Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER–VIII • Remedial EXAMINATION – WINTER 2013

Subject Code: 182004 Date: 13/09/2013

Subject Name: Design of Mechanisms - II

Time: 03:00 pm – 05:30 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)** A centrifugal pump is driven from an electric motor of 5.5 kW at 1440 rpm using a flexible coupling. Design and sketch the coupling. Choose your own values for the stresses. **12**

(b) What are the desired properties of the break lining materials? **02**

Q:2 **(a)** Design a crane hook for lifting capacity of 50 kN. It is made from steel and has approximate triangular section. Take permissible tensile stress 80 N/mm^2 for forged steel. Assume bed diameter = 85 mm. **07**

$$Rn = \frac{A}{\frac{bRo}{d}\ln\frac{Ro}{Ri} - b}$$

(b) A mine hoist employs 6 x 37 wire rope and has 6 falls of the rope. The maximum lifting capacity is 25 kN. The maximum velocity of 2 m/sec is attained by the hoist trolley within 1.5 seconds. The dead load weight accounts for 10%, of the service load. Design the rope for above application using following data : **07**

Breaking load = 470 d^2 N; Wire diameter d_w = 0.045 d ; Effective area of rope A = 0.4 d^2 and Minimum sheave diameter D = 25 d. Where, d = Diameter of the rope and assume factor of safety = 5.

OR

(b) A cold drawn C-1025 steel rod of circular section is subjected to a variable bending moment of 600 Nm to 1200 Nm as the axial load varies from 20 kN to 40 kN. The maximum bending moment occurs at the same instant the axial load is maximum. Determine the required diameter of the rod for a factor of safety 2.25. Neglect any stress concentration and column effect. **07**

Ultimate strength of C-1025 cold drawn steel is 560 MPa and yield strength is 280 MPa. Take, size factor of 0.85 and machine surface finish factor of 0.78.

Q:3 A pump, running at 250 rpm, is driven by a 20 kW, 1000 rpm motor through a pair of 20^0 full depth involute spur gears. The gears are made of carbon **14**

steel ($f_{b\ static}$ = 210 MPa). The starting torque of the motor can be assumed to be 150 % of the rated torque. Determine the module and the face width of the gears. BHