

Total No. of Questions : 10]

P2928

SEAT No. :

[Total No. of Pages : 5

[5669]-517

T.E. (Mechanical)

DESIGN OF MACHINE ELEMENTS - II

(2015 Pattern)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer Five questions from following.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of electronic pocket calculator is allowed.
- 5) Use of programmable calculator is not permitted.
- 6) Assume Suitable data if necessary.

Q1) a) Differentiate between straight bevel gear and spiral bevel gear. **[4]**

- b) A pair of spur gear with 20° full-depth involute teeth 20 teeth pinion meshing with 41 teeth gear. The velocity factor is to be used to account for dynamic load. The pinion rotates at 1450 rpm motor. The service factor 1.75. The pinion as well as gear is made of plain carbon steel 40C8 ($S_{ut} = 600\text{N/mm}^2$). The factor of safety as 1.5. The module 3 mm and face width 40 mm, the gears are heat treated to a surface hardness 400 BHN, Determine the rated power that the gear can transmit. **[6]**

Use following data :

i) Lewis form factor, $Y = 0.484 - \frac{2.87}{z}$

ii) Velocity factor $C_v = \frac{3}{3 + v}$

OR

- Q2) a)** A pair of parallel helical gears consists of 20 teeth pinion meshing with 100 teeth gear. The pinion rotates 720 rpm. The normal pressure angle is 20° , while the helix angle is 25° . The face width is 40 mm and normal module is 4 mm. The pinion is made of plain carbon steel 55C8 ($S_{ut} = 720\text{ N/mm}^2$) while the gear is made of plain carbon steel 40C8 ($S_{ut} = 580\text{ N/mm}^2$). The pinion and gear are heat treated to a surface hardness of 350 BHN and 300 BHN respectively. The service factor and factor of safety are 1.5 and 2.0 respectively. Calculate Beam strength & Wear strength of gear pair. **[4]**

Use following data :

$$Y' = 0.484 - \frac{2.87}{z}$$

$$K = 0.16 \left(\frac{\text{BHN}}{100} \right)^2$$

- b) Give classification of gear. Explain various Gear tooth failures, and state their remedies. **[6]**

Q3) a) Derive an expression for the beam strength of a Helical gear. **[4]**

- b) The radial load acting on ball bearing is 2500 N for first five revaluations and reduces to 1500 N for next ten revaluation. The load variation the repeat itself. The expected life of bearing is 25 million revaluations. Determine dynamic load carrying capacity of bearing. **[6]**

OR

Q4) a) Derive the equation for Virtual Number of teeth on bevel gear. **[4]**

- b) It is required to select a ball bearing suitable for a 50 mm diameter shaft rotating at 1500 rpm. The radial and thrust loads at the bearing are 4500 N and 1600 N respectively. The values of X and Y factors are 0.56 and 1.2 respectively. Select a proper ball bearing from the following table for the rating life of 22500 hr. **[6]**

Bearing No.	6010	6210	6310	6410
C (N)	21600	35100	61800	87100

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P.T.O.

- Q5) a)** Explain why in design of worm gear, worm gear governs the design. [4]
b) A pair of worm and worm wheel is designated as 2/41/10/08.. The worm wheel is made of sand cast & chilled phosphor bronze and worm is made of case harden alloy steel. The drive is use to obtained speed reduction of 20.5 from an input speed of 1450 rpm. Determine input power rating based on
 i) Beam strength
 ii) Wear strength [12]

Assume following data,

Table - 1

Worm	Worm wheel
Speed factor strength – 0.24 at 1450 rpm	Speed factor strength – 0.44 at 70.732 rpm
Bending Stress factor – 33.11	Bending Stress factor – 6.4
Speed factor for Wear – 0.106	Speed factor for Wear – 0.25
Surface stress factor – 5.41	Surface stress factor – 1.27
Zone factor – 1.231	$\mu = 0.04$, $\alpha = 20^\circ$

OR

- Q6) a)** Write a note on thermal consideration of worm gear. [4]
b) A pair of worm gear is designated as 1/52/10/8 transmit 5 kW power at 900 rpm is supplied to worm shaft. If the coefficient of friction is 0.04 and pressure angle is 20° , determine : [12]
 i) Components of tooth forces acting on the worm and worm wheel;
 ii) The efficiency of the worm gear drive; and
 iii) The temperature rise the lubricating oil, if effective surface area is 3.0 m^2 with heat transfer coefficient of $15 \text{ W/m}^2 \text{ }^\circ\text{C}$.

