Total No. of Questions : 6]

SEAT No. :

P508

[Total No. of Pages : 4

APR - 18/TE/Insem. - 107

T.E. (Mechanical)

DESIGN OF MACHINE ELEMENTS - II

(2015 Course) (Semester - II)

Time : 1½ Hour] *[Max. Marks : 30*

Instructions to the candidates:

1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right indicate full marks.*
4) *Assume suitable data if necessary and clearly mention the assumed data.*

UNIT - I

Q1) a) Choose any four appropriate and correct parameters to be considered in design of Spur gear **[4]**

i) Static bending strength

ii) Fatigue endurance limit

iii) Friction and heat

iv) Pitting

v) Manufacturing considerations

vi) Dynamic load

vii) Space Constraint

viii) Noise and vibrations

ix) Lubrication requirements

x) Environment friendliness.

b) A spur pinion with 20 teeth meshes with a 50 teeth gear with a module 3 mm and 24 mm face width. The pinion is made of Steel (UTS 550 MPa and Hardness 300 BHN) and the gear is made of steel (UTS 360 MPa and hardness 240 BHN). With a required factor of safety 2 and service factor 1.5, determine the power transmission capacity of the drive. Barth factor as 6/(6 + v). Lewis form factor can be found using relation Y = 0.484 – 2.87/Z. Pinion rotates at 1000 rpm. **[6]**

OR

P.T.O.

Q2) A pair of 20º involute spur gears transmits 10 kW power. The input shaft rotates at 1500 rpm and the output shaft located at a centre distance 205 mm rotates at 250 rpm. The gears are made of steel with ultimate tensile strength 450 MPa and hardened to 300 BHN. Determine module from the space constraint and determine the available factor of safety against bending and pitting. Consider criteria to avoid interference. Take service factor as 1.25 and Barth factor as 6/(6 + v). Lewis form factor can be found using relation Y = 0.484 – 2.87/Z. **[10]**

UNIT - II

Q3) a) What is effect of the errors in profiles on the performance of the gears? How it is accounted in design of helical gears? **[4]**

b) A pair of parallel helical gears consists of a 20 teeth pinion meshing with 100 teeth gear. The pinion rotates at 1000 rpm. The normal pressure angle is 20º and the helix angle is 22º. The normal module and face width of the gears are 4 mm and 40 mm respectively. The pinion and gear are made of 40C8 (S_{ut} = 600 MPa and Hardness = 300 BHN). The service factor and the factor of safety are 1.5 and 2 respectively. Assuming that velocity factor accounts for the dynamic load, calculate the power transmitting capacity of gears. Use Lewis form factor as 0.3475 and velocity factor $C_v = \dfrac{5.6}{5.6+\sqrt{v}}$. **[6]**

OR

Q4) A pair of straight bevel gears mounted on shafts which are intersecting at right angles consists of a 24 teeth pinion meshing with 32 teeth gear. The pinion shaft is connected to an electric motor developing 12.5 kW rated power at 1440 rpm. Take service factor of 1.5 and 20º pressure angle. Both the gears are made of case hardened steel with ultimate tensile strength 750 MPa. The total tooth error can be taken as 12.5 microns and factor of safety 2. **[10]**

i) Initially determine the module using velocity factor by relation $C_v = \dfrac{5.6}{5.6+\sqrt{v}}$ assuming pitch line velocity as 7.5 m/s. Take Lewis form factor as 0.358.

ii) Select the first preference module and determine exact dynamic load using Buckingham's equation to determine the available factor of safety in bending. Take deformation factor as 11400 N/mm^2.

iii) Specify the surface hardness for the gears using the initial factor of safety.

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

UNIT - III

Q5) a) Suggest the suitable rolling contact bearing for the following applications with justification **[4]**

i) Table fan rotor.

ii) Lathe spindle.

iii) Motor shaft.

iv) Handle for two wheeler.

b) A single row deep groove ball bearing is subjected to a radial force of 8 kN and a thrust force of 3 kN. The shaft rotates at 1500 rpm. The expected life of the bearing is 20,000 hours. The minimum acceptable diameter of the shaft is 75 mm. Determine the dynamic load carrying capacity of the bearing such that the bearing can be selected from the manufacturer's catalogue. Take static load carrying capacity as 9800 N.

Table 1

F_a/C_0	$F_a/F_r < e$		$F_a/F_r > e$		e
	X	Y	X	Y	
0.04	1	0	0.56	1.8	0.24
0.07	1	0	0.56	1.6	0.27
0.13	1	0	0.56	1.4	0.31
0.25	1	0	0.56	1.2	0.37
0.5	1	0	0.56	1	0.44

[6]

OR

Q6) A transmission shaft rotating at 720 rpm and transmitting power from the pulley to a spur gear as shown in Fig. 1. The belt tensions on the pulley and the gear tooth forces on the gear are represented in the Fig. 1. The centre distance between B1 and spur gear is 100 mm, Spur gear and B2 is 150 mm and B2 to Pulley is 150 mm respectively. The weight of the pulley and gear are 100 N and 40 N respectively. The diameter of the shaft at the bearings is 20 mm.Take load factor as 2.5 and expected life of 90% the bearings is 8500 hours. Select the rolling contact bearing from manufacturer's catalogue. Use Table 1 and 2. **[10]**

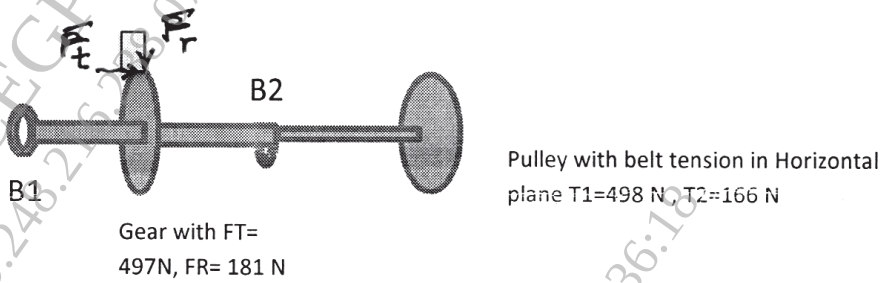

Figure 1

Table 2

Shaft diameter	C	C_0	Designation
	2700	1500	61804
	7020	3400	16404
	9360	4500	6004
20	12700	6200	6204
	15900	7800	6304
	30700	16600	6404

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