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B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Sixth Semester

Mechanical Engineering

ME 8651 — DESIGN OF TRANSMISSION SYSTEMS

(Common to Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering)

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Why tight-side of the belt should be at the bottom side of the pulley?
2. What are the various losses during power transmission by belts?
3. Define working depth of a gear tooth.
4. Where do we use the skew helical gears?
5. When is a bevel gear preferred?
6. In which gear-drive, self-locking is available?
7. What are the possible arrangements to achieve 12 speeds from a gear box?
8. List the applications of constant mesh gear box.
9. Under what condition of a clutch, the uniform rate of wear assumption is more valid?
10. Name the profile of cam that gives no jerk.

PART B — (5 × 13 = 65 marks)

11. (a) Design a belt drive to transmit 20 kW at 720 rpm to an aluminium rolling machine, the speed ratio being 3. The distance between the pulley is 3 m. Diameter of rolling machine pulley is 1.2 m.

Or

- (b) A truck equipped with a 9.5 kW engine uses a roller chain as the final drive to the rear axle. The driving sprocket runs at 900 rpm and the driven sprocket at 400 rpm with a center distance of approximately 600 mm. Select the roller chain.

12. (a) A Bakelite pinion is driving a cast iron gear. The pinion rotating at 700 rpm transmits 5 kW to the gear. The velocity ratio is 3, the teeth are 20° full depth, and the load is smooth. Design a spur gear drive. Take allowable static stress for Bakelite as 40 N/mm².

Or

- (b) Design a helical gear to transmit 15 kW at 1440 rpm to the following specifications :

Speed reduction = 3 ; Pressure angle = 20° ; Helix angle = 15° ; The material of both the gear = C45 steel ; Allowable static stress = 180 N/mm² ; Surface endurance limit = 800 N/mm² ; Young's modulus of material = 2 × 10⁵ N/mm².

13. (a) A pair of bevel gears is to transmit 10kW from a pinion rotating at 420 rpm to a gear mounted on a shaft which intersects the pinion shaft at an angle of 70°. Assuming that the pinion is to have an outside pitch diameter of 180 mm, a pressure angle of 20°, a face width of 45mm, and the gear shaft is to rotate at 140 rpm, determine:

- (i) The pitch angle for the gears. (4)
(ii) The forces on the gears, and (4)
(iii) The torque produced about the shaft axis. (5)

Or

- (b) Design a worm gear drive to transmit 1.5 kW at a worm speed of 240 rpm. Velocity ratio is 10:1. An efficiency of at least 80% is desired. The temperature rise should be restricted to 45°C. Determine the required cooling area. Take the overall heat transfer coefficient as 10 w/m²°C.

14. (a) In a machine tool application, 12 different speeds are required from 100 rpm to 355 rpm in the output shaft. The motor speed is 360 rpm.
- (i) Determine the 12 standard speed in G.P, (4)
 - (ii) Draw the ray diagram (4)
 - (iii) Sketch the kinematic layout. (5)

Or

- (b) A nine speed gear box, used as a head stock gear box of a turret lathe, is to provide a speed range of 180 rpm to 1800 rpm. Using standard step ratio, draw the speed diagram and the kinematic layout. Also find and fix the number of teeth on all gears.
15. (a) A single plate friction clutch, with both sides of the plate being effective, is used to transmit power at 1440 rpm. It has outer and inner radii 80mm and 60mm respectively. The maximum intensity of pressure is limited to $10 \times 10^4 \text{ N/m}^2$. If the coefficient of friction is 0.3, determine:
- (i) Total pressure exerted on the plate, and (6)
 - (ii) Power transmitted. (7)

Or

- (b) In a single block brake, the diameter of the drum is 250mm and the angle of contact is 90° . The operating force of 700 N is applied at the end of lever which is at 250 mm from the center of the brake block. The coefficient of friction between the drum and the lining is 0.35. Determine the torque that may be transmitted. Fulcrum is at 200 mm from the center of brake block with an offset of 50 mm from the surface of contact.

PART C — (1 × 15 = 15 marks)

16. (a) Design a wire rope for an elevator in a building 60 meters high and for a total load of 20 kN. The speed of the elevator is 4 m/sec and the full speed is reached in 10 seconds.

Or

- (b) A multi-disc clutch has three discs on the driving shaft and two on the driven shaft is to be designed for a machine tool, driven by an electric motor of 22 kW running at 1440 rpm. The inside diameter of the contact surface is 130 mm. The maximum pressure between the surfaces is limited to 0.1 N/mm^2 . Design the clutch. Take $\mu = 0.3$, $n_1 = 3$; $n_2 = 2$.