

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 = $10 \times$ 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 = $11500 e, \text{ N/mm}$
- Combine teeth error = 28 micron

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

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

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

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 $S_{ut} = 600 \text{ N/mm}^2$. 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

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

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 teeth 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?