- Q7) a)** Discuss stresses developed in wire rope? [4]
b) The flat belt drive is used to transmit 15 kW power at 1440 rpm to another pulley running at 480 rpm. Centre distance between pulleys is two times the diameter of bigger pulley; thickness of belt is 5 mm and operates at a velocity of 20.35 m/s approximately. The coefficient of friction is 0.35 and the permissible tensile stress for the belt material is 2.27 N/mm^2 . The density of leather is 0.95 gm/cc . Calculate [12]
 i) Diameters of both pulleys
 ii) Length and width of the belt and
 iii) Belt tensions.

OR

- Q8) a)** What is polygonal action in roller chain drive? How to control it? [4]
b) Explain the procedure for the selection of V belt from manufacturer's catalogue. [4]
c) A single v belt is used to transmit power from a grooved pulley of pitch diameter 200 mm running at 1500 rpm to a flat pulley of diameter 600 mm. The centre distance between the pulley is 1000 mm. The mass of the belt is 0.3 kg/m . The coefficient of friction between the belt and pulley is 0.25. The v belt pulley groove angle is 38° . If the allowable tension in the belt is 800 N. Determine [8]
 i) power transmitting capacity of the belt
 ii) initial tension required in the belt.

- Q9) a)** Following data is given for 360° hydrodynamic journal bearing, [6]

- Radial load – 6.5 kN
 - Journal speed – 1200 rpm
 - Journal diameter – 60 mm
 - Journal length – 60 mm
 - Minimum oil film thickness – 0.009 mm
- The fit between journal & bearing is H_7/e_7 , for which,

$$\text{Hole diameter} - 60^{+0.00}_{+0.03} \text{ mm}$$

$$\text{Shaft Diameter} - 60^{+0.06}_{+0.09} \text{ mm}$$

Specify the viscosity of lubricating oil for given journal bearing. Refer Table - 2.

- b)** Compare the sliding contact bearing with rolling contact bearings? [4]
c) Explain significance of the following variables in connection with hydrodynamic bearing : [8]
 i) Unit bearing pressure;
 ii) Radial clearance;
 iii) Minimum oil film thickness;
 iv) Maximum Oil Film Temperature.

OR

Q10)a) The following data is given for a 360° hydrodynamic bearing [14]

- Radial load = 3.2 kN
- Journal diameter = 50 mm.
- Bearing length = 50 mm.
- Journal speed = 1490 rpm
- Radial clearance = 50 microns
- Viscosity of lubricants = 25 cP
- Density of lubricant = 860 kg/m³
- Specific heat of lubricant = 1.76 kJ/Kg°C

Assume that the total heat generated in the bearing is carried by the total oil flow in the bearing. calculate :

- Minimum oil-film thickness;
- Coefficient of friction;
- Power lost in friction;
- Total flow rate of lubricant in litres/min;
- Side leakage;
- Temperature rise

Refer Table 2 Dimensionless parameters for Full Journal Bearings

l/d	h_0/c	ϵ	S	$(r/c) f$	Q/rcn_l	Q/Q	P_{max}/P
1.0	0.2	0.8	0.0446	1.70	4.62	0.842	3.195
	0.4	0.6	0.121	3.22	4.33	0.680	2.409
	0.6	0.4	0.264	5.79	3.99	0.497	2.066
	0.8	0.2	0.631	12.8	3.59	0.280	1.890

Table 2 : Dimensionless parameters for Full Journal Bearings

- b) Derive the equation of friction loss in hydrodynamic journal bearing. [4]

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