Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII • EXAMINATION – WINTER • 2014

Subject Code: 182004 Date: 27-11-2014

Subject Name: Design of Mechanisms - II

Time: 02:30 pm - 05:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q : 1 A pair of a carefully cut spur gear with 20° full depth involute teeth consists of 19 pinion meshing with 40 teeth gear. The pinion shaft is directly coupled to a single cylinder diesel engine developed power 8 kW at 1500 rpm. The gear shaft is transmitting a power to a two stage reciprocating air compressor. The service factor and factor of safety are 1.5 and 3 respectively. The pinion as well as gear are made of plain carbon steel 45C8 (S_{ut}= 600 N/mm2). The module and face width are 3 mm and 50 mm respectively. The gears are heat treated to a surface hardness of 450 BHN. Calculate the factor of safety of the above gear drive. **14**

$$Yp=0.154-\frac{0.912}{Z_p}\text{(full depth)}$$

$$Yp=0.175-\frac{0.841}{Z_p}\text{(stub gear)}$$

$$F_s = f_b \times b \times Y_p \times \pi \times m$$

$$C = 11860 \times e$$

$$e = 0.025$$

$$F_d = F_t + \frac{21v(cb + F_t)}{21v + (cb + F_t)^{1/2}}$$

$$Q = \frac{2Z_g}{Z_g + Z_p}$$

$$k = \frac{f_{es}{}^2 \sin\phi}{1.4}\left[\frac{1}{E_p} + \frac{1}{E_g}\right]$$

$$F_w = D_p \times Q \times k \times b$$

Q : 2 **A** Write the steps to design flexible coupling mention all necessary equations. **07**

B Design a crane hook with the useful load lifting capacity of crane as 50 kN. The weight of the hook with grabbing tongs is 10 kN. Assume triangular cross section of hook. **07**

$$R_n = \frac{(1/2)b_i h}{\frac{b_i r_o}{r_o - r_i}\log e\frac{r_o}{r_i} - b_i}$$

OR

B Discuss the Gerber criterion and Goodman criterion for design of mechanical component under fluctuate loading. **07**

Q : 3 **A** A ball bearing carries a load of 400 N at 1700 rpm for 40% of time, 600 N at 880 **07**

rpm for 30% of time, 200 N at 1000 rpm for 10% of time and no load at 1500 rpm for remaining period of cycle. If the expected life of bearing is 10000 hours with 95% reliability. Calculate:

1. The basic dynamic load rating of the bearing and
2. The average speed of operation

Element no	Time %	Radial load (N)	Radial Factor X	Service Factor K_s	Speed (rpm)	Revolutions N in Element time
1	40	400	1.00	1.00	1700	704
2	30	600	1.00	1.00	880	264
3	10	200	1.00	1.00	1000	100
4	20	0	-	-	1500	300
Total	100					n=1368

B Select a suitable size of 6×7 monitor steel wire rope to lift a cage of vertical mine hoist 500 m deep. The cage has a mass of 400 kg and it has to lift 1200 kg mass of iron ore at a speed of 120m/min. The full speed is to be attained in 2 m. Assume the factor of safety as 7. Take sheave diameter = 60d, E =8 ×10^4MPa. Mass of rope = 0.35d^2 kg/100 meter, diameter of wire = 0.1d mm, Area of wires in rope = 0.38d^2, ultimate strength = 560d^2 N, where d is diameter of rope in mm. **07**

OR

Q:3 **A** The following data is given for 360° hydrodynamic bearing, **07**

Journal diameter = 100 mm
Bearing length = 100 mm
Radial load = 50 kN
Journal speed = 1440 rpm
Radial clearance = 0.12 mm
Viscosity of lubricant = 16 cP
Calculate:

1. Minimum film thickness
2. Co-efficient of friction
3. Power loss in friction

$\left(\frac{l}{d}\right)$	ε	$\left(\frac{h_o}{c}\right)$	S	ϕ	$\left(\frac{r}{c}\right)f$	$\left(\frac{Q}{rcn_s l}\right)$	$\left(\frac{Q_s}{Q}\right)$	$\left(\frac{p}{p_{max.}}\right)$
1	0	1.0	∞	(85)	∞	π	0	–
	0.1	0.9	1.33	79.5	26.4	3.37	0.150	0.540
	0.2	0.8	0.631	74.02	12.8	3.59	0.280	0.529
	0.4	0.6	0.264	63.10	5.79	3.99	0.497	0.484
	0.6	0.4	0.121	50.58	3.22	4.33	0.680	0.415
	0.8	0.2	0.0446	36.24	1.70	4.62	0.842	0.313
	0.9	0.1	0.0188	26.45	1.05	4.74	0.919	0.247
	0.97	0.03	0.00474	15.47	0.514	4.82	0.973	0.152
	1.0	0	0	0	0	0	1.0	0

