

(3 Hours)



- N.B.**
- 1) **Question No. 1 is compulsory**
  - 2) Solve **Any Three** from remaining **Five** questions.
  - 3) Use of standard data book is permitted
  - 4) Assume suitable data if necessary, giving justification

- Q1 Answer any **Four** from the following
- a) Explain how assumptions made in Lewis equation are taken in to account during design? 5
  - b) Explain how the following factors influence the life of a bearing 5  
(a) Load (b) Speed (c) Temperature
  - c) Briefly explain chain drives? 5
  - d) Why it is necessary to dissipate the heat generated when clutches operate? 5
  - e) Define the following terms used in worm gearing with neat sketch. 5  
(a) Lead (b) Lead angle (c) Normal pitch (d) Helix angle.
- Q2 Design a Two-stage spur gear reduction unit with  $20^\circ$  F.D involute teeth. The input shaft is connected to 9.5 KW, 1400 rpm motor through a flexible coupling. The output shaft speed shall be approximately 200 rpm. The gears are made up of plain carbon steel. 20
- i) Find dynamic load and check for wear load.
  - ii) Decide the constructional details of the gear and pinion showing neat sketch.
- Q3 a) Design a hydrodynamic bearing for a centrifugal pump to support a load of 8 KN when operating at 1600 rpm. Write assumptions if required and analyze the performance. 12
- Q3 b) A multiple disc clutch, steel on bronze, is to transmit 8 KW at 800 r.p.m. The inner radius of the contact is 40 mm and outer radius of the contact is 70 mm. The clutch operates in oil with an expected coefficient of 0.1. The average allowable pressure is  $0.5 \text{ N/mm}^2$ . Use uniform wear theory. 08
1. The total number of steel and bronze discs
  2. The actual axial force required.
  3. The actual average pressure.
  4. The actual maximum pressure.

- Q4 A rotary disc cam and central translator follower has following motion:- 20  
Forward stroke = 20 mm in  $100^\circ$  rotation of cam with SHM, dwell to complete the cycle.  
Return stroke = 20 mm with SHM in  $100^\circ$  of cam rotation remaining dwell to complete.  
Mass of follower is 1 Kg and cam shaft rotates at 500 rpm and maximum pressure angle is  $25^\circ$  during forward stroke. The external force is 310N during forward stroke and 55 N during return stroke. Determine
1. Base circle radius
  2. Design the cam
  3. Design the spring
  4. Calculate maximum cam shaft torque.
- Q5 A pair of bevel gear is required to transmit 8 KW power from a pinion shaft rotating at 400 rpm with reduction ratio 3.5. The shaft angle is  $90^\circ$  and drive is subjected to moderate shock and operates at 12 hrs/day. Design stresses for pinion are 380 MPa and 1100 MPa. Design and check pair in strength and wear and also perform arm design. 20
- Q6 a) A V- Belt drive is to transmit 15 KW to a compressor. The motor speed is 1100 rpm and compressor pulley runs at 400 rpm. The coefficient of friction between the belt and pulley is 0.25. The compressor operates for 10-12 hrs/ day. Design the drive for above application. Design should include following 12
1. Section of V-Belt material
  2. Exact centre distance
  3. Belt size
  4. Number of belts
  5. Life of belt.
- Q6 b) An angular contact ball bearing is used for gear shaft to support a radial load of 9 KN and 6 KN along the axial direction. The shaft rotates at 50 rpm. Select suitable size of bearing, if it is required to have a life of 30000 hrs with a probability of survival of 93 %. Check selected bearing is safe for given application. 08

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