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BME-024

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

00045

Term-End Examination

December, 2014

BME-024 : MECHANICAL ENGINEERING DESIGN

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any* ***five*** *questions. All questions carry equal marks. Use of calculator and design data hand book is permitted. Assume missing data if any.*

1. (a) Sketch $\sigma - \varepsilon$ diagram for mild steel and describe salient points and yielding zone.

(b) What are the assumptions made for the simple theory of bending of beams ?

(c) Describe maximum principal strain theory and maximum shearing stress theory.

(d) Enumerate the factors that decide factor of safety. $4 \times 3\frac{1}{2} = 14$

2. (a) Define efficiency of a riveted joint and write expressions for various strengths. *4*

(b) A screw press is required to exert a force of 50 kN when applied torque is 600 Nm. The supported length of the screw is 450 mm, and a thrust bearing of hardened steel of cast iron is provided at the power end. The permissible stresses in the steel screw are :

- Tension and compression; 85 MPa and Shear 55 MPa
- The permissible bearing pressure = 13·5 MPa for steel screw and CI material
- The permissible shearing stress in CI = 20 MPa
- The yield strength of steel of screw σ_c = 260 MPa
- The coefficient of friction in screw and nut = 0·15

Determine the dimensions of screw and nut. *10*

3. (a) With the help of neat sketch, define (i) arc of contact and (ii) pressure angle in spur gear trains. *4*

(b) A driving shaft is joined with coaxial driven shaft through a muff coupling. The shaft transmits 80 kW of power at 150 rpm. Design the shaft, key and muff. Assume a factor of safety of 5 with the following ultimate strength values. *10*

Ultimate shear strength for
shaft = 300 N/mm^2

Ultimate shear strength for
key = 200 N/mm^2

Ultimate shear strength for
muff = 50 N/mm^2

Ultimate compressive strength for
key = 500 N/mm^2

4. (a) Write the assumptions of Petroff's equation. Discuss the stable and unstable lubrication with the help of sketches. *4*

(b) A multiple disc clutch, steel on bronze is required to transmit 4 kW at 900 rpm. The inner radius of contact is 40 mm and outer radius of contact is 70 mm. The clutch runs in oil with μ = 0·1. The permissible pressure between the plates is 0·35 N/mm^2. Calculate the number of discs of bronze and steel and axial force required to keep the plates in contact. Compare the average pressure and maximum pressure. *10*

5. (a) With the help of a neat sketch, describe the functioning of a centrifugal clutch. *4*

(b) A 40 mm diameter journal bearing supports a load of 3,200 N. The length of the bearing is 52 mm and clearance is 0·038 mm. The viscosity of lubricating oil is 0·04 Pa.s at operating temperature. The shaft rotates at 2,000 rpm. Compare power loss in friction from Petroff's method and that calculated from characteristics numbers of bearing. Also find minimum oil film thickness and calculate rise in oil temperature assuming 70% of heat is carried in lubricant. Use ρ = 861 kg/m^3, C_H = 1760 J/kg °C. *10*

6. A shaft transmitting 210 kW is to be connected to a coaxial shaft through cast iron flange coupling. The shaft runs at 180 rpm. The key and shaft are to be made of same material for which permissible shearing stress is 60 N/mm^2 and compressive strength is 120 N/mm^2. The steel bolts may be subjected to maximum shearing stress of 26 N/mm^2. Design protected type flange coupling. *14*

7. (a) With the help of a neat sketch, describe the pressure developed around bearing surface in oil film. *4*

(b) At the bottom of an elevator shaft 12 helical coiled springs are placed in parallel to absorb the shock in case the elevator falls freely due to failure. The elevator cage weighing 36 kN falls freely through a height of 1·2 m from rest. Determine the stress in spring if each spring is made from rod of 31 mm diameter. The spring index of each spring is 6 and the number of turns is 16. Take 80 GPa as modulus of rigidity. *10*

8. Attempt any ***two*** of the following : *14*

(i) With the help of a diagram, describe the three stages of creep.

(ii) Define and classify the fits and tolerances.

(iii) What is the effect of surface finish on the fatigue strength ? List all the factors that affect fatigue behaviour.
