

Code : 102802

B.Tech 8th Semester Exam., 2022

( New Course )

## DESIGN OF TRANSMISSION SYSTEMS

Time : 3 hours

Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.  
 (ii) There are **NINE** questions in this paper.  
 (iii) Attempt **FIVE** questions in all.  
 (iv) Question No. 1 is compulsory.

1. Choose the correct answer of the following  
 (any seven) : 2×7=14

(a) In a flat belt drive, the belt can be subjected to a maximum tension ( $T$ ) and centrifugal tension ( $T_C$ ). The condition for transmission of maximum power is given by

- (i)  $T = T_C$   
 (ii)  $T = 2T_C$   
 (iii)  $T = 3T_C$   
 (iv)  $T = 4T_C$

- (b) All stresses produced in a belt are  
 (i) compressive stresses  
 (ii) tensile stresses  
 (iii) both tensile and compressive stresses  
 (iv) shear stresses
- (c) The thickness of rim for all sizes of steel pulleys should be  
 (i) 5 mm  
 (ii) 10 mm  
 (iii) 15 mm  
 (iv) 20 mm
- (d) The groove angle of the pulley for V-belt drive is usually  
 (i)  $20^\circ-25^\circ$   
 (ii)  $25^\circ-32^\circ$   
 (iii)  $32^\circ-38^\circ$   
 (iv)  $38^\circ-45^\circ$
- (e) The face angle of a bevel gear is equal to  
 (i) pitch angle - addendum angle  
 (ii) pitch angle + addendum angle  
 (iii) pitch angle - dedendum angle  
 (iv) pitch angle + dedendum angle

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(f) If  $b$  denotes the face width and  $L$  denotes the cone distance, then the bevel factor is written as

- (i)  $b/L$
- (ii)  $b/2L$
- (iii)  $1-2b/L$
- (iv)  $1-b/L$

(g) The number of starts on the worm for a velocity ratio of 40 should be

- (i) single
- (ii) double
- (iii) triple
- (iv) quadruple

(h) If contacting surface is 7, then the number of discs used in multiplate clutch is

- (i) 5
- (ii) 6
- (iii) 7
- (iv) 8

(i) The material used for brake lining should be \_\_\_\_\_ coefficient of friction.

- (i) low
- (ii) medium
- (iii) high
- (iv) moderate

(j) Hand brake used in automobile is which type of brake?

- (i) Internal expanding brake
- (ii) External contracting brake
- (iii) Disc brake
- (iv) None of the above

2 (a) What are the various factors upon which the coefficient of friction between the belt and the pulley depend? 4

(b) With the help of neat sketches, what are the different types of various flat belt drives? 4

(c) Two pulleys, one 450 mm diameter and the other 200 mm diameter, on parallel shafts 1.95 m apart are connected by a crossed belt. Find the length of the belt required and the angle of contact between the belt and each pulley. What power can be transmitted by the belt when the larger pulley rotates at 200 rev/min, if the maximum permissible tension in the belt is 1 kN and the coefficient of friction between the belt and the pulley is 0.25? 6

3. (a) Discuss the different types of pulleys used in belt drives. 4

(b) What are the advantages and disadvantages of V-belt drive over flat belt drive? 3

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(c) A belt drive consists of two V-belts in parallel, on grooved pulleys of the same size. The angle of the groove is  $30^\circ$ . The cross-sectional area of each belt is  $750 \text{ mm}^2$  and  $\mu = 0.12$ . The density of the belt material is  $1.2 \text{ mg/m}^3$  and the maximum safe stress in the material is  $7 \text{ MPa}$ . Calculate the power that can be transmitted between pulleys of  $300 \text{ mm}$  diameter rotating at  $1500 \text{ r.p.m.}$  Find also the shaft speed in  $\text{r.p.m.}$  at which the power transmitted would be a maximum.

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4. (a) Define the following with respect to bevel gears :

6

Cone distance; Addendum angle;  
Root angle.

(b) A pair of cast iron bevel gears connects two shafts at right angles. The pitch diameters of the pinion and gear are  $80 \text{ mm}$  and  $100 \text{ mm}$  respectively. The tooth profiles of the gears are of  $14\frac{1}{2}^\circ$  composite form. The allowable static stress for both the gears is  $55 \text{ MPa}$ . If the pinion transmits  $2.75 \text{ kW}$  at  $1100 \text{ r.p.m.}$ , find the module and number of teeth on each gear from the standpoint

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of strength and check the design from the standpoint of wear. Take surface endurance limit as  $630 \text{ MPa}$  and modulus of elasticity for cast iron is  $84 \text{ kN/mm}^2$ .

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5. (a) Define the following terms used in worm gearing :

4

- (i) Lead
- (ii) Lead angle
- (iii) Normal pitch
- (iv) Helix angle

(b) A double-threaded worm drive has an axial pitch of  $25 \text{ mm}$  and a pitch circle diameter of  $70 \text{ mm}$ . The torque on the worm gear shaft is  $1400 \text{ N-m}$ . The pitch circle diameter of the worm gear is  $250 \text{ mm}$  and the tooth pressure angle is  $25^\circ$ . Find the—

- (i) tangential force on the worm gear;
  - (ii) torque on the worm shaft;
  - (iii) separating force on the worm;
  - (iv) velocity ratio;
  - (v) efficiency of the drive;
- if the coefficient of friction between the worm thread and gear teeth is  $0.04$ .

10

6. (a) Why is geometric progression selected in machine tool drives? 4
- (b) Design a nine-speed gearbox for a machine to provide speeds ranging from 100 r.p.m to 1500 r.p.m. The input is from a motor of 5 kW at 1440 r.p.m. Assume any alloy steel for the gear. 10
7. (a) List the significance of pressure angle in cam design. 4
- (b) Name four profiles normally used in cams. 4
- (c) A radial cam rotates at 1200 r.p.m. with the follower rising 20 mm with SHM in 150° of the cam rotation. The roller is 32 mm in diameter and the prime circle is 80 mm in diameter. Check whether undercutting will occur. 6
8. (a) If a multidisc clutch has 6 discs in the driving shaft and 7 discs in the driven shaft, then how many number of contact surfaces it will have? 4
- (b) An engine developing 45 kW at 1000 r.p.m. is fitted with a cone clutch built inside the flywheel. The cone has a face angle of 12.5 degree and a maximum

mean diameter of 500 mm. The coefficient of friction is 0.2. The normal pressure on the clutch face is not exceeded  $0.1 \text{ N/mm}^2$ . Determine the (i) face width required and (ii) axial spring force necessary to engage the clutch. 10

9. An internal expanding shoe brake has the following dimensions :

Diameter of the drum = 300 mm;  
 distance between the fulcrum centers = 80 mm; distance of fulcrum centers and that of cam axis, both from the drum center = 100 mm; distance of the line of action of braking force from the cam axis = 90 mm; distance between the points where the cam acts on the two brake shoes = 30 mm

Each shoe subtends an angle of  $90^\circ$  at the drum center. If the braking force is 750 N and the coefficient of friction is 0.3, find the braking torque on the drum. Assume the reaction between the brake shoes and the drum passes through the point bisects the contact angle. Also assume that forces exerted by the cam ends on the two shoes are equal. 14

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