Total No. of Questions : 10] SEAT No. :

P3917 [Total No. of Pages : 7

[4758] - 516

T.E. (Mechanical) (End-Semester)

DESIGN OF MACHINE ELEMENTS - II

(2012 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) What are the advantages and disadvantages for increasing the helix angle in helical gear. **[4]**

b) Design a pair of spur gear with 20° full-depth involute teeth based on Lewis Equation. The velocity factor is to be used to account for dynamic load. The pinion shaft is to be connected to 10kW, 1440 rpm motor. The starting torque of the motor is 150% of the rated torque. The speed reduction is 4:1. The pinion as well as gear is made of plain carbon steel 40C8 (S_{ut} = 600 N/mm^2). The factor of safety as 1.5. Design the gears based on Velocity factor and, determine their dimensions. **[6]**

Use following data :

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

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

iii) Number of teeth on pinion : 18

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OR

Q2) a) A spur gear pair with 20° full depth involute tooth profile consist of 18 teeth pinion meshing with 36 teeth gear. The pinion & gear is made of steel with ultimate tensile strength 600 N/mm^2 & 510 N/mm^2 respectively, the module is 5 mm while the face width is 10 x module. The surface hardness of pinion & gear are 330 BHN & 280 BHN respectively. **[6]**

Calculate : i) Beam strength

ii) Wear strength

Use following Data :

- Factor of safety - 2
- pinion speed - 1440 rpm
- Lewis form factor - Y = 0.484 - 2.87/Z
- Velocity factor - $V = \dfrac{5.6}{5.6 + \sqrt{V}}$

b) What are different mountings of bevel gear Explain any one with sketch.**[4]**

Q3) a) A right hand 18 teeth pinion meshes with 40 teeth helical gear mounted on parallel shaft. The pinion is to be driven by 22 KW, 1440 rpm motor. The tooth system is 20° full Depth involute, while helix angle 23° & normal module is 6mm. Determine the components of tooth forces. **[4]**

b) Write selection of bearing from manufacturer's catalogue. **[6]**

OR

Q4) a) Differentiate between Spiral bevel with Hypoid bevel gear with sketch.**[4]**

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

Q5) a) Derive an expression for the efficiency of worm gear pair. **[5]**

b) A worm transmitting 2.2 kW power at 1000 rpm drives a worm gear rotating at 20 rpm. The pitch diameter of the right hand, single start worm is 60mm. The transverse pitch of the worm gear is 15.7mm, while the normal pressure angle is 14.5°. The worm is above the worm gear and rotates in clockwise direction as viewed from the right side. **[11]**

Determine :

i) The components of tooth forces acting on the worm and worm gear along with directions and free body diagram.

ii) The efficiency of worm gear pair.

iii) The power lost in friction.

iv) The designation of worm gear pair.

The coefficient of friction between the worm and worm gear teeth is 0.0406.

OR

Q6) a) In a design of worm gear pair why worm gear governs the design. **[3]**

b) A worm gear pair 2/30/10/8 consist of worm gear made of phosphor bronze with Sut-245N/mm^2 & worm made of case hardened steel with Sut-700N/mm^2. The coefficient of friction between the worm & worm gear is 0.04 while normal pressure angle is 20°. The wear factor of worm gear teeth is 0.825 N/mm^2. The fan is used for which overall heat transfer coefficient is 22/w/m^2/°C. The permissible temperature rise for the lubricating oil above the atmospheric temperature is 45°C. The worm rotates at 720 rpm. Assume service factor 1.25. Determine the input power rating based on, **[13]**

i) Beam strenght

ii) Wear strenght.

iii) Thermal consideration

Also. Suggest the input power that the worm gear can take. Use following data,

Lewis form factor – $Y = 0.484 - \frac{2.87}{Zg}$

Velocity factor – $Cv = \frac{6}{6 + Vg}$

Area of housing – $A = 1.14. \times 10^{-4} \times a^{1.7}.m2$

Where a = center distance in mm

Q7) a) A pulley of 1000mm diameter is driven by an open type flat belt from 25 KW, 1440 rpm electric motor. The pulley on motor shaft is 250mm in diameter and the center distance between the two shaft is 2m. The allowable tensile stress for the belt material is $2N/mm^2$ and coefficient of friction between belt and pulley is 0.28. The density of belt material is 900 kg/m^3. If the width of belt is 125mm, **[12]**

Determine :

i) Thickness of belt.

ii) Length of belt.

iii) Initial tension required in the belt.

b) What are the different belt tensioning methods, Explain any one with neat sketch. **[4]**

OR

Q8) a) Draw neat sketch of 6 × 7 and 6 × 19 rope. **[6]**

b) Give the classification of chain, Explain polygonal effect of chain. **[4]**

c) Explain selection of V belt from manufacturers catalogue. **[6]**

Q9) a) The following data is given for a 360° hydrodynamic bearing. **[12]**

- Radial load = 3.2 KN.
- Journal diameter = 50mm.
- Bearing length = 50mm
- Journal speed = 1490 rpm.
- Radial clearance = 50 microns.
- Viscosity of lubricants = 25 cP.
- Density of lubricant = 860 kg/m^3.
- 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 :

i) Minimum oil - film thickness;

ii) Coefficient of friction;

iii) Power lost in friction;

iv) Total flow rate of lubricant in litres/min;

v) Side leakage;

vi) Temperature rise

l/d	ho/c	ε	S	(r/c)f	$Q/rcn_s l$	Qs/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

Dimensionless parameters for Full Journal Bearings

b) Explain design variables and performance variable of Hydrodynamic bearing. **[6]**

OR

Q10) a) Derive the Petroff's equation for hydrodynamic bearing. State it's limitations. **[7]**

b) The following data refers to short hydrodynamic full Journal bearing :**[11]**

- Radial Load = 1000N
- Journal speed = 2100 rpm

(1/d) Ratio = 0.5

- Eccentricity ratio = 0.65
- Radial clearance = 0.002 × journal radius
- Flow rate of lubricant = 3.45 litres per hour

Calculate,

i) the diameter of journal

ii) the radial clearance

iii) the dimensions of bearing

iv) the minimum oil film thickness

v) the absolute viscosity of lubricant

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