Total No. of Questions : 6] **SEAT No. :**

P1436 **[Total No. of Pages : 4**

TE/Insem/APR-107

T.E. (Mechanical)

DESIGN OF MACHINE ELEMENTS - II

(2015 Pattern) (Semester - II)

Time : 1½ Hour] ***[Max. Marks : 30***

Instructions to the candidates :

1) ***Answer Three 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) State and explain different types of gear tooth failures ,their causes and remedies. **[4]**

b) A pair of spur gears with 25 teeth meshing with 60 teeth gear. The module is 5 mm while its face width is 50 mm. The pinions rotate at 600 RPM. The gears are made of steel and heat treatment to a surface hardness of 250 BHN. Assume the dynamic load is accounted by means of velocity factor the service factor and factor of safety are 1.75 and 2.1 respectively. Calculate **[6]**

i) Wear Strength

ii) Maximum static load that gears can transmit without pitting and

iii) Rated power that can be transmitted

$$\text{Assume, } c_v = \frac{3}{3+v}$$

OR

P.T.O.

Q2) A spur gear pair transmitting 5kW power from an electric motor running at 1440 rpm to a machine running at 480 rpm. **[10]**

- Consider the following data:
- No. of teeth on pinion = 18
- Center distance = 216mm
- Face width =10 × module mm.
- Allowable bending stress for pinion and gear = 160 N/mm^2
- Surface hardness for gear pair = 300 B.H.N.
- Tooth system = 20° full depth involute.
- Deformation factor = 11500 e, N/mm
- Combine teeth error = 28 micron

Lewis form factor $Y = 0484 - \frac{2.87}{z}$

Assuming dynamic load is accounted by the Buckingham's equations,

$$P_d = \frac{21V(bC + Pt \text{ max})}{21V + \sqrt{bC + Pt \max}}$$

Calculate:

i) The factor of safety against bending failure and

ii) The factor of safety against pitting failure.

Q3) a) What is formative number of teeth in helical gear .Derive the expression for formative number of teeth in helical gear. **[4]**

b) A helical gear of 20° full depth involute system consist of 18 teeth pinion meshing with 36 teeth gear. Both pinion and gear are made of same material having Sut = 600 N/mm^2. The normal module is 5 mm, face width is ten times normal module. Whereas surface hardness is 280 BHN, Helix angle is 23° and pinion speed is 1440 rpm. Assume factor of safety is 2, Assume velocity factor accounts for dynamic load. Calculate **[6]**

i) Beam strength

ii) Wear strength

iii) Rated power that the gear can transmit

Use, Lewis form factor $Y = 0484 - \frac{2.87}{Z'}$

OR

Q4) A pair of bevel gear with 20° full depth involute tooth profile consist of 24 teeth pinion meshing with 48 teeth gear. The axes of pinion & gear are right angle to each other. The module at large end of the tooth is 6 mm while the face width is 50 mm. The gear pair is made of gray cast iron FG220 . The teeths are generated, the surface hardness of gear pair is 250 BHN. The application factor & factor of safety are 1.5 & 2.0 respectively. The pinion rotates at 300 rpm. Assuming velocity factor accounts for dynamic load, Determine **[10]**

i) Beam strength

ii) Wear strength

iii) Maximum static load on gear and

iv) Rated power that the gear can transmit

Use, Lewis form factor $Y = 0484 - \frac{2.87}{Z'}$

Q5) a) Derive Stribeck's equation for the basic static capacity of bearing. **[4]**

b) A deep groove ball bearing of 50 mm diameter and rotating at 1440 rpm is subjected radial load of 2500 N and axial load of 1200 N. The radial and axial load factors are 0.56 and 2 respectively. The load factor is 1.2. If expected life of bearing is 25000 hrs for 95% reliability. Calculate dynamic load carrying capacity of bearing so that it can be selected from manufactures catalog. Assume inner race of bearing is rotating. **[6]**

Use following relation

$$L_{95} = 4.48\ L_{10}\ [\text{Log}_e\ (1/R)]^{1/1.5}$$

Bearing No.	6010	6210	6310	6410
C,KN	22.90	37.10	65.13	87.10

OR

Q6) A single row deep groove ball bearing operates with the following work cycle. **[10]**

Element No.	Element Time,%	Radial Load 'Fr' kN	Thrust Load 'Fa' kN	Radial Factor 'X'	Thrust Factor 'Y'	Race Rotating	Service Factor	Speed rpm
1	30	5.0	1.5	0.56	1.1	Inner	1.25	960
2	40	3.7	0.73	0.56	1.3	Outer	1.4	1440
3	Remaining	No load	No load	-	-	Outer	-	720

If the expected life of the bearing is 13000 hours with a reliability of 90%, calculate the basic dynamic load rating of the bearing so that it can be selected from the manufacturers catalogue. If there are four such bearings in a system, what is the probability that all bearing will survive for 13000 hours?