Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 71856

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Fifth Semester

Mechanical Engineering

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

(Common to Fifth Semester, Automobile Engineering and Mechanical and Automation Engineering, Fourth Semester — Manufacturing Engineering, Industrial Engineering and Management and Industrial Engineering)

(Regulation 2008/2010)

(Common to PTME 2303/PTME 3214/10122 ME 504 – Design of Machine Elements/ Machine Design for B.E. (Part-Time) Fourth/Fifth Semester Mechanical Engineering — Regulation 2009/2010)

Time : Three hours Maximum : 100 marks

(Approved Data Book as permitted)

Any missing data can suitably be assumed.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define limits and fits.

2. What is an adaptive design?

3. What is the difference between spindle and axle?

4. How the length and diameter of a shaft affects its critical speed?

5. What is known as proof strength of the bolts?

6. What is bearing failure in rivets?

7. What is the effect of change in spring index on Wahl's factor and on the stress induced in a helical compression spring?

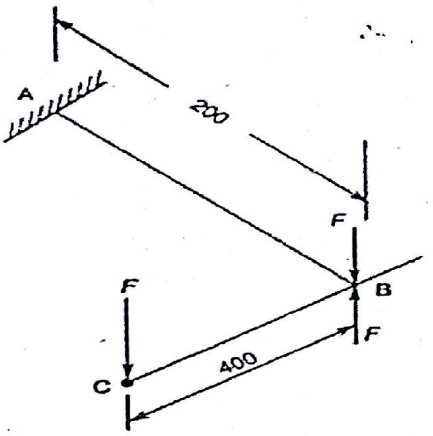
8. State the purpose of using concentric springs.

9. What is Sommerfield number? State its importance in the design of journal bearing?

10. What is self aligning ball bearing? State its unique feature.

PART B — (5 × 16 = 80 marks)

11. (a) The shaft of an overhang crank is subjected to a force F of 2 kN as shown in fig. below. The shaft is made of 30Mn2 steel having a allowable shear strength equal to 100 N/mm². Determine the diameter of the shaft. (16)



Or

(b) Design a muff coupling to connect two steel shafts transmitting 25 kW power at 360 rpm. The shafts and key are made of plain carbon steel 30C8 $\left(S_{yt} = S_{yc} = 400\,\text{N/mm}^2\right)$. The sleeve is made of grey cast iron FG 200 (S_{ut} = 200 N/mm²). The factor of safety for the shafts and key is 4. For the sleeve, the factor of safety is 6 based on ultimate strength. (16)

12. (a) It is required to design a square key for fixing a gear on a shaft of 30 mm diameter. The shaft is transmitting 20 kW power at 600 rpm to the gear. The key is made of steel 50C4 (S_{yt} = 460 N/mm²) and the factor of safety is 4. For key material, the yield strength in compression can be assumed to be equal to the yield strength in tension. Determine the dimensions of the key. (16)

Or

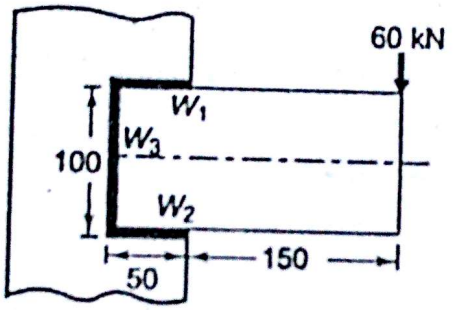
(b) A rigid coupling is used to transmit 60 kW power at 350 rpm. There are six bolts. The outer diameter of the flanges is 250 mm, while the recess diameter is 175 mm. The co efficient of friction between the flanges is 0.15. The bolts are made of steel 45C8 (S_{yt} = 380 N/mm²) and the factor of safety is 3. Determine the diameter of the bolts. Assume that the bolts are fitted in large clearance holes. (16)

13. (a) 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, heat generated and type of oil required. (16)

Or

(b) Enumerate the detail steps involved in the selection of bearings from the manufacturer's catalogue. (16)

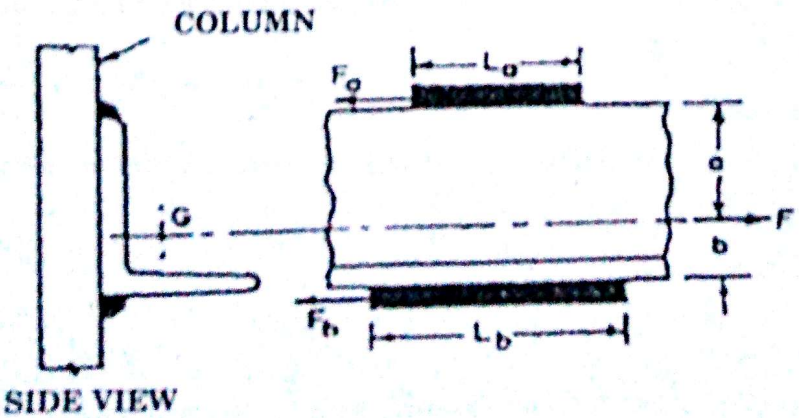
14. (a) A welded connection, as shown below is subjected to an eccentric force of 60 kN in the plane of welds. Determine the size of the welds, if the permissible shear stress for the weld is 90 N/mm². Assume static conditions. (16)



Or

(b) (i) A butt welded joint with ground and flush surface is subjected to tensile load which varies from 50 kN to 100 kN. Plates are 10 mm thick. Determine the length of weld required for over 2,500,000 cycles. (8)

(ii) The fig. below shows an angle welded to a column and carries a static load F as shown. Determine the ratio of the weld lengths L_a and L_b and F_a and F_b in terms of F. (8)



15. (a) Design a helical compression spring to sustain an axial load of 4 kN. The deflection is 80 mm. Spring index is 6. The shear stress is not to exceed 350 MPa. Rigidity modulus for spring material is 81 GPa. (16)

Or

(b) Design a leaf spring for the following specifications for a truck. Assume FOS = 2. (16)

Maximum load on springs = 100 kN

No. of springs = 4

Material of springs = Cr Va steel (σ_u = 1380 MPa and $E = 206 \times 10^3$ MPa)

Span of spring = 1000 mm

Width of central band = 150 mm

Permissible deflection = 100 mm

Assume 2 full length leaves and 6 graduated leaves.
