

(3hours)



Max.Marks: 80

- Instructions: 1) Question No. 1 is compulsory.
 2) Answer any **three** from the remaining five questions.
 3) Use of **PSG Design data book** is permitted.
 4) Use your judgment for unspecified data, if any.

Q.1. Answer any **four** of the followings:

(4 x 5 = 20)

- a) Discuss the applications of the following types of the gears
 i) Spur gears ii) Helical gears iii) Bevel gears and iv) Worm and worm gears
 b) Explain the following terms as applied to rolling contact bearings:
 i) Rated life ii) Basic static load rating iii) Basic dynamic load rating
 c) What is pressure angle and its significance in the design of cam and roller follower mechanisms.
 d) Enumerate the qualities of the friction material used in clutches.
 e) What do you mean by experience or service factor? How is it decided in different applications.
 f) What are the desirable properties of good bearing materials used in sliding contact bearings.

Q.2 a) Design a spur gear drive to transmit 25 H.P. at 850 r.p.m. Speed reduction is 2.5. Materials for pinion and wheel are C15 steel and CI grade 30 respectively. Take pressure angle of 20° . Design bending stress for pinion material is 85 N/mm^2 and surface endurance limit for pinion material is 620 N/mm^2 . (10)

b). Design a pair of helical gears to transmit a power of 36,800 Watts at 30 rps of the pinion. Gear ratio is 4. Helical angle is 15° . Teeth is 20° full depth. Material used is C50. (10)

Q.3 a) A CI bevel gear pair, having pitch circle diameters of 80 mm and 100 mm, is used for transmitting 3 kW power at a pinion speed of 1200 r.p.m. The tooth system is $14 \frac{1}{2}^\circ$ composite. If the static strength of pinion and gear is 56 MPa, determine:

- i) the module ii) the face width; and iii) the surface hardness

Assume velocity factor accounts for dynamic load. (14)

b) Why dissimilar materials for worm and worm wheel? In worm gear drive, the worm gear always governs the design. Justify. (6)

[Turn Over]

Q.4 a) A single row deep-groove ball bearing No. 6403 is used to support the lay shaft of a four speed automobile gear box. It is subjected to the following loads :

Gear	Axial Load (N)	Radial Load (N)	Time Engaged
I	3250	4000	1 %
II	500	2750	3 %
III	50	2700	21 %
IV	0	0	75 %

The lay shaft is connected to the engine shaft and rotates at 1750 r.p.m. If the bearing is expected to be in use for 4000 hours., determine the reliability of bearing. (10)

b) The following data is given for 360° hydrodynamic bearing:

Journal diameter	:	110 mm
Bearing length	:	55 mm
Journal speed	:	1400 r.p.m.
Minimum oil-film thickness	:	15 microns
Viscosity of lubricant	:	30 cP
Specific gravity of lubricant	:	0.86
Specific heat of lubricant	:	2 kJ/kg $^\circ$ C

Calculate:

- The load carrying capacity of bearing ;
- the coefficient of friction ;
- the power lost in friction ;
- the side leakage ; and
- the temperature rise.

(10)

Q.5 a) A V-belt drive is used to transmit 38 kW power at 1440 r.p.m. from a three phase induction motor to a centrifugal pump, required to be operated at 360 r.p.m. The motor pulley pitch diameter is 225 mm and the groove angle is 38° . The central distance between the pulleys is 1 m. The coefficient of friction for the belt pulley combination is 0.2 and the density of the belt material is 0.97 gm/cc. If the allowable tension in the belt is 800 N, determine:

- the number of belts required; and
- the pitch length of the belt.

Assume suitable cross-section for the belt based on the power to be transmitted. (10)

b) A chain drive is to be used to transmit 5 kW power from an electric motor running at 1000 r.p.m. to a machine running at 500 r.p.m. The service conditions involve light shock.

- Select a standard roller chain.
- Determine the pitch circle diameters of driving and driven sprockets.
- Determine the length of the chain.
- Specify the correct centre distance between the axes of sprockets.

(10)

[Turn Over]

Q.6 a) A plate cam operates a radial, translator roller follower having following particulars:
Rise of 24 mm in an angle of 80° of cam rotation by cycloidal motion, dwell for 20° return in 70° by SHM and remaining dwell to complete cycle. Speed of rotation 500 rpm, maximum pressure angle 20° , mass of follower is 1.3 kg, minimum spring force 20 % of maximum inertia force and external resistance 500 N during rise and 50 N during return.

- i) Determine base circle diameter and draw cam profile to scale. (5)
- ii) Design spring for the follower using static approach. (4)
- iii) Determine width of the follower. (4)

b) An engine developing 30 kW at 1250 r.p.m. is fitted with a cone clutch built into the flywheel. The cone has a face angle of 12.5° and a mean diameter of 350 mm. The coefficient of friction is 0.2 and normal pressure on the clutch face is not to exceed 80 kN/m^2 . Determine the required face width and the force necessary to engage the clutch.

Assume uniform wear criterion.

(7)