximum bending moment that should be imposed on this section if the tensile stress in the top flange is not to exceed 20 N/mm^2. What is then the value of the compressive stress in the bottom flange ? [10]

Or

6. (*a*) State the assumptions made in the theory of simple bending. [6]

(*b*) The T-beam section shown in Fig. 7 is subjected to sagging moment. If the extreme tensile stress is two times the extreme compressive stress, find the thickness of the flange and the web. Note that the thickness of the flange is two times the thickness of the web. [10]

SECTION II

UNIT IV

7. (*a*) Show that in a direct stress system, the maximum shear stress in a body is half the magnitude of the applied stress. [8]

(*b*) At a certain point in a strained material the principal stresses are 100 N/mm^2 and 40 N/mm^2 both tensile. Find the normal, tangential and resultant stresses across a plane through the point at 48º to the major principle plane, using Mohr's circle of stress. [8]

Or

8. (*a*) What is strain energy of a material ? Derive the expressions for the same in different forms. [8]

(*b*) A rod 12.5 mm in diameter is stretched by 3.20 mm under a steady load of 10,000 N. What stress would be produced in the bar by a weight of 700 N falling through 75 mm before commencing to stretch the rod if it is initially unstressed. The value of E may be taken as 2.1×10^5 N/mm^2. [8]

UNIT V

9. (*a*) Deduce the torsion equation stating the assumptions made. [8]

(*b*) Determine the diameter of a solid shaft which will transmit 90 kW at 160 rpm if the shear stress in the shaft is limited to 60 N/mm^2. Find also the length of the shaft, if the twist must not exceed 1º over the entire length.

Take $C = 8 \times 10^4$ N/mm^2. [10]

Or

10. (*a*) Two shafts of the same meterial are subjected to the same torque. If the first shaft is of solid circular section and the second shaft is of hollow section whose internal diameter is 2/3 of the outside diameter, compare the weights of the two shafts. [10]

(*b*) A solid circular shaft is to transmit 300 kW at 100 rpm. If the shear stress is not to exceed 80 N/mm^2, find the diameter of the shaft. What percentage saving in weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals 0.6 of the external diameter, the length, the material and the mxaimum shear stress being the same. [8]

Unit VI

11. (*a*) A horizontal beam, simply supported at its ends carries a load of varying intensity which varies uniformly from 10 kN/m at one end to 50 kN/m at the other. Find the central deflection if the span is 9 m in length and 500 mm deep. Take maximum bending stress as 80 MPa and E = 210 GPa. [8]

(*b*) Explain Maculay's method of beam deflection analysis and discuss its advantages over the dierct integration method. [8]

Or

12. (*a*) What is Euler's curve ? Describe its features. [6]

(*b*) A 800 mm long straight bar of alloy steel and of 10 mm × 4 mm section is mounted in a strut testing machine and loaded axially. The load is increased till the bar buckles. Determine the maximum central defection before the material attains the yield point of 300 MPa. Assume the Euler's formula for pinned ends. E = 75 GPa. [10]