

Total No. of Questions : 10]

P1301

SEAT No. :

[Total No. of Pages : 4

[4858] - 1016

T.E. (Mechanical)

DESIGN OF MACHINE ELEMENTS - II

(2012 Pattern) (End Semester)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8, and Q.9 or Q.10
- 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 is the beam strength of spur gear? Derive the expression for it [6]

b) What is virtual number of teeth for a helical gear? [4]

OR

Q2) a) A spur gear pair with 20° full depth involute tooth profile, consist of 19 teeth pinion meshing with 40 teeth gear. The pinion is mounted on a crank shaft of 7.5 kW single cylinder diesel engine running at 1500 rpm, the driven shaft is connected to a machine. Take service factor as 1.5. The pinion & gear are made of steel with ultimate tensile strength 600 N/mm^2 , the module is 4 mm while the face width is $10 \times$ module. The gears are ordinarily cut. Take Lewis form factor as 0.314 for 19 teeth. Calculate the factor of safety based on beam strength. [6]

b) Explain the following terms related to helical gears. [4]

- i) Tooth advance
- ii) Leading edge
- iii) Trailing edge
- iv) Minimum face width

P.T.O.

- Q3) a)** For a bevel gear explain the force analysis by considering the total load is shared by one pair of teeth. [4]
- b)** Suggest suitable bearing for the following applications with Justification[6]
- Lathe spindle
 - Table fan shaft
 - Wind turbine shaft
 - Railway wheels and axle
 - Hand drill spindle
 - Household mixer grinder

OR

- Q4) a)** What is addendum modification in gears? How it is done? [4]
- b)** A ball bearing, subjected to a radial load of 5000 N is expected to have a life of 8000 hours with a reliability of 99% at 1450 rpm. Calculate the dynamic load carrying capacity of the bearing, so that the bearing can be selected from the manufacturer's catalogue. Use the following relation.[6]

$$\frac{L}{L_{10}} = \left(\frac{\ln\left(\frac{1}{R}\right)}{\ln\left(\frac{1}{R_{90}}\right)} \right)^{\frac{1}{1.17}}$$

- Q5) a)** A Vee belt is used to connect an electric motor with an agitator. Determine the number of belts required and the pitch length of the belt using following data. [12]

Power capacity	20 kW
Motor speed	1440 rpm
The pitch diameter of the motor pulley	300 mm
The pitch diameter of the agitator pulley	900 mm
Coefficient of friction for the belt and pulleys as	0.2
Centre distance of	1 m
Mass density of the belt material	0.97 g/cc
Maximum tension in the belt	850 N
Maximum width at top	22 mm
Minimum width at bottom	12 mm
Depth	14 mm
Groove angle	40°

- b)** Explain the various methods used for the belt tensioning. [6]

OR

- Q6) a) Derive an expression for the length of the open flat belt drive. [6]
b) Explain the procedure for the selection of flat belt from manufacturer's catalogue. [6]
c) What is polygonal action in roller chain drive? How to control it? [6]

- Q7) a) Design a worm gear pair based on wear strength and suggest the minimum surface area to be provided for the gear box if it has to work with natural circulation. Use following data [12]

- Number of starts on worm single
- Motor power 3 kW
- Motor speed 1500rpm
- Required reduction 30:1
- Wear factor 0.6 N/mm²
- Gear tooth system 20° full depth involute
- Service factor 1.2
- Factor of safety 1.4
- Permissible temperature rise 50° C
- Coefficient of friction 0.03
- Overall heat transfer coefficient 18 W/m² °C
- Standard modules: 1, 1.25, 1.5, 2, 2.5, 3, 4, 6, 8, 10, 12, 16 mm

- b) Why the worm gear is always weaker than the worm? [4]

OR

- Q8) a) Compare crossed helical gear drive with worm and worm gear drive.[4]
b) A worm gear box with an effective surface area of 1.5 m² is working in still air with a heat transfer coefficient of 15 W/m² °C. The permissible temperature rise of the lubricant is 50° C. The worm gear drive is designated as 1/30/10/8. The motor speed is 1440 rpm and the normal pressure angle is 20°. Calculate the power rating of the motor using a coefficient of friction 0.024. Consider a wear factor of 0.6 N/mm² the material strength as 180 N/mm² and a Lewis form factor as 0.46. Take required factor of safety as 1.5 & service factor 1.2. [12]

Q9) a) The following data refers to a 360° hydrodynamic journal bearing. **[12]**

Radial load	10kN
Journal speed	1440 rpm
l/d	1
Unit bearing pressure	1000 kPa
Clearance ratio	800
Viscosity of the lubricant	30 MPa - S

Assuming that the total heat generated in the bearing is carried away by the total oil flow in the bearing, Determine

- i) Dimensions of the bearing
- ii) Coefficient of friction
- iii) Power lost in friction
- iv) Total oil flow
- v) Side leakage
- vi) Temperature rise

Refer the following table.

l/d	h_0/c	ϵ	S	$(r/c)f$	$Q/(rcn_l)$	Q_s/Q	P/P_{max}
0	1.0	0	0	0	0	1	0
0.03	0.97	0.00474	0.514	4.82	0.973	0.152	
0.1	0.9	0.0188	1.05	4.74	0.919	0.247	
1	0.2	0.8	0.0446	1.7	4.62	0.842	0.313
	0.4	0.6	0.121	3.22	4.33	0.68	0.415
	0.6	0.4	0.264	5.79	3.99	0.497	0.484
	0.8	0.2	0.631	12.8	3.59	0.28	0.529

b) Derive an expression for friction loss in hydrodynamic journal bearing. **[4]**

OR

Q10)a) Explain the desirable properties of the material used for the sliding contact bearings. Also suggest the suitable materials mapped with the desirable properties **[8]**

b) Write the Reynolds's equation for 2D flow and explain the significance of each term in it. **[4]**

c) Compare the sliding and rolling contact bearings. **[4]**

