CBCS SCHEME

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18ME62

Sixth Semester B.E. Degree Examination, Feb./Mar. 2022
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. ***Missing data can be suitable assumed.***

Module-1

1 a. Derive an expression for the shear stress induced in helical coil spring (compression) with usual notation.

$$C = \frac{8FD}{\pi d^3}$$

(06 Marks)

b. The spring used in an automobile engine has to exert 500 N when the valve is closed and 600 N when the valve is open. The displacement of the valve is 5 mm. The engine Crankshaft rotates at 800 rpm. Design the spring if permissible stress in the material of the spring is 300 MPa. The ratio of mean coil diameter to the wire diameter is 6. The specific weight and the modulus of rigidity of the spring material are 7.35×10^{-5} N/mm^3 and 8×10^4 MPa respectively. The ends of the springs are square and ground. Inspect the suitability of the spring for this engine. At what speed of the engine does the spring resonate? **(14 Marks)**

OR

2 a. Derive the equation $\frac{T_1}{T_2} = e^{\mu\theta}$ where T_1 – tension in the belt on the tight side, T_2 – tension in the belt on the slack side, coefficient of friction – μ, θ – angle of contact in radius. **(05 Marks)**

b. Select the type and number of V-belts required to drive a crusher, which works 8 hours a day. The power transmitted is 65 KW. The motor shaft runs at 900 rpm and carries a pulley of 250 mm diameter, the crusher shaft rotates at 300 rpm and the centre distance is 700 mm. Determine the pitch length of the belt. **(15 Marks)**

Module-2

3 a. What are the common modes of gear failure? Explain any two modes briefly. **(06 Marks)**

b. A pair of spur gears has to transmit 20 KW from a shaft rotating at 1000 rpm to a parallel shaft which is to rotate at 310 rpm. Number of teeth on pinion is 31 with 20° full depth involute tooth form. The material for pinion is steel SAE 1040 untreated with allowable static stress 206.81 MPa and the material for the gear is cast steel 0.2% C untreated with allowable static stress 137.34 MPa. Determine the module and face width of the gear pair. Also find the dynamic tooth load on the gears. Take the service factor as 1.5. **(14 Marks)**

OR

4 a. Write a note on gear materials. **(04 Marks)**

b. Design a helical gear pair to transmit a power of 15 KW from a shaft rotating at 1000 rpm to another shaft to be run at 360 rpm. Assume involute profile with a pressure angle of 20°. The material of the pinion is forged steel SAE 1030 whose σ_d = 172.375 MPa and the material for gear is cast steel 0.2% C untreated with σ_d = 137.4 MPa. The gears operate under a condition of medium shocks for a period of 10 hrs/day. Check for dynamic load, if load factor C = 580 N/mm and also for wear load. **(16 Marks)**

Module-3

5 a. Derive expression for pitch angle of bevel gears. **(06 Marks)**

b. Give a detailed classification of bevel gears. **(04 Marks)**

c. A two teeth right hand worm transmits 2 KW at 1500 rpm to a 36 teeth wheel. The module of the wheel is 5 mm and the pitch diameter of the worm is 60 mm. The pressure angle is 14.5°. The coefficient of friction is found to be 0.06.

(i) Find the centre distance, the lead and lead angle

(ii) Determine the forces

(iii) Determine the efficiency of the drive. **(10 Marks)**

OR

6 A pair of straight bevel gears are to transmit 15 KW at 1500 rpm input speed. The number of teeth on pinion is 20 and the speed ratio is 5. Design the gears assuming 14½° full depth form. **(20 Marks)**

Module-4

7 a. Derive power transmitting capacity of a single plate clutch for :

(i) Uniform Pressure Condition

(ii) Uniform Wear Condition **(10 Marks)**

b. Design a cone clutch to transmit 40 KW at 750 rpm. Also determine (i) Axial force required to transmit the torque (ii) Axial force required to engage the clutch. Assume f = 0.4 and p = 0.2 N/mm^2 for the frictional material ($\alpha = 12.5°$). Take $D_m/b = 6$. **(10 Marks)**

OR

8 a. What are the uses of clutch and brake in power transmission systems? **(04 Marks)**

b. A single plate friction clutch of both sides effective has 0.3 m outer diameter and 0.16 m inner diameter. 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 maximum pressure is 0.08 MPa. **(08 Marks)**

c. The diameter of the drum of a single block brake shown in Fig.Q8(c) is 200 mm and the angle of contact is 90°. If the operating force of 700 N is applied at the end of a lever and the coefficient of friction between the drum and the lining is 0.35, determine the torque that may be transmitted by the block brake.

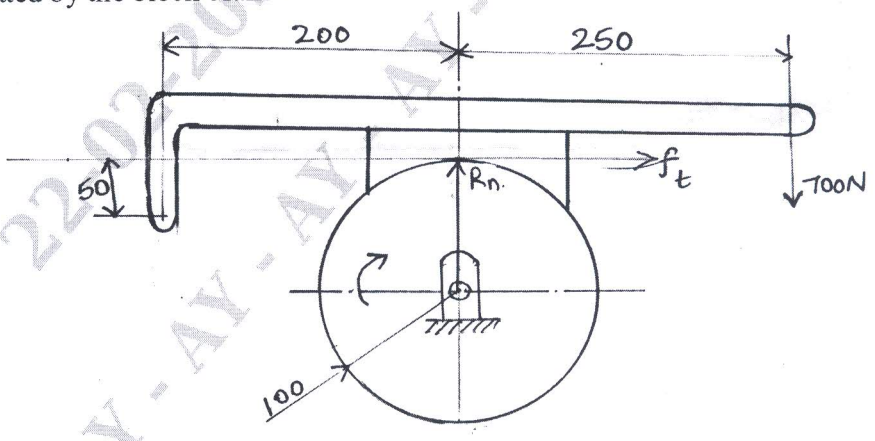

Fig.Q8(c) **(08 Marks)**

Module-5

9 a. Derive the Petroff's equation for frictional power loss for a lightly loaded journal bearing rotating at high speed concentric to the bearing. **(06 Marks)**

b. A full journal bearing of 50 mm diameter and 100 mm long has a bearing pressure of 1.4 N/mm^2. The speed of the journal is 900 rpm and the ratio of journal diameter to the diametrical clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011 kg/m-s. The room temperature is 35°C. Find:
(i) The amount of artificial cooling required.
(ii) The mass of lubricating oil required, if the difference between the outlet and the inlet temperature of the oil is 10°C. Take specific heat of oil as 1850 J/kg°C. **(14 Marks)**

OR

10 a. Discuss the mechanism of fluid film lubrication. **(05 Marks)**

b. Explain with sketch theory of hydrodynamic lubrication. **(05 Marks)**

c. SAE 20 oil is used to lubricate a hydrodynamic journal bearing of diameter 75 mm and length 75 mm, oil enters at 40°C. The journal rotates at 1200 rpm. The diametral clearance is 75 μm (0.075 mm). Assume operating temperatures of the oil as 53°C and determine:
(i) Magnitude and location of the minimum oil film thickness
(ii) Power loss
(iii) Oil flow through the bearing
(iv) Side leakage **(10 Marks)**

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