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Question Paper Code : 11529

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Fifth Semester

Mechanical Engineering

ME 2303/ME 53/10122 ME 504 — DESIGN OF MACHINE ELEMENTS

(Common to Automobile Engineering)

(Regulation 2008)

(Common to PTME 2303 — Design of Machine Elements for B.E. (Part-Time)
Fourth Semester Mechanical Engineering — Regulation 2009)

Time : Three hours

Maximum : 100 marks

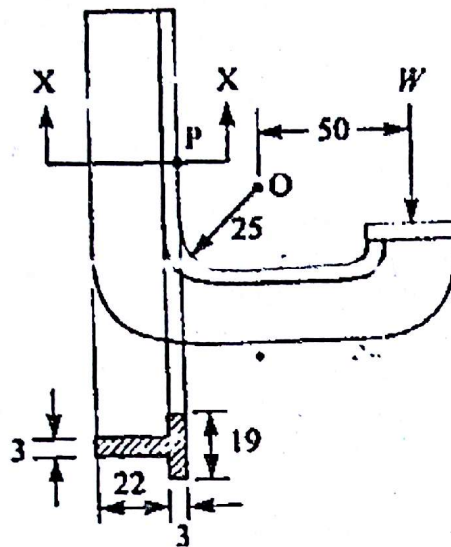
Note : Approved Design Data Book is permitted to use in the examination.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is 'Adaptive design? Where is it used? Give examples.
2. State the difference between straight beams and curved beams.
3. Why a hollow shaft has greater strength and stiffness than solid shaft of equal weight?
4. Under what circumstances flexible couplings are used?
5. Define the term self-locking of power screws.
6. What are the possible modes of failure of riveted joint?
7. Write the formula for natural frequency of spring.
8. How does the function of flywheel differ from that of governor?
9. Explain the term Dynamic load carrying capacities of rolling contact bearing.
10. What type of external forces act on connecting rod?

11. (a) A C-clamp is subjected to a maximum load of W , as shown in figure. If the maximum tensile stress in the clamp is limited to 140 MPa. Find the value of load W . (16)



Section of X-X

All dimensions in mm

Or

- (b) A pulley is keyed to a shaft midway between two bearings. The shaft is made of cold drawn steel for which the ultimate strength is 550 MPa and the yield strength is 400 MPa. The bending moment at the pulley varies from -150 N-m to + 400 N-m as the torque on the shaft varies from -50 N-m to + 150 N-m. Obtain the diameter of the shaft for an indefinite life. The stress concentration factors for the keyway at the pulley in bending and in torsion are 1.6 and 1.3 respectively. Take the following values: Factor of safety = 1.5; Load correction factors = 1.0 in bending, and 0.6 in torsion; Size effect factor = 0.85; Surface effect factor = 0.88. (16)
12. (a) A horizontal nickel steel shaft rests on two bearings, A at the left and B at the right end and carries two gears C and D located at distances of 250 mm and 400 mm respectively from the centre line of the left and right bearings. The pitch diameter of the gear C is 600 mm and that of gear D is 200 mm. The distance between the centre line of the bearings is 2400 mm. The shaft transmits 20 kW at 120 rpm. The power is delivered to the shaft at gear C and is taken out at gear D in such a manner that the tooth pressure F_{tC} of the gear C and F_{tD} of the gear D act vertically downwards.

Find the diameter of the shaft, if the working stress is 100 MPa in tension and 56 MPa in shear. The gear C and D weighs 950 N and 350 N respectively. The combined shock and fatigue factors for bending and torsion may be taken as 1.5 and 1.2 respectively. (16)

Or

(b) Design a bushed- pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 r.p.m. The overall torque is 20 percent more than mean torque. The material properties are as follows :

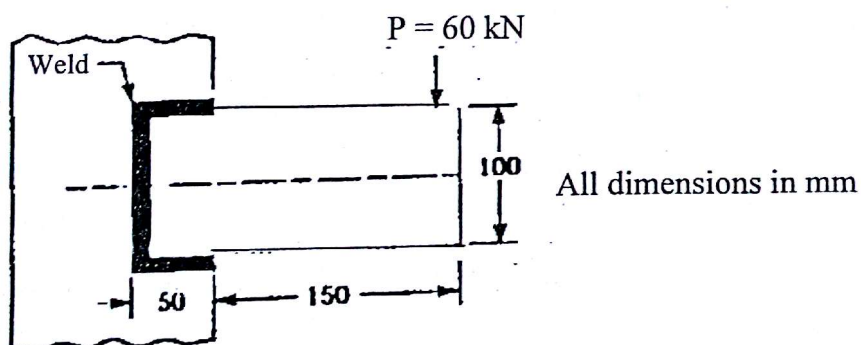
- (i) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively
- (ii) The allowable shear stress for cast iron is 15 MPa,
- (iii) The allowable bearing pressure for rubber bush is 0.8 N/mm²
- (iv) The material of the pin is same as that of shaft and key.

Draw neat sketch of the coupling. (16)

13. (a) Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. (16)

Or

(b) A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load P, as shown in figure Determine the weld size if shear stress in the same is not to exceed 140 MPa. (16)



14. (a) Design a helical spring for a spring loaded safety valve (Ramsbottom safety valve) for the following conditions: Diameter of valve seat = 65mm; Operating pressure = 0.7 N/mm² ; Maximum pressure when the valve blows off freely = 0.75 N/mm² ; Maximum lift of the valve when the pressure rises from 0.7 to 0.75 N/mm² = 3.5 mm ; Maximum allowable stress = 550 MPa; Modulus of rigidity = 84 kN/mm² ; Spring index = 6. (16)

Or

(b) Design a cast iron flywheel used for a four stroke I.C engine developing 180 kW at 240 r.p.m. The hoop or centrifugal stress developed in the flywheel is 5.2 MPa, the total fluctuation of speed is to be limited to 3% of the mean speed. The work done during the power stroke is 1/3 more than the average work done during the whole cycle. The maximum torque on the shaft is twice the mean torque. The density of cast iron is 7220 kg/m³. (16)

15. (a) (i) Select a suitable deep groove ball bearing for supporting a radial load of 10 kN and an axial load of 3 kN for a life of 4000 hrs at 800 r.p.m. Select from series 63. Calculate the expected life of the selected bearing. (8)
- (ii) A journal bearing 150 mm diameter and 300 mm long carries a radial load of 9 kN at 1200 rpm. The diametral clearance is 0.075 mm. If 6 kW is being lost in friction, what is the viscosity of the oil used at given operating temperature? (8)

Or

- (b) Design a suitable connection rod for a petrol engine for the following details. Diameter of the piston = 100 mm; Weight of reciprocating parts per cylinder = 20 N ; connecting rod length = 300 mm; Compression ratio = 7:1 ; Maximum explosion pressure = 3 N/mm² ; Stroke = 140 mm; speed of the engine = 2000 r.p.m. (16)
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