CBCS SCHEME

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18ME62

Sixth Semester B.E. Degree Examination, Dec.2023/Jan.2024
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 handbook is permitted.
3. Assume missing data suitably.

Module-1

1 a. Derive an expression for shear stress induced in helical compression spring. **(08 Marks)**

b. A truck spring has a overall length of 1.2m and sustain a load of 60kN. The spring has 3 full length and 15 graduated leaves. All the leaves are stressed to 360MPa when fully loaded. The ratio of total depth to width is 2. Take E = 206GPa. Determine the width and thickness of leaves, the camber and load exerted on band. **(12 Marks)**

OR

2 a. Define slip and creep in belt. Explain the effect of slip on velocity ratio. **(10 Marks)**

b. Select a V-belt drive to transmit 10kW of power from a pulley of 200mm pitch diameter mounted on an electric motor running at 720rpm to another pulley mounted on compressor running at 200rpm. The service is heavy duty varying from 10 hrs to 14 hrs per day and centre distance between centres of pulleys is 600mm. **(10 Marks)**

Module-2

3 a. Derive Lewis equation of spur gear teeth. **(05 Marks)**

b. It is required to transmit 25kW power from a shaft running at 1000rpm to a parallel shaft with speed reduction 2.5:1. The centre distance of shafts is to be 300mm. The material used for pinion is steel $(\sigma_{d_1} = 200\text{MPa}, \text{BHN} = 250)$ and the gear is CI $(\sigma_{d_2} = 140\text{MPa}, \text{BHN} = 200)$. Considering class-II gear with tooth profile is 20° FDI. Design the spur gear and check the design for dynamic and wear load. **(15 Marks)**

OR

4 A pair of steel helical gear is to transmit 15kW at 5000rpm of the pinion, both pinion and gears are made of the same material, hardened steel with allowable bending stress of 120MPa. The gears are to be operated at a centre distance of 200mm, speed reduction is 4:1. The teeth are 20° FDI. On transverse plane, helix angle is 45°. The gears are manufactured to class-III accuracy (precision class). Face width can be taken as 16 times the normal module. Design the helical gears and suggest suitable hardness. **(20 Marks)**

Module-3

5 a. Derive an equation for "formative number of teeth" on bevel gear. **(08 Marks)**

b. A pair of bevel gears transmitting 7.5kW at 300rpm of pinion. The pressure angle is 20°. The pitch diameters of pinion and gear at their large ends are 150mm and 200mm respectively. The face width of the gears is 40mm. Determine the components of the resultant gear tooth force and draw a free body diagram of forces acting on the pinion and the gear. **(12 Marks)**

OR

6 Complete the design and determine the input capacity of a worm gear speed reducer unit which consists of a hardened steel worm and a phosphor bronze gear having 20° stub involute teeth. The centre distance is to be 200mm and transmission ratio is 10 and worm speed is 2000rpm. **(20 Marks)**

Module-4

7 a. Derive an equation for torque transmitted by disc clutch. **(10 Marks)**

b. A cone clutch with asbestos friction lining transmits 30kW at 500rpm. The coefficient of friction is 0.2 and the permissible intensity of pressure is $0.35N/mm^2$. The semi-cone angle is 12.5°. The outer diameter is fixed as 300mm from space limitations. Assuming uniform wear theory calculate:

i) The inner diameter
ii) The face width of friction lining and
iii) The force required to engage the clutch. **(10 Marks)**

OR

8 a. A single block brake shown in Fig.Q.8(a) is to balance a torque of 500Nm on a drum shaft at 1000rpm. Assuming coefficient of friction to be 0.25 and $2\theta < 60°$ determine:

i) Tangential force on the shoe
ii) Normal force
iii) Force 'F' required to apply brake
iv) The dimension 'C' required to make the brake self locking assuming other dimensions remain the same.
v) Heat generated. **(10 Marks)**

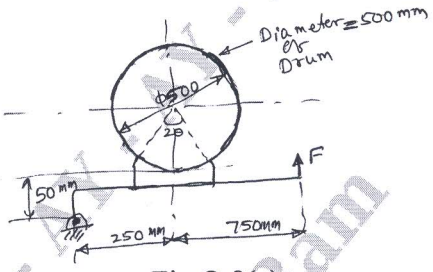

Fig.Q.8(a)

b. A differential band brake is shown in Fig.Q.8(b). The width and the thickness of the steel band are 100mm and 3mm respectively and the permissible tensile stress in the band is limited to $50N/mm^2$. The coefficient of friction between the friction lining and the brake drum is 0.25, calculate: i) Tensions in the band ii) The actuating force iii) The torque iv) Find out whether the brake is self locking? **(10 Marks)**

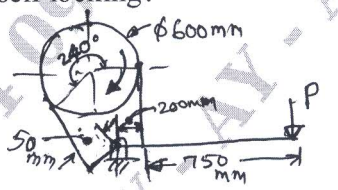

Fig.Q.8(b)

Module-5

9 a. Derive Petroff's equation, also list the assumptions made. **(08 Marks)**

b. A 200mm diameter bearing is 100mm long and has a load of 30kN. It runs at 900rpm. Clearance is 0.1mm. Oil used as SAE40. Operating temperature = 70°C. Find the power loss due to friction. **(12 Marks)**

OR

10 Select suitable single row radial ball bearings to carry a radial load of 1.5kN and a thrust load of 1.2kN at 900rpm. The bearing is to be used 7 hours per day and average service life of 8 years is desired. Consider the design load for bearing during selection with speed factor, life factor, thrust factor and application factor. **(20 Marks)**

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