Total No. of Questions : 10] [Total No. of Printed Pages : 4

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AU/ME–504

B. E. (Fifth Semester) EXAMINATION, Dec., 2011

(Common for AU and ME Engg. Branch)

MACHINE COMPONENT DESIGN

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : Attempt any *five* questions in all selecting *one* question from each Unit. All questions carry equal marks. PSG Design Data/Mahadevan and Reddy's design data books are permitted to use.

Unit – I

1. (a) Explain Miner's hypothesis used to calculate cumulative fatigue damage. 5

   (b) A cylindrical rough machined member made from C-50 steel of 50 mm is reduced to 25 mm diameter by a 6 mm fillet. It is subjected to light shock load producing a completely reversed stress in bending and the life is estimated to be 10 million cycles. Find the bending moment. Take factor of safety as 1·5. $\sigma_y = 373$ MPa and $\sigma_e = 317$ MPa. 15

Or

2. Explain the following : 5 each

   (i) Gerber's parabola

   (ii) Soderberg line

   (iii) Goodman's line

   (iv) Stress concentration

Unit – II

3. (a) Explain the rigidity considerations for design of shaft. 6

   (b) A nickel steel shaft transmits 26 kW at 150 r. p. m. It carries a central load of 800 N and is simply supported between the bearings 2·5 m apart. Determine the size of the shaft if permissible shear and tensile stresses are $\tau = 42$ MPa and $\sigma = 56$ MPa. Also determine the diameter when shaft is subjected to gradually applied loads. 14

Or

4. (a) What is the function of a key ? Classify various types of keys used in power transmission. 6

   (b) A cast iron flange coupling is used to connect two co-axial shafts to transmit 175 kW at 150 r. p. m. The key and shaft are to be made of same material for which permissible shearing stress is 68 MPa and compressive strength is 120 MPa. The steel bolts may be subjected to maximum shear stress of 25 N/mm^2 and the permissible shearing stress in cast iron is 7·5 N/mm^2. Design protected type flange coupling. 14

Unit – III

5. (a) Derive the relation of maximum efficiency of a square threaded screw : 6

$$\eta_{max} = \frac{1 - \sin\phi}{1 + \sin\phi}$$

   ϕ = angle of friction.

(b) With neat sketch explain the design process of a screw jack. 14

Or

6. (a) Explain the term surge in springs. 6

(b) Design a spring for a balance to measure 100 N to 1000 N over a scale length of 80 mm. The spring is to be enclosed in a casing of 25 mm diameter. The approximate number of turns is 30. The modulus of rigidity is 85 kN/mm^2. Also calculate the maximum shear stress induced. 14

Unit – IV

7. (a) Explain the uniform pressure and uniform wear theories for clutch design. 6

(b) A cone clutch faced with leather to transmit 30 kW at 750 r. p. m. from an electric motor to an air compressor. Sketch a sectional front view of the clutch and provide the main dimensions on the sketch.

Assume : Semiangle of the cone $= 12\frac{1^\circ}{2}$; $\mu = 0{\cdot}2$, mean diameter of cone = 6 to 10 d where d is the diameter of shaft, allowable normal pressure for leather and cast iron = 0·075 to 0·1 N/mm^2, load factor = 1·75 and mean diameter to face width ratio = 6. Determine the principal dimensions of clutch. 14

Or

8. (a) With neat sketch explain the working principle of internal expanding shoe brake. 6

(b) In a band and block brake, the band is lined with 14 blocks, each of which subtends an angle 20° at the drum centre. One end of the band is attached to the

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(b) In a band and block brake, the band is lined with 14 blocks, each of which subtends an angle 20° at the drum centre. One end of the band is attached to the

fulcrum of the brake lever and other to a pin 150 mm from the fulcrum. Find the force required at the end of the lever 1 metre long from the fulcrum to give a torque of 4 kN-m. The diameter of the brake drum is 1 metre and the coefficient of friction between the blocks and the drum is 0·25. 14

Unit – V

9. (a) Explain the term bearing modulus and its effect on performance of bearing. 6

(b) Design a suitable journal bearing for a centrifugal pump from the following available data.

Load on the bearing = 13·5 kN, Diameter of the journal = 80 mm, speed = 1440 r. p. m., Bearing charateristic number at the working temperature (75°C) = 30° ; Permissible bearing pressure intensity = 0·7 N/mm^2 to 1·4 N/mm^2. Average atmospheric temperature = 30°. Calculate cooling required if any. 14

Or

10. (a) Derive the expression for dynamic load rating of roller bearing under variable load : 10

$$W = \left\{ \frac{F_1^3 N_1 + F_2^3 N_2 + \ldots\ldots\ldots}{N} \right\}^{1/k}$$

(b) A single row angular contact ball bearing number 310 is used for an axial flow compressor. The bearing is to carry a radial load of 2500 N and an axial load of 1500 N. Assuming light shock, determine the rating life of the bearings. 10