Total No. of Questions : 10]

SEAT No. :

P2405

[Total No. of Pages : 7

[5253]-117

T.E. (Mechanical) (Semester - II)

DESIGN OF MACHINE ELEMENTS - II

(2012 Pattern)

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, Q.9 or Q.10.***
2) ***Neat diagrams must be drawn whenever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of electronic pocket calculator is allowed.***
5) ***Assume suitable data if necessary.***

Q1) a) Discuss why "tangential" component of gear tooth forces is called "useful" component & "radial" component is called " separating" component. **[4]**

b) The following data given for spur gear pair with 20° full depth involute system teeth. **[6]**

No. of teeth on pinion = 24

No. of teeth on gear = 56

Speed of pinion = 1200 rpm

Module = 3 mm

Service factor = 1.5, face width = 30 mm.

Both gears are made of steel with ultimate tensile strength of 600 N/mm^2. using velocity factor for Dynamic load calculate.

i) Beam strength

ii) Velocity factor

P.T.O

iii) Rated power without bending failure.

Factor of safety is 1.25

Lewis factor $Y = \pi\left[0.154 - \frac{0.912}{Z}\right]$

Where, Z = no. of teeth.

OR

Q2) a) What is the virtual No. of teeth on helical gear. **[4]**

b) A pair of parallel helical gear consist of 20 teeth pinion meshing with 100 teeth gear. The pinion rotates 720rpm. Normal pressure angle is 20º while helix angle is 25º. Face width is 40mm & normal module 4mm. The pinion made of plain carbon steel 55C8 (S_{ut} - 580 N/mm^2) mesh with gear made of plain carbon steel 40C8 (S_{ut} - 580 N/mm^2) & heat treated surface hardness is 300 BHN & 350 BHN resp. The service factor & factor of safety is 1.5 & 2.0 resp. Assume velocity factor for dynamic load & calculate power transmitting capacity of gear use following data: **[6]**

Lewis factor $Y' = 0.484 - \frac{2.87}{Z'}$

Loud stress factor K = 0.16 (BHN/100)^2

Velocity factor $C_v = \frac{5.6}{5.6 + \sqrt{v}}$

Q3) a) A pair of straight bevel gear consists of 28 teeth pinion meshing with 42 teeth gear. If the shaft angle is 90º determine following: **[4]**

i) PCD of pinion & gear.

ii) Pitch cone distance.

iii) Pitch cone Angle of pinion & gear.

iv) Mean radii of pinion & gear.

Assume module m = 5mm & b = 40 mm.

b) A pair of straight bevel gear with 20° pressure Angle consists of 20 teeth pinion meshing with 30 teeth gear. The module is 4mm while the face width is 20mm. The pinion & gear material has syrface hardness of 400 BHN. The pinion rotates 720 rpm & receives 3kW power from a motor. Taking service factor of 1.5 & factor for dynamic loading determine factor of safety in pitting. **[6]**

OR

Q4) a) What is L_{10} & L_{50} life of Rolling contact bearing. **[4]**

b) A ball bearing is operating on a work cycle consisting of three parts - a radial load of 3000 N at 1440 rpm for one quarter cycle, a radial load of 2500 N at 1440 rpm for the remaining cycle. The expected life of bearing is 10,000 h. Calculate the dynamic load carrying capacity of the bearing. **[6]**

Q5) a) Explain the Efficiency of worm & worm gear drive. **[6]**

b) A worm transmit 3kW power at 1440 rpm & drives a gear having 60 teeth. The pitch circle diameter of worm is 90 mm & triple threaded. The module of worm gear is 4mm the worm is right handed & rotates in clockwise direction when seen from left.Assume worm is above the worm wheel. Calculate, **[6]**

i) Component of tooth forces.

ii) Efficiency of drive.

c) Derive an expression for components of force acting on worm & worm gear. **[6]**

OR

Q6) a) Explain the following. **[6]**

i) Lead

ii) Diametral quotient

iii) No. of starts of worm.

iv) Lead Angle.

b) A pair of worm & worm wheel is designated as 2/72/10/6. the worm is transmitted 8 kW at 1800 rpm to worm wheel. The permissible bending stress is 110 N/mm^2. The wear load fator is 0.83N/mm^2. The coefficient of friction is 0.05 & Normal pressure angle is 20º, find: **[12]**

i) Factor of safety in bending

ii) Factor of safety in wearing.

iii) Factor of safety in heat dissipation.

