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Question Paper Code: 35703

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2018

Fifth Semester

Mechanical Engineering

01UME503 – DESIGN OF MACHINE ELEMENTS

(Approved Design Data book is permitted)

(Regulation 2013)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. State Rankine's theory.
2. How will you classify machined design and explain it?
3. What types of stresses are induced in shafts?
4. Under what circumstances flexible couplings are used?
5. State three conditions where tap bolts are used.
6. What is threaded joint?
7. What is nipping in a leaf spring?
8. What is surge in springs?
9. What are journal bearings? Give a classification of these bearings?
10. List the important physical characteristics of a good bearing material.

PART - B (5 x 16 = 80 Marks)

11. (a) A cantilever beam of circular cross section is fixed at one end and subjected to completely reversed force of 10kN at the free end. The force is perpendicular to the axis of the beam. The distance between free and fixed ends is 100mm . The beam is made of steel with ultimate tensile strength of 540MPa . And tensile yield strength of 320MPa . The construction of the cantilever is such that there is no stress concentration. The size factor, surface finish factor and reliability factor are 0.85, 0.8, and 0.868 respectively. The operating temperature is 50°C for which the temperature factor is 1.010. If the diameter of the beam is 35mm determine the life of the beam. (16)

Or

- (b) A bar of circular cross section is subjected to alternating tensile forces varying from a minimum of 200KN to a maximum of 500KN . It is to be manufactured of material with an ultimate tensile strength of 900Mpa and an endurance limit of 700Mpa . Determine the diameter of bar using safety factors of 3.5 related to ultimate tensile strength and 4 related to endurance limit and stress concentration factor of 1.65 for a fatigue load. Use Goodman straight line as basis for design. (16)
12. (a) A shaft is supported by two bearings which are 1100 mm apart. The shaft carries two belt pulleys A and B. The pulley A, of diameter 620 mm , is keyed at 400 mm to the right of left bearing and drives a pulley directly below it with the maximum belt tension of 2.75 kN . The pulley B, of diameter 400 mm , is keyed at 200 mm to the left of right bearing and is driven by an electric motor placed horizontally to the right. The angle of lap for the pulleys is 180° and the coefficient of friction between the belt and pulley is 0.3. The shaft is made of steel with an ultimate tensile strength of 300 N/mm^2 and tensile yield strength of 190 N/mm^2 . If K_b and K_t are 3.0 and 2.5 respectively, design the shaft. (16)

Or

- (b) Design a cast iron protective flange coupling to connect two shafts in order to transmit 7.5 kW at 720 r.p.m . The following permissible stresses may be used: Permissible shear stress for shaft, bolt and key material = 33 MPa Permissible crushing stress for bolt and key material = 60 MPa Permissible shear stress for the cast iron = 15 MPa . (16)
13. (a) Design a cotter joint to connect two mild steel rods for a pull of 30 kN . The maximum permissible stresses are 55 MPa in tension ; 40 MPa in shear and 70 MPa in crushing. Draw a neat sketch of the joint designed. (16)

Or

- (b) A cylindrical beam of size 60 mm is attached to support by a complete circumferential fillet weld of 6 mm . Find (i) torque and (ii) bending moment that can be applied if limiting shear stress is 140 MPa . (16)
14. (a) Design a leaf spring for the following specifications : Total load = 140 kN ; Number of springs supporting the load = 4 ; Maximum number of leaves = 10 ; Span of the spring = 1000 mm ; Permissible deflection = 80 mm . Take Young's modulus, $E = 200 \text{ kN/mm}^2$ and allowable stress in spring material as 600 MPa . (16)

Or

- (b) Design a cast iron flywheel for a four stroke cycle engine to develop 110 kW at 150 r.p.m . The work done in the power stroke is 1.3 times the average work done during the whole cycle. Take the mean diameter of the flywheel as 3 metres . The total fluctuation of speed is limited to 5 per cent of the mean speed. The material density is 7250 kg / m^3 . The permissible shear stress for the shaft material is 40 MPa and flexural stress for the arms of the flywheel is 20 MPa . (16)
15. (a) A single row deep groove ball bearing operating at 2000 r.p.m . is acted by a 10 kN radial load and 8 kN thrust load. The bearing is subjected to a light shock load and the outer ring is rotating. Determine the rating life of the bearing. (16)

Or

- (b) Load on a hydrodynamic full journal bearing is 30 kN . The diameter and speed of the shaft are 150 mm and 1200 mm respectively. Diametral clearance 0.2 mm . Sommerfield number is 0.631 . L/D ratio $1:1$. Calculate temperature rise of oil, quantity of the oil, and amount of heat generated. (16)
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