CBCS SCHEME

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18ME62

Sixth Semester B.E. Degree Examination, Dec.2024/Jan.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 suitable missing data.

Module-1

1 a. A helical spring is made from a 8 mm diameter wire and has an outer diameter of 100 mm. if the permissible shear stress is 420 MPa and modulus of rigidity is 84 GPa. Find the axial load the spring can carry and the deflection per active turn :
(i) Neglecting curvature effect.
(ii) Considering curvature effect. **(10 Marks)**

b. A semi elliptical laminated leaf spring with two full length leaves and ten graduated leaves are to be designed to support a central load of 6 KN over two points 1000 mm apart. The central band width is 100 mm. The ratio of total depth of the spring to its width is 2.5. The design normal stress (pre-stress) of the material of the leaves is 400 MPa and the modulus of elasticity is 208 GPa. Determine,
(i) Width and thickness of the leaves.
(ii) The initial gap between full length and graduated leaves.
(iii) The central bolt load **(10 Marks)**

OR

2 a. A belt 125 mm wide and 10 mm thick is transmiting power at 900 m/min. The net driving tension is 2 times the tension on slack side. If safe permissible stress on the belt is 1.5 MPa. Calculate the power that can be transmitted at this speed. Take density of belt material as 1000 kg/m^3. Also find the maximum power that can be transmitted by this belt and the velocity at which this can be transmitted. **(10 Marks)**

b. A 8×19 steel wire rope is to hoist 50 KN of load from a depth of 1000 m. Determine the number of ropes required if the maximum speed is 2.5 m/s and acceleration is 1.25 m/sec^2 assuming the rope is made of 25 mm diameter. Neglect the weight of the tackle. **(10 Marks)**

Module-2

3 a. Derive the Lewis equation for the beam strength of a spur gear tooth. Also list the assumptions made. **(04 Marks)**

b. Specify the details of a spur gear to transmit 20 kW at 120 rpm. The teeth are of 20° full depth involute system having 16 teeth on pinion and a speed ratio of 3 : 1. Assume that the starting torque is 20% more than the mean torque. Both gears are made of steel C45, untreated with $\sigma_d = 233.4$ MPa and BHN 200. **(16 Marks)**

OR

4 a. Define formative number of teeth in helical gears and derive the expression for the same. **(04 Marks)**

b. A compressor running at 350 rpm is driven by a 120 kW motor running at 1400 rpm. The center distance is 400 mm and helix angle is 25°. The motor pinion is made of forged steel and the driven gear is cast steel. Design the gear pair using 20° FDI system. The pinion has 20 teeth. **(16 Marks)**

Module-3

5 A pair of 20° pressure angle bevel gears is used to transmit power between two perpendicular shafts. The pinion rotates at 600 rpm with a module of 8 mm and has 30 teeth while gear has 60 teeth. If both gears are made of steel having design strength of 200 MPa, determine the power that can be transmitted based on,

(i) Bending strength,

(ii) Surface endurance strength if Fen = 1.25 Fd.

Assume 8 to 10 hours service per day with medium shocks and $\hat{e}n$=350 MPa. **(20 Marks)**

OR

6 Design a worm gear drive for a speed reduction ratio of 25. The pinion rotates at 600 rpm and transmits 35 kW. Worm is made of C30 heat treated steel $(\sigma_{d_1} = 220.6\,\text{MPa})$ and gear of phosphor bronze $(\sigma_{d_2} = 82.4\,\text{MPa})$ **(20 Marks)**

Module-4

7 a. A multiple disc clutch of steel on bronze category is to tranmit 4 kN at 750 rpm. The inner diameter of contact is 80 mm and the outer diameter of contact is 140 mm. The clutch operates in oil with a co-efficient of friction of 0.1. The average allowable maximum pressure is 0.35 MPa. Assume uniform wear theory and determine,

(i) Number of steel and bronze discs.

(ii) Axial force required. **(10 Marks)**

b. A cone clutch transmits 180 N-m of torque at 1200 rpm. The larger diameter of the clutch is 300 mm and face angle of the cone is 12.5° with a face width of 60 mm and μ = 0.2. Determine

(i) Axial force required to transmit the torque.

(ii) Axial force required to engage the clutch.

(iii) Average normal pressure when maximum torque is transmitted.

(iv) Maximum and minimum normal pressures. **(10 Marks)**

OR

8 a. A cast iron disc of 0.9 m in diameter and 200 mm thick is used as a fly wheel which rotates at 400 rpm. It is brought to rest in 2.2 sec by means of a brake. Calculate

(i) Energy absorbed by the brake.

(ii) Torque capacity of the brake.

(iii) Number of turns. Take density of CI as 7200 kg/m^3 and radius of gyration = 0.125 m. **(10 Marks)**

b. A simple band brake as shown in Fig.Q8 (b) is to be designed to absorb a power of 30 kN at a rated speed of 750 rpm. Determine
(i) The effort required to stop clockwise rotation of the brake drum.
(ii) The effort required to stop counter clockwise rotation of the brake drum.
(iii) The dimensions of the rectangular cross-section of the brake lever assuming its depth to be twice the width.
(iv) The dimensions of the cross section of the band assuming its width to be ten times the thickness. **(10 Marks)**

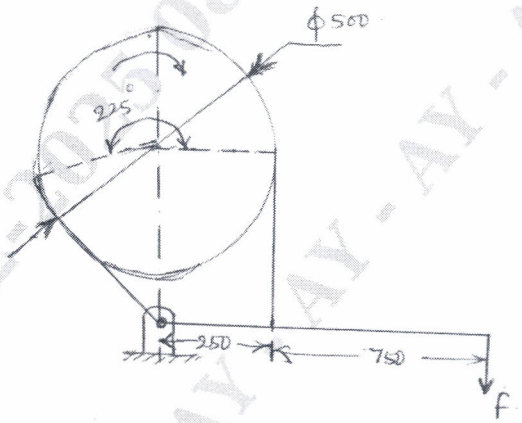

Fig. Q8 (b)

Module-5

9 a. Derive Petroff's equation for a lightly loaded bearing. **(06 Marks)**

b. Explain the formation of continuous oil film in Journal bearing. **(04 Marks)**

c. A full Journal bearing of diameter 80 mm and 120 mm long supports a radial load of 6000 N. The shaft rotates at 600 rpm and r/c = 1000. The room temperature is 30 °C and the surface of the bearing is limited to 60 °C. Determine the viscosity of the oil to satisfy the above requirements if the bearing is well ventilated and if no artificial cooling is required. Also determine the temperature of the oil. **(10 Marks)**

OR

10 a. Define the following :
(i) Static load
(ii) Dynamic load
(iii) Bearing life
(iv) Rating life **(06 Marks)**

b. What change in the loading of Rolling contact bearing will cause the expected life to be doubled? Derive the condition. **(04 Marks)**

c. A bell bearing is operating on a work cycle consisting of three parts namely Radial load of 2500 N at 1420 rpm for one quarter cycle, radial load of 1000 N at 710 rpm for one half cycle, radial load of 5000 N at 1420 rpm for remaining cycle. The expected bearing life is 10,000 hrs. Calculate the dynamic load capacity of the bearing. **(10 Marks)**

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