Total No. of Questions—**12**] [Total No. of Printed Pages—**7**

[3762]-22

S.E. (Mechanical)(I Sem.) EXAMINATION, 2010

STRENGTH OF MACHINE ELEMENTS

(2003 COURSE)

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

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

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

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

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

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

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

SECTION I

1. (*a*) Define the following terms : [4]

(*i*) Factor of safety

(*ii*) Ratio

(*iii*) Modulus of rigidity

(*iv*) Bulk modulus.

(*b*) Derive the relation between modulus of elasticity and modulus of rigidity within elastic range. [6]

(*c*) A bar of length 300 mm, width 40 mm and depth 40 mm is subjected to an axial compressive load of 400 kN. Determine the Young's modulus and Poisson's ratio when decrease in length is 0.75 mm and increase in width is 0.03 mm. [6]

P.T.O.

Or

2. (*a*) Explain thermal stresses and strains. [4]

(*b*) Derive the expression for volumetric strain of a rectangular bar subjected to axial load. [6]

(*c*) A steel rod of 40 mm diameter and 5 m long is connected to two grips and is maintained at a temperature of 100°C. Determine stress when temperature falls to 40°C, if : [6]

(*i*) the ends do not yield

(*ii*) the ends yield by 1.2 mm

E = 200 GPa, $\alpha = 12 \times 10^{-6}$/°C.

3. (*a*) Derive the flexure formula with usual notations. [8]

(*b*) A C.I. T section of dimensions flange 90 mm × 20 mm, web 30 mm × 40 mm is acted upon by 3 kN-m couple as shown in Fig. 1. Determine : [8]

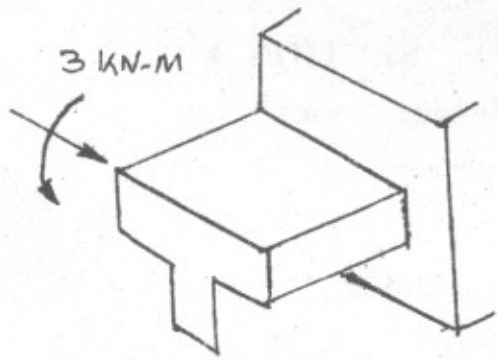

Fig. 1

(*i*) Maximum tensile and compressive stresses in casting.

(*ii*) Radius of curvature of casting.

Take E = 165 GPa.

Or

4. (*a*) Derive the relation between maximum shear stress and average shear stress for a rectangular section. [6]

(*b*) A steel beam of I section is 600 mm deep. Each flange is 250 mm wide and 25 mm thick. The web is 15 mm thick. The beam section is subjected to a shear force of 500 kN. Determine the shear stress distribution for the beam section when :

(*i*) the web is vertical

(*ii*) the web is horizontal. [10]

5. (*a*) State the theorems of area moment method. [4]

(*b*) A simply supported beam of span 'L' carries a triangular load whose intensity varies from zero at one end to W at the other end. Find maximum deflection for the beam. [6]

(*c*) A simply supported beam 6 m long is subjected to a clockwise couple of 200 kN-m at a distance of 2 m from left and anticlockwise couple of 80 kN-m at a distance of 4 m from left end. Find deflection at the points of application of couples.

EI = 41500 kN-m^2. [8]

Or

6. (*a*) Derive the expression for maximum slope and deflection for a cantilever of length 'L' carrying uniformly distributed load over entire span. [6]

(*b*) A cantilever of length 3 m carries a uniformly distributed load of 80 kN/m length over entire span. If $E = 2 \times 10^8$ kN/m^2 and $I = 10^8$ mm^4, find slope and deflection at free end. Use conjugate beam method. [6]

(*c*) Derive the relation : [6]

$$EI = \frac{d^2y}{dx^2} = M$$

with usual notations.

SECTION II

7. (*a*) A plane element of a body is subjected to a compressive stress of 300 MPa in a *x-x* direction and a tensile stress of 200 MPa in *y-y* direction. Each of the above stresses is subjected to shear stress of 100 MPa, such that, when it is associated with compressive stress, it tends to rotate the element in the anticlockwise direction.

Find graphically or analytically, the normal and shear stress on a plane inclined at an angle of 30° with the *x-x* axis. [8]

(*b*) A thin spherical shell 1 m in diameter with its wall of 1.2 cm thickness is filled with a fluid at atmospheric pressure. What intensity of pressure will be developed in it, if 175 cm^3 more fluid is pumped into it ?

Also calculate the circumferential stress at that pressure and increase in diameter. Take E = 200 GPa and Poisson's ratio = 0.3. [8]

Or

8. (*a*) A rod at 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 (impact) of 700 N falling through 75 mm before commencing to stretch the rod, if it is initially unstressed. Take $E = 2.1 \times 10^5$ N/mm^2. [8]

(*b*) A bolt is subjected to an axial pull of 8 kN and a transverse shear force of 3 kN. Determine the diameter of bolt based on :

(*i*) the maximum principal theory

(*ii*) the maximum shear stress theory

(*iii*) the maximum strain energy theory. [8]

9. (*a*) Derive a relation for the Euler's crippling load for a column having one end fixed and other end free.

Explain the limitation of Euler's formula in case of slenderness ratio. [8]

(*b*) A solid shaft transmits power of 90 kW at 160 rpm and the shear stress in the shaft is limited to 60 N/mm^2. Determine the diameter of the solid shaft.

Find also the length of the shaft, if the twist must not exceed 1° over the entire length.

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

Or

10. (*a*) Derive the torsion equation with usual notations as : [8]

$$\frac{T}{J} = \frac{Z}{R} = \frac{G\theta}{l}.$$

(*b*) A hollow alloy tube 5 meter long with external and internal diameters equal to 40 mm and 25 mm resp. was found to extend by 6.4 mm under a tensile load of 60 kN. Find the buckling load for the tube, when used as a column with both ends pinned.

Also find the safe compressive load for the tube, with a factor of safety of 4. [8]

11. (*a*) Explain weight point method for selection of engineering material for particular application. [6]

(*b*) What are the causes of stress concentration and methods to reduce it. [6]

(*c*) Define the following terms : [6]

(*i*) Fatigue failure

(*ii*) Endurance limit

(*iii*) Resilience

(*iv*) Toughness

(*v*) Brittleness

(*vi*) Hardness.

Or

12. (*a*) Define creep. Draw a typical creep curve and explain its 3 stages. [6]

(*b*) Suggest suitable material for the following applications with reasons : [6]

(*i*) IC engine piston

(*ii*) Condenser tubes

(*iii*) Valve spring.

(*c*) What do you understand by the following designation of material ? [6]

(*i*) FG 200

(*ii*) 40 C8

(*iii*) SG 700/2

(*iv*) 50 Cr 1 V23

(*v*) C 40

(*vi*) Fe 360.