Use following data:

Lewis factor $Y = 0.484 - \frac{2.85}{Z_G}$

Z_G – No. of teeth on gear.

$C_v = \frac{6}{6 + v}$

Input, kW = $\frac{a^{1.7}}{34.5(i+5)}$

Where, i = gear ratio

a = centre distance

Q7) a) Discuss stresses developed in wire ropes. **[4]**

b) Explain the procedure of selection of flat belt from munufacturing catalogue. **[4]**

c) It is required to select a flat belt drive to connect two transmission shaft rotating at 800 r.p.m. & 400 r.p.m. resp. The centre to centre distance between the shaft approximately 3.5 m & belt drive is open-type. The power transmitting by belt is 30 kW & load correction factor is 1.3. The belt should be operate at velocity between 17.8 to 22.9 m/s. The power transmitting capacity of belt per mm width per ply at 180º arc of contact & belt velocity of 5.08 m/s is 0.0147 kW. Select preferred pulley diameter & specify the belt. Use following data: **[8]**

• Standard pulley diameters: 90,100, 112, 125, 140 160, 180, 200, 224, 250, 280, 315, 355, 400, 450, 500, 560, 630, 710, 800, 900 mm

Arc of contact (θ)	120º	130º	140º	150º	160º	170º	180º
F_d	1.33	1.26	1.19	1.13	1.08	1.04	1.00

• No. of plies & standard belt width:

No. of ply	Std. belt width 'b'mm
4	40,44, 50, 63, 76, 90, 100, 125, 152
5	76,100,125,152

OR

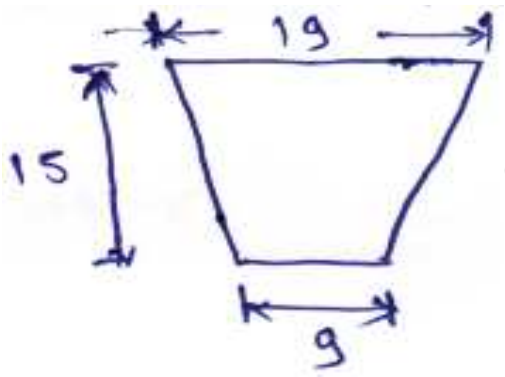
Q8) a) Give the classification of chain drive, explain polygonal effect of chain. **[4]**

b) A V-belt drive is used to transmit 38 kW power from three phase induction motor to a centrifugal pump. Speed of motor is 1440 r.p.m. & centrifugal pump is required to operate at 360 rpm. For motor pulley pitch diameter is 225 mm & groove angle 32º. Centre distance between two pulley 1.5m. Coefficient of friction for the belt pulley combination is 0.2 & density of belt material is 970 kg/m^3. Allowable tension in belt is 800 N. Determine. **[8]**

i) No. of belt required

ii) Pitch length of belt.

Assume cross - section for belt As shown in fig.



(All dimensions in mm)

c) What are the different belt tensioning methods, explain any one with neat sketch. **[4]**

Q9) a) The following data is given for a 360° hydrodynamic bearing: **[12]**

Radial load = 3.2 KN, Journal speed = 1490 rpm. Journal diameter = 50 mm, Bearing length = 50 mm. Radial clearance = 0.05 mm, viscosity of lubricant = 25 cp Assuming that the total heat generated in the bearing is carried by the total oil flow in the bearing,

Calculate:

i) Coefficient of friction

ii) Power lost in friction

iii) Minimum oil film thickness

iv) Flow required in lit /min

v) Temperature rise.

Refer table:

S	(l/d)	E	ho/c	ϕ	$\left(\frac{r}{c}\right)\cdot f$	$\left(\frac{Q}{r.c.n_s.l}\right)$	$\frac{Q_s}{Q}$	$\frac{P}{P_{max}}$
0.1212	1	0.6	0.4	50.38	3.22	4.33	0.680	2.409

b) State assumptions made in deriving the 'Reynolds equation'. **[4]**

OR

Q10)a) Derive Petroff's equation for hydrodynamic bearing. **[8]**

b) Explain significance of the following variable in connection with hydrodynamic bearing. **[8]**

i) l/d ratio.

ii) Unit bearing pressure.

iii) Radial clearance.

iv) Minimum oil film thickness