Total No. of Questions : 10]

SEAT No. : ____

P1699

[Total No. of Pages : 5

[5460]-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) Derive beam strength equation for straight bevel 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 5.29 kW, 1450 rpm motor. The service factor 1.75. 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. The module 3 mm and face width 40 mm, the gears are heat treated to a surface hardness 400 BHN. Determine Beam strength, Wear strength, and maximum static load that the gear can transmit. **[6]**

Use following data :

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

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

iii) Number of teeth on pinion: 20

iv) Number of teeth on gear: 41

OR

P.T.O.

Q2) a) A helical gear pair with 20° full depth involute tooth profile consist of 18 teeth pinion meshing with 36 teeth gear. The pinion and gear is made of steel with ultimate tensile strength 600 N/mm^2, the module is 5 mm while the face width is 10 × module while helix angle 23°. The surface hardness of pinion & gear is 280 BHN. **[4]**

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 – $V = \frac{5.6}{5.6 + \sqrt{V}}$

b) Explain: Gear tooth failures and their remedies. **[6]**

Q3) a) Draw the free body diagram for components of tooth forces when pinion rotates in clockwise direction when seen from left. Assume pinion having right hand teeth and is below the gear. **[4]**

b) With neat sketch explain designation of rolling contact bearing. **[6]**

OR

Q4) a) Differentiate beween straight bevel with hypoid bevel gear. **[4]**

b) A cylindrical roller bearing is subjected to a radial load of 5000N. The expected life of bearing with 90% reliability is 15000 hrs. The application factor is 1.5. If shaft rotates at 1440 rpm calculate dynamic rating of bearing. Assume radial load factor unity. **[6]**

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

b) A pair of worm and worm wheel is designated as 1/30/10/10. Input speed of worm is 1200 rpm. The worm is made of centrifugally cast phosphor

bronze and worm is made of case harden carbon steel 14 C6. Determine input power rating based on **[12]**

i) Beam strength

ii) Wear strength

Assume following data.

Table - I

Worm	**Worm wheel**
Speed factor strength 0.25 at 1200 rpm	Speed factor strength - 0.48 at 40 rpm
Bending Stress factor - 28.2	Bending Stress factor - 7
Speed factor for Wear - 0.112	Speed factor for Wear - 0.26
Surface stress factor - 4.93	Surface stress factor - 1.55
Zone factor - 1.143	

OR

Q6) a) Explain why in design of worm gear, worm gear governs the design. Also explain single enveloping & double enveloping worm gear with sketch. **[7]**

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 also calculate component of tooth forces acting on worm and worm gear and efficiency of worm gear. **[9]**

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 centre distance between input and output shaft is 800 mm. The sheave 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) Explain the procedure for the selection of flat belt from manufacturer's catalogue. **[4]**

OR

Q8) a) Discuss 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 fan running at 750 rpm is driven by an electric motor running at 1500 rpm through the 8mm × 225mm flat leather belt. The centre distance is 1400 mm. The coefficient of friction between the belt and pulley is 0.35 and belt mass is 950 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) With neat sketch show the radial & axial pressure distribution in hydrodynamic journal bearing. **[6]**

b) State assumptions made in Petroffs equation. Derive Petroff's equation. **[8]**

c) Compare Hydrodynamic Bearing with Hydrostatic bearing. **[4]**

OR

Q10) a) Following data is given for 360° hydrodynamic bearing : **[10]**

- Radial load = 3 kN.
- Journal diameter = 50 mm
- Bearing length = 50 mm
- Journal speed = 1490 rpm
- Radial clearance = 50 microns
- Viscosity of lubricant = 23.4375cP

Calculate Minimum oil film thickness, coefficient of friction, power lost in friction and flow rate.

I/d	**ho/c**	ε	**S**	**(r/c)f**	**Q/ren$_s$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

b) Explain the significance of following variables in connection with hydrodynamic bearing : **[8]**

i) I/d ratio

ii) Unit bearing pressure

iii) Radial clearance

iv) Minimum oil film thickness

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