CBCS SCHEME

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18ME62

Sixth Semester B.E. Degree Examination, June/July 2025
Design of Machine Elements II

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Design Data Hand Book is permitted.
3. Assume missing data suitably.

Module-1

1 a. Derive an expression for the stress induced in an helical spring with usual notations. **(08 Marks)**

b. Select a V-belt drive to transmit 18 KW power from a pulley of diameter 100 mm rotating at 1500 rpm to another pulley to run at 750 rpm. The centre distance between the shafts is 1000 mm. Take correlation factor for service (F_a) = 1.2 **(12 Marks)**

OR

2 a. Write the advantages and disadvantages of V-belt drives. **(06 Marks)**

b. Design a helical spring for an axial load of 1000 N. The deflection under the load is 25 mm. The spring index is 6 and the material for the spring is oil tempered wire with an yield shear stress of 550 MPa. Assume Factor of Safety as 2.5 and Rigidity Modulus as 79 GPa. **(14 Marks)**

Module-2

3 Design a pair of Spur gears to transmit a power of 12 KW from a shaft running at 1000 rpm to a parallel shaft to run at 250 rpm maintaining a distance of 160 mm between the shaft axes. The material for pinion is cast steel 0.20% C (σ_0 = 191.3 MPa) and for gear cast steel 0.20 % C untreated (σ_0 = 137.3 MPa). Use 20° pressure angle involute teeth and service factor as 1.25. Suggest suitable hardness for gear pair. Take Factor for dynamic loading, C = 950 N/mm. **(20 Marks)**

OR

4 Design a pair of Helical gears to transmit power of 15 KW at 3200 rpm with speed reduction of 4. Pinion is made of cast steel 0.4% untreated (σ_0 = 69.6 MPa) and gear of High grade Cast Iron (σ_0 = 31 MPa) Helix angle is 26° and number of teeth on pinion is 20. Check the gears for dynamic and wear considerations. Use service factor as 1.5, wear and lubrication factor as 1.25 load factor C = 200 N/mm, $\alpha = 20^\circ$ FDI **(20 Marks)**

Module-3

5 Design a pair of right angled bevel gears to transmit 12.5 KW at 4000 rpm of steel pinion $(\sigma_0 = 138\,\text{MPa})$ having 24 teeth to cast iron gear $(\sigma_0 = 103\,\text{MPa})$ to run at 800 rpm. The teeth are $14\frac{1}{2}^\circ$ involute. Assume service factor as 1.5, Face width as 10 m, load factor C = 210 N/mm. **(20 Marks)**

OR

6 Design a worm gear to transmit a power of 2 KW at 1000 rpm. Velocity ratio is 20 : 1 and centre distance is 200 mm. Assume pressure angle as $14\frac{1}{2}^{\circ}$ Full depth involute. **(20 Marks)**

Module-4

7 a. A single plate clutch of both sides effective has 300 mm outer dia and 160 mm inside dia. The coefficient of friction is 0.2 and it runs at 1000 rpm. Find the power transmitted for uniform wear and uniform pressure distribution cases if the allowable pressure is 0.08 MPa. **(10 Marks)**

b. A simple band brake shown in Fig. Q7 (b) is to be designed to absorb a power of 30 KW at a rated speed of 750 rpm. Determine

(i) Effort required to stop clockwise and counter clockwise rotation of brake drum.

(ii) Dimensions of lever of rectangular cross section taking depth twice the width and allowable bending stress for lever as 80 MPa.

(iii) Dimensions of rectangular cross section band assuming width 10 times thickness and allowable tensile stress in band as 50 MPa. Assume $\mu = 0.3$ **(10 Marks)**

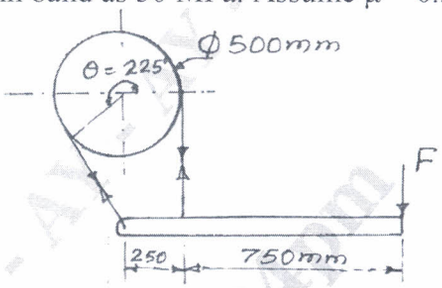

Fig. Q7 (b)

OR

8 a. A multiplate clutch consists of 5 steel plates and 4 bronze plates. The inner and outer diameter of the friction disc are 75 mm and 150 mm respectively. Coefficient of friction is 0.1. Intensity of pressure is limited to 0.3 MPa. Assuming uniform wear theory, calculate (i) Operating force (ii) Power capacity at 750 rpm. **(10 Marks)**

b. A differential band brake is arranged as shown in the Fig. Q8 (b). The drum rotates at 300 rpm.

(i) Find the force 'F' to stop the rotation of drum.

(ii) What is the width of the band required if the stress in the band is not to exceed 60 MPa. The thickness of the band being 2 mm. The power absorbed by brake is 10 KW. Assume $\mu = 0.25$. **(10 Marks)**

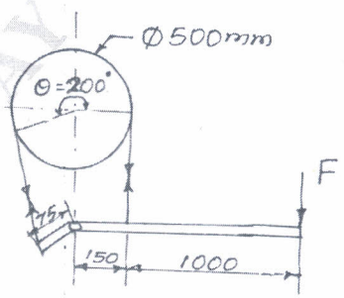

Fig. Q8 (b)

Module-5

9 a. Derive Petroff's equation for coefficient of friction for an hydrodynamic bearing. **(08 Marks)**

b. Select a suitable ball bearing to carry a radial load of 3000 N and a thrust load of 2000 N. The bearing will be in use for 3 years at 10 hrs/day. The speed of shaft is 1200 rpm and the shaft diameter is 50 mm. Take service factor $K_s = 1.25$ **(12 Marks)**

OR

10 a. Enumerate the advantages and disadvantages of rolling contact bearings. **(06 Marks)**

b. A 75 mm long full journal bearing of diameter 75 mm supports a radial load of 12 kN at a shaft speed of 1800 rpm. Assume ratio of diameter to diametral clearance as 1000. The viscosity of oil is 0.01 pas at the operating temperature. Determine

(i) Sommerfeld number

(ii) COF based on McKee equation

(iii) Amount of heat generated. **(14 Marks)**

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