Total No. of Questions : 10]

SEAT No. :

P2551

[Total No. of Pages : 4

[5153]-517
T.E. (Mechanical)
DESIGN OF MACHINE ELEMENTS - II
(2012 Course) (Semester - II) (End Semester)

Time : 3 Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Answer five questions from the 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) Explain the effective load on helical gear tooth. How to estimate the effective load of helical gear tooth. **[4]**

b) A pair of spur gear with 20° full depth involute teeth consists of 20 teeth pinion meshing with 60 teeth internal gear. The pinion shaft is coupled to 7.5 KW electric motor running at 1440 rpm. The velocity factor is 1.5 and service factor is 1.25. Both the pinion and gears are made of alloy steel having S_{ut} 1500 N/mm^2. The module and face width are 3 mm and 30 mm respectively. The gears are finish to meet the specifications of grade – 8. The dynamic load accounted by Buckingham equation is 8500 N. Calculate the factor of safety against bending failure. **[6]**

OR

Q2) a) A pair of parallel helical gear consisting of 18 teeth pinion meshing with 63 teeth gear. The pinion rotates at 1440 rpm. The normal pressure angle is 20° while the helix angle is 23°. The face width is 30 mm and the normal module is 3 mm. The pinion and gear are made of plain carbon steel 40C8 (S_{ut} = 600 N/mm^2). The service factor and factor of safety are 1.5 and 2.0 respectively. Assume that the velocity factor accounts dynamic load. Calculate the power transmitting capacity of the gears.**[6]**

$$c_v = 5.6 / 5.6 + \sqrt{v}$$

b) Obtain the expression for ratio factor used in wear strength equation of bevel gear. **[4]**

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Q3) a) Explain formative number of teeth in helical gear. Derive an expression for formative number of teeth for helical gear. **[4]**

b) An electric motor running at 1500 rpm is directly coupled to a shaft of 25 mm diameter, which is supported by two cylindrical roller bearings. The shaft transmits power to another line shaft through flat pulley of 200 mm diameter, which is placed midway between two bearings. The tension on tight and slack side of belt is 4980 and 1660 N respectively. The belt is horizontal. The load factor is 1.4. If the expected life of the bearing is 40000 hours. Find the dynamic load carrying capacity of the bearing, so that bearing can be selected from the manufacturer's catalog. **[6]**

OR

Q4) a) Explain force analysis of bevel gear with neat sketch. **[4]**

b) A deep groove ball bearing is to be selected for the following: It is subjected to varying cyclic load as listed in the table. The expected life of Bearing at 90% reliability is 13000 hours. Assume radial load factor as 0.56 and the axial load factor as 1.2. Find the equivalent Dynamic radial load acting on bearing. **[6]**

Fraction of Cycle	Type of load	Radial(N)	Axial(N)	Speed (RPM)	Shock and service factor
1/6	Heavy shock	3500	1300	600	2.5
2/6	Moderate shock	2800	1100	700	2
remaining	Light shock	2200	900	800	1.2

Q5) a) Write short note on thermal considerations in worm gear. **[4]**

b) A pair of worm and worm wheel is designated as 2/54/10/5. The worm is transmitting 6 kW at 1800 rpm to a wheel. The permissible bending strength is 120 N/mm^2, the wear load factor is 0.83 N/mm^2, the coefficient of friction is 0.05 and normal pressure angle is 20°. **[12]**

Find

i) Factor of safety in bending

ii) Factor of safety in wearing

iii) Factor of safety in heat dissipation. Use following data

Lewis form factor - y' = 0.484 – 2.87/z', and Barth factor $= \frac{6}{6+v}$

Input KW $= \frac{a^{1.7}}{34.5(i+5)}$ Where, a = center distance, i = Gear ratio.

OR

Q6) a) Explain overhauling and self-locking conditions for worm gearing. **[4]**

b) A pair of worm gear designated as 2/52/10/4 transmit 10 kW power at 720 rpm supplied to worm shaft. The coefficient of friction is 0.04 and pressure angle is 20. Assume worm is above the worm gear and rotates clockwise direction when viewed from left. If worm is left hand, determine and show by neat sketch. **[12]**

i) Component of tooth forces acting on worm and worm gear.

ii) Efficiency of worm gear.

Q7) a) Three V-belts are to be used to transmit a power from an electric motor running at 2800 rpm to a machine at 700 rpm. The center distance between input and output shaft is 800 mm. The groove angle is 38° and the coefficient of friction between the belt and sheave is 0.5. The density of belt material is 1100 kg/m^3 and allowable tensile stress for the belt material is 1.75 N/mm^2. If the cross sectional area of each belt is 600 mm^2, determine **[12]**

i) The Pulley pitch diameter

ii) Maximum power the belt can transmit

iii) The required initial tension in each belt

b) Expalin the procedure for the selection of flat belt from manufacture's catalog. **[4]**

OR

Q8) a) Write a note on stresses in wire rope. **[4]**

b) In chain drives the sprocket has odd number of teeth and chain has even number of links. Why? **[4]**

c) A compressor running at 750 rpm is driven by an electric motor running at 1500 rpm through the 8 mm X 225 mm flat leather belt. The center distance is 1.5 m. The coefficient of friction between the belt and pulley is 0.35 and belt mass is 900 kg per cubic meter. If the allowable tensile stress for the belt material is 2 N/mm^2 determine **[8]**

i) The tensions in belt

ii) Maximum power transmitting capacity of the belt

Q9) a) What is bearing characteristics number as applied to journal bearing and its significance. **[4]**

b) Derive Petroff's equation. **[8]**

c) Write notes on **[6]**

i) Additive for mineral oil

ii) Properties of bearing material

OR

Q10)a) Explain Raimondi and boyd Method. **[6]**

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

Radial load = 9 KN

Unit bearing pressure = 900kPa

Clearance ratio = (r/c) = 800

Journal speed = 1440 rpm

Viscosity of lubricant = 30 mpas

Assume that the total heat produced in the bearing is carried by the total oil flow and 1/d is equal to 1. Calculate dimensions of the bearing, coefficient of friction, power lost in friction, total flow of oil, side leakage and temperature rise. Refer Table 1 for bearing data.

l/d	ϵ	h_0/c	S	ϕ	$(\frac{r}{c})f(\frac{Q}{rcn_s l})$		$\frac{Q}{Q_s}$	$\frac{P}{P_{max}}$
1	0.1	0.9	1.33	79.5	26.4	3.37	0.150	0.540
	0.2	0.8	0.631	74.02	12.8	3.59	0.280	0.529
	0.4	0.6	0.264	63.10	5.79	3.99	0.497	0.484
	0.6	0.4	0.121	50.58	3.22	4.33	0.680	0.415
	0.8	0.2	0.0446	36.24	1.70	4.62	0.842	0.313
	0.9	0.1	0.0188	26.45	1.05	4.74	0.919	0.247
	0.97	0.03	0.00474	15.47	0.514	4.82	0.973	0.152

Table 1 : Dimensionless numbers for hydrodynamic bearings.