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**R 3459**

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Fifth Semester

(Regulation 2004)

Mechanical Engineering

ME 1302 — DESIGN OF MACHINE ELEMENTS

(Common to B.E.(Part-Time) Fourth Semester – Regulation 2005)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

Use of approved design data book is permitted.

Assumptions and assumed data have to be stated clearly.

PART A — (10 × 2 = 20 marks)

1. What do you mean by optimum design?
2. State Rankine's theory.
3. A line shaft rotating at 200 rpm is to transmit 20 kW. It may be assumed to be made of mild steel with an allowable shear stress of 42 MPa. Determine the diameter of the shaft, neglecting the bending moment on the shaft.
4. Where are spline couplings used?
5. State the advantages of threaded joints.
6. Sketch atleast two types of welded joints.
7. When two concentric springs of stiffness 100 N/mm and 50 N/mm respectively are subjected to an axial load of 750 N, what will be the deflection of each spring?
8. Name any four applications of levers in engineering practice.
9. What is known as self-acting bearing?
10. Define Co-efficient of fluctuation of energy, in flywheel.

PART B — (5 × 16 = 80 marks)

11. (a) (i) A simply supported beam has a concentrated load at the centre which fluctuates from a value of  $P$  to  $4P$ . The span of the beam is 500 mm and its cross-section is circular with a diameter of 60 mm. Taking for the beam material an ultimate stress of 700 MPa, a yield stress of 500 MPa, endurance limit of 330 MPa for reversed bending and a factor of safety of 1.3, calculate the maximum value of  $P$ . Take a size factor of 0.85 and a surface finish factor of 0.9. (12)
- (ii) Define stress concentration. Give some methods of reducing stress concentration. (4)

Or

- (b) A mild steel bracket as shown in Fig (1), is subjected to a pull of 6000 N acting at  $45^\circ$  to its horizontal axis. The bracket has a rectangular section whose depth is twice the thickness. Find the cross-sectional dimensions of the bracket, if the permissible stress in the material of the bracket is limited to 60 MPa.

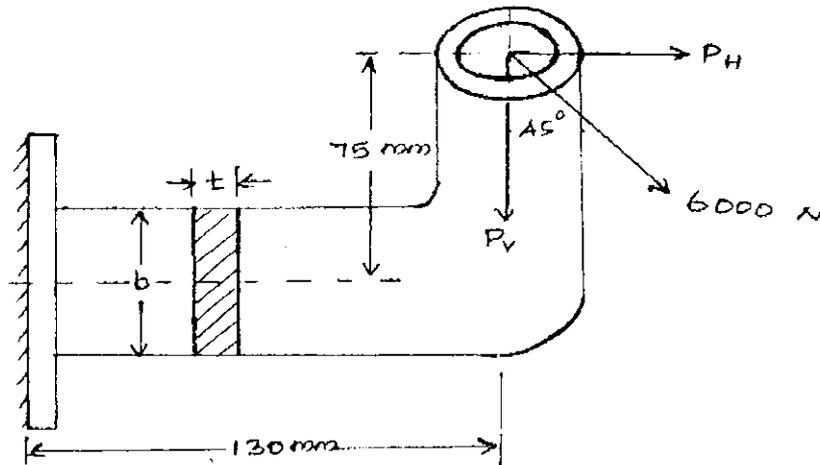


Fig. (1)

12. (a) A mild steel shaft transmits 23 kW at 200 r.p.m. It carries a central load of 900 N and is simply supported between the bearings 2.5 metres apart. Determine the size of the shaft, if the allowable shear stress is 42 MPa and the maximum tensile or compressive stress is not to exceed 56 MPa. What size of the shaft will be required, if it is subjected to gradually applied loads?

Or

- (b) Design a cast iron flange coupling for a mild steel shaft transmitting 90 kW at 250 r.p.m. The allowable shear stress in the shaft is 40 MPa and the angle of twist is not to exceed  $1^\circ$  in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30 MPa.

13. (a) A steam engine of effective diameter 300 mm is subjected to a steam pressure of  $1.5 \text{ N/mm}^2$ . The cylinder head is connected by 8 bolts having yield point 330 MPa and endurance limit at 240 MPa. The bolts are tightened with an initial preload of 1.5 times the steam load. A soft copper gasket is used to make the joint leak-proof. Assuming a factor of safety 2, find the size of bolt required. The stiffness factor for copper gasket may be taken as 0.5.

Or

- (b) A 50 mm diameter solid shaft is welded to a flat plate as shown in Fig. (2). If the size of the weld is 15 mm, find the maximum normal and shear stress in the weld.

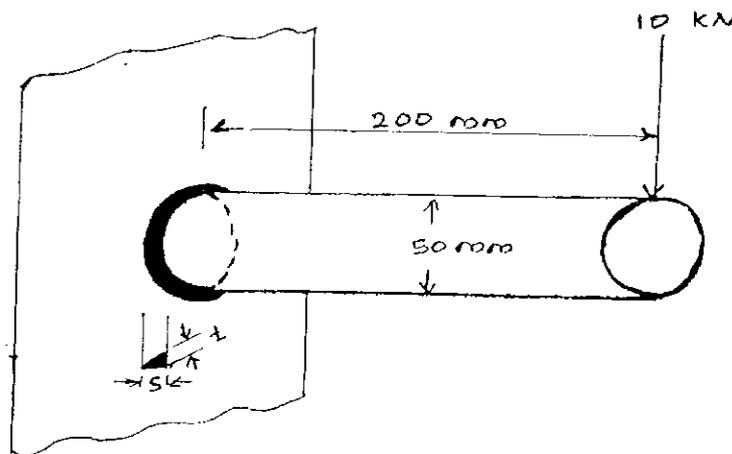


Fig. (2)

14. (a) (i) Derive the stress equation for a helical spring. (6)
- (ii) Design a helical compression spring for a maximum load of 1000 N for a deflection of 25 mm using the value of spring index as 5. The maximum permissible shear stress for spring wire is 420 MPa and modulus of rigidity is  $84 \text{ kN/mm}^2$ . (10)

Or

- (b) (i) A truck spring has 12 number of leaves, two of which are full lengthy leaves. The spring supports are 1.05 m apart and the central band is 85 mm wide. The central load is to be 5.4 kN with a permissible stress of 280 MPa. Determine the thickness and width of the steel spring leaves. The ratio of the total depth to the width of the spring is 3. Also determine the deflection of the spring. (12)
- (ii) Briefly write about "Nipping" in leaf spring. (4)

15. (a) Design a journal bearing for a centrifugal pump with the following data :

Diameter of the journal = 150 mm

Load on bearing = 40 kN

Speed of journal = 900 r.p.m (16)

Or

(b) A single cylinder double acting steam engine delivers 185 kW at 100 r.p.m. The maximum fluctuation of energy per revolution is 15 percent of the energy developed per revolution. The speed variation is limited to 1 percent either way from the mean. The mean diameter of the rim is 2.4 m. Design the suitable flywheel.

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