

Total No. of Questions : 10]

SEAT No. :

**P3475**

**[5560]-117**

[Total No. of Pages : 4

**T.E. (Mechanical)**

**DESIGN OF MACHINE ELEMENTS - II**

**(2012 Course) (Semester - II)**

*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 an expression for minimum number of teeth on helical gear. [4]
- b) A pair of spur gear with  $20^\circ$  full depth involute teeth consists of 20 teeth pinion meshing with 85 teeth internal gear. Pinion is made of 40C8  $S_{ut} = 580$  N/mm<sup>2</sup> and gear is of FG200. The pinion shaft is coupled to 15 kW electric motor running at 1440 rpm. The face width is 12 times module. The grade is 7 and deformation factor is 240 N/mm. If F.O.S is 1.5 design the gear pair using dynamic factor  $(6/6+v)$  and Buckingham equation. [6]

OR

- Q2)** a) Following data is given for a steel helical gear pair transmitting 150 kW power from a shaft rotating at 1440 rpm to another shaft rotating at 360 rpm, for a  $20^\circ$  full depth system. Center distance: 435 mm, helix angle= $24^\circ$ , face width= $14m_n$ , number of teeth on pinion:20, permissible bending strength for pinion = 152 N/mm<sup>2</sup>, permissible bending strength for gear = 1125 N/mm<sup>2</sup>, service factor:1/53. Combined tooth error: 0.0406 mm, deformation factor: 11600 e N/mm. Calculate factor of safety against bending failure and surface hardness if FOS is 1.5 for pitting failure. [6]
- b) Explain Force analysis of spur gears. [4]

**P.T.O.**

**Q3) a)** Why mountings are used in bearings? What are different types of mountings. [4]

b) An electric motor running at 1440 rpm is directly coupled to a shaft of 60 mm diameter, which is supported by two cylindrical roller bearings. The radial force is 2500 N and axial force 1200 N. The radial and thrust factors are 0.56 and 2.0. The load factor is 1.2. If the expected rating life is 25000 hrs. Calculate the required basic dynamic capacity of the bearing. [6]

OR

**Q4) a)** How to account for formative number of teeth of bevel gears. [4]

b) A deep groove ball bearing operates on following cycle: [6]

Element No.	Radial Load (N)	Speed(RPM)	Element Time
1	3000	720	30
2	7000	1440	40
3	5000	900	30

The dynamic load capacity of bearing is 16600 N. Calculate the average speed of rotation, equivalent radial load and bearing life.

**Q5) a)** A worm drive transmits 15 kW at 2000 rpm to machine carriage at 75 rpm. The worm is triple threaded and has 65 mm pitch diameter. The worm gear has 90 teeth of 6 mm module. The tooth form is to be 20° full depth involute. The coefficient of friction between the mating teeth may be taken as 0.10. [8]

Calculate

- Tangential force acting on worm
- Axial thrust and separating force on worm and
- Efficiency of worm drive

b) Explain thermal consideration in worm gears? [8]

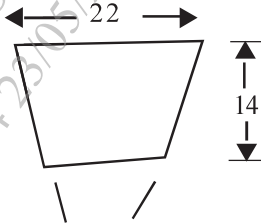
OR

**Q6) a)** What are the design criterion of worm gears? [8]

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 [8]

- Component of tooth forces acting on worm wheel
- Efficiency of worm gear.

- Q7) a)** A V-belt drive connecting 20 kW, 1440 rpm motor to a compressor having pitch diameter of pulley 300 and 900 mm respectively. The pulley rotates at 480 rpm and coefficient of friction between pulley and belt is 0.2. The center distance between pulley is 1 m and the cross section of the belt are as shown in figure. The density of belt is 0.97g/cc and allowable tension per belt is 850 N. How many belts are required for this application. The included angle of V is  $40^\circ$ . [12]



- b) Explain the procedure for the selection of v belt from manufacturer's catalogue. [4]
- OR
- Q8)a)** Discuss advantages and applications of rope drives. [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  $\times$  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<sup>2</sup> determine [8]
- The tensions in belt
  - Maximum power transmitting capacity of the belt

**Q9)** Explain following with reference to journal bearings

- Materials of journal bearings [4]
- Construction of hydrodynamic bearings [6]
- Design procedure of hydrodynamic bearings [8]

OR

- Q10)a)** Compare long and short journal bearings. [6]
- b) The following data is given for a  $360^\circ$  hydrodynamic bearing :  
 Journal diameter : 100 mm, bearing length : 50 mm, journal speed : 1500 rpm, minimum oil thickness : 15 microns, viscosity : 30 cP, specific gravity: 0.86, specific heat of lubricant: 2.09 kJ/kgC.  
 Assuming that the total heat produced in the bearing is carried by the total oil flow. Calculate dimensions of bearing, coefficient of friction, power lost in friction, total flow of oil, side leakage and temperature rise. [12]

$\frac{l}{d}$	$\frac{h_a}{e}$	$\epsilon$	$\delta$	$\left(\frac{r}{e}\right)_f$	$\frac{Q}{r \text{ cm, l}}$	$\frac{Q_s}{Q}$	$\frac{P_{max}}{p}$
$\infty$	0.0	1.0	0	0	0	0	$\infty$
	0.1	0.9	0.0115	0.756	0.411	0	2.793
	0.2	0.8	0.021	0.961	0.760	0	2.020
	0.4	0.6	0.0389	1.20	1.56	0	1.499
	0.6	0.4	0.0626	1.52	2.26	0	1.309
	0.8	0.2	0.123	2.57	2.83	0	1.228
	0.9	0.1	0.240	4.80	3.03	0	1.210
	1.0	0.0	$\infty$	$\infty$	3.142	0	-
1	0.0	1.0	0	0	-	1.0	-
	0.03	0.97	0.00474	0.514	4.82	0.973	6.579
	0.1	0.9	0.0188	1.05	4.74	0.919	4.048
	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
	0.9	0.1	1.33	26.4	3.37	0.150	1.852
	1.0	0.0	$\infty$	$\infty$	3.142	0	-
1/2	0.0	1.0	0	0	-	1.0	$\infty$
	0.03	0.97	0.0061	0.610	5.88	0.980	7.936
	0.1	0.9	0.0313	1.60	5.69	0.939	4.854
	0.2	0.8	0.0923	3.26	5.41	0.874	3.745
	0.4	0.6	0.319	8.10	4.85	0.730	2.739
	0.6	0.4	0.779	17.0	4.29	0.552	2.267
	0.8	0.2	2.03	40.9	3.72	0.318	1.976
	0.9	0.1	4.31	85.6	3.43	0.173	1.912
	1.0	0.0	$\infty$	$\infty$	3.142	0	-
1/4	0.0	1.0	0	0	-	1.0	$\infty$
	0.03	0.97	0.0101	0.922	6.12	0.984	9.259
	0.1	0.9	0.0736	3.50	5.91	0.945	5.555
	0.2	0.8	0.261	8.8	5.60	0.884	4.166
	0.4	0.6	1.07	26.7	4.99	0.746	2.994
	0.6	0.4	2.83	61.1	4.37	0.567	2.409
	0.8	0.2	7.57	153.0	3.76	0.330	2.045
	0.9	0.1	16.2	322.0	3.45	0.180	1.941
	1.0	0.0	$\infty$	$\infty$	3.142	0	-

x x x