B A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having minimum value of 20 kN and maximum value of 50 kN. Determine the diameter of the bar by taking factor of safety of 1.5, size effect of 0.85, surface finish factor of 0.9. the material properties of bar are given by : ultimate strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa. **07**

Q : 4 Write the complete procedure for rolling element bearing selection which used to support the shaft, carrying a rotor at its mid-length. Mention all the necessary equations. **14**

OR

Q : 4 A A pulley of 0.9 diameter revolving at 200 rpm is to transmit 7.5 kW find the width of a leather belt if the maximum tension is not to exceed 145 N in 10 mm width. The tension in the tight side is twice that in the slack side. Determine the diameter of the shaft and the dimension of the various parts of the pulley assuming it to have six arms. Maximum shear stress of shaft material is not to exceed 63 MPa. **09**

B Explain the importance of lubrication in machine components. What do you understand by boundary lubrication, hydrodynamic lubrication and hydrostatic lubrication? **05**

Q : 5 A Derive the expression for the effort 'P' to be applied to lift load 'Q' in hoisting and tackle mechanism having more than one pulley. **07**

B Answer the following questions.

I. Explain the Belt slip and Creep. **02**

II. Derive the necessary expressions for Energy absorbed and heat dissipation in brakes. **03**

III. What do you understand by self-locking brake? **02**

OR

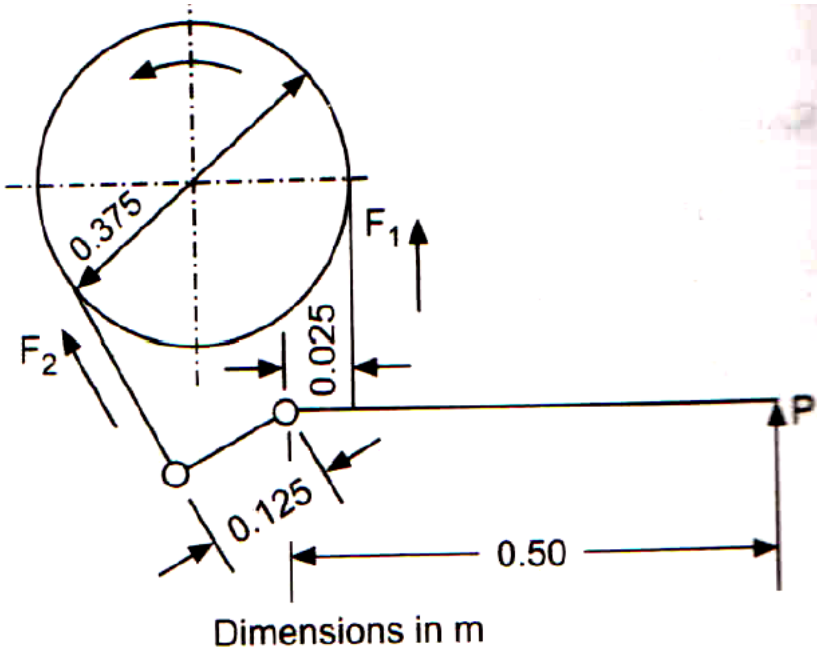
Q : 5 A Explain the importance of ergonomics and aesthetic consideration in machine design. **04**

B A differential band brake is shown in the following figure. The angle of contact is 280°. The brake is to sustain a torque of 400 Nm. The band has a compressed woven lining and presses against Cast Iron drum of 0.375 m diameter. Assuming coefficient of friction as 0.3.: **10**

a. Determine the necessary operating force, P.

b. Find the width of the steel band, assuming safe stress in tension as 55 N/mm^2 and thickness of band 2 mm.

c. Find the section of the lever and pins, assuming safe tensile stress as 60 N/mm^2 and bearing pressure as 10 N/mm^2.



****