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

P3975 **[Total No. of Pages : 5**

[5353]-517
T.E. (Mechanical) (End Semester)
DESIGN OF MACHINE (Elements - II)
(2015 Pattern)

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

Instructions to the candidates:

1) ***Answer five questions from the following.***
2) ***Draw neat labeled diagrams wherever necessary.***
3) ***Figures to right indicate full marks.***
4) ***Use of electronic calculator is permitted.***
5) ***Use of Programmable calculator is not allowed.***
6) ***Assume suitable/standard data if necessary.***

Q1) a) What is addendum modification in gears? State the advantages and limitations of it. **[4]**

b) A pair of spur gears has a module of 3 mm and face width 27 mm. It is used to connect a prime mover of 3 kW power running at 1440 rpm with a machine requiring a torque of 59.683 N-m. The gears are made of alloy steel with ultimate tensile strength of 720 MPa with a hardness of 350 BHN. Determine the factor of safety based on bending and pitting if the total tooth error is 40 microns and the deformation factor is 11200 N/mm^2. The number of teeth on pinion is 12 and 20° stub involute profile is used for both the gears. Use following data: **[6]**

$$Y = 0.55 - \frac{2.64}{z}$$

Service factor 1.2.

$$P_d = \frac{21v\left(Ceb + P_t\right)}{21v + \sqrt{\left(Ceb + P_t\right)}}$$

P.T.O.

OR

Q2) a) Explain significance of the helix angle on the performance of helical gears. **[4]**

b) A pair of bevel gears is transmitting a power of 5 kW from an electric motor running at 2880 rpm to a machine running at 720 rpm. Use following data: **[6]**

Module 4 mm

Face width is 40 mm.

Number of teeth on pinion 20

Tooth system: 20° full depth involute.

Ultimate tensile strength: 550 MPa

Hardness: 340 BHN

Dynamic tooth load: 1537.2 N

Service factor 1.15

Lewis form factor for pinion: 0.3876

Determine the available factor of safety in bending and pitting.

Q3) a) Explain the terms: **[4]**

i) Dynamic load carrying capacity of a bearing

ii) Bevel factor.

b) A shaft 1000 mm long carrying a spur gear transmitting a power of 3 kW at 1500 rpm is supported by a deep groove ball bearing. The gear is located midway between the bearings with a weight of 2 kg and has a tangential force of 900 N while the radial load is 799 N. If the expected life of this bearing is 2000 hours, determine the dynamic load carrying capacity of the bearing.

If the spur gear is mounted at the one end of shaft and one bearing supports the shaft at the other end, determine the dynamic load carrying capacity of this bearing. **[6]**

OR

Q4) a) Determine dynamic load carrying capacity for a pair of ball bearing for a shaft such that it can be selected from the manufacturer's catalogue. Use following data. **[6]**

- Length of the shaft 1 m,
- Diameter of the shaft 35 mm
- A radial load of 1.45 kN acts on left side bearing, and 1.3 kN on right side bearing.
- An axial load of 300 N acts on right side bearing (away from left side bearing)

- Expected life of the bearing 20,000 hours with a reliability of 95 %.
- Speed of shaft 1000 rpm.
- Take X=1, Y=0.56 and b= 1.17

b) What are various bearing mounting methods? Explain using neat sketches. **[4]**

Q5) a) A pair of worm and worm wheel is designated as 3/60/10/6. The worm is transmitting 5 kW power at 1440 rpm to the worm wheel. The coefficient of friction is 0.112 and the normal pressure angle is 20°. Determine **[12]**

i) the components of tooth forces acting on the worm and worm wheel.

ii) Also represent the directions of the forces on the drawing if the worm rotates anti-clockwise.

iii) Efficiency of the drive.

b) Discuss the thermal considerations in worm gear drive. **[4]**

OR

Q6) a) Explain force analysis on a worm and worm gear tooth. **[4]**

b) A pair of worm and worm wheel is designated as 1/30/10/10. The speed of worm is 1500 rpm. The worm wheel is made of centrifugally cast phosphor bronze and worm is made of case hardened carbon steel 14C6. Determine the power transmitting capacity of this pair based on **[12]**

i) Strength rating

ii) Wear rating

Use following data

Particulars	Worm	Worm Wheel
Bending stress factor (S_b)	28.2	7
Speed factor for strength (X_b)	0.234	0.46
Surface stress factor(S_c)	4.93	1.55
Speed factor for wear(X_c)	0.115	0.25
Zone factor (Y_z)	1.143	

Q7) a) Explain the terms (Any Three): **[6]**

i) Slip and creep

ii) Centrifugal tension

iii) Maximum tension in the belt

iv) Initial tension in the belt

b) A pulley of 1000 mm diameter is driven by an open type flat belt from 20kW, 1440 rpm electric motor. The pulley on the motor shaft is 300 mm in diameter and the centre distance between the two shafts is 2.0 m. The allowable tensile stress for the belt material is 2 N/mm^2 and the coefficient of friction between the belt and pulley is 0.28. The density of the belt material is 900 kg/m^3. If the width of the belt is 125 mm, determine: **[12]**

i) The thickness of belt

ii) The length of belt and

iii) The initial tension required in the belt.

OR

Q8) a) What are the stresses induced in wire ropes? How the wire ropes are designed for the given applications? **[6]**

b) What are different standard types of chain? Describe with the appropriate sketches. **[12]**

A single v belt is used to transmit power from a grooved pulley of pitch diameter 300 mm running at 1500 rpm to a flat pulley of diameter 600 mm. The centre distance between the pulleys is 1000 mm. The mass of the belt is 0.25 kg per meter. 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 600 N. Determine.

i) Power transmitting capacity of the belt, and

ii) Initial tension required in the belt.

Q9) a) What are desirable properties for a material of sliding contact bearings? **[4]**

b) A hydrodynamic bearing has a diameter and length of 100 mm. The radial load on the bearing is 20 kN. The journal speed is 1500 rpm and the radial clearance is 60 microns. If the viscosity of the oil is 25 cP, determine. **[12]**

i) Minimum oil film thickness

ii) Probable coefficient of friction

iii) Power lost in friction

iv) Quantity of oil in circulation

v) Side leakage

vi) If the make-up oil is supplied at 30°C, find the average oil temperature.

Assume specific gravity of oil is 0.86 and the specific heat as 2.09 kJ/kg°C. Refer Table 1.

OR

Q10)a) What are different types of lubricants used for sliding contact bearings? **[6]**

b) A Babbit lined steel back bush bearing is used to support a shaft of diameter 50 mm. The radial load on the bearing is 3550 N. The oil filter restricts a clearance at the bearing as 40 microns. The length of the bearing is 50 mm. Shaft rotates at 950 rpm. The oil used as a viscosity of 60 cP at operating temperature. Calculate, **[10]**

i) Coefficient of friction

ii) Minimum oil film thickness

iii) Requirement of oil flow

iv) Power lost in friction

v) Temperature rise, assuming that heat generated is carried away by the total oil flow.

Assume specific gravity of oil as 0.86. Specific heat oil is 1.85 kJ/kg°C. Refer Table 1.

Table 1(Use for Question 9 and 10)

$\frac{l}{d}$	$\frac{h_0}{c}$	S	$\left(\frac{r}{c}\right)f$	$\left(\frac{Q}{rcn_s l}\right)$	$\frac{Q_s}{Q}$
1	0.8	0.631	12.8	3.59	0.529
	0.6	0.264	5.79	3.99	0.484
	0.4	0.121	3.22	4.33	0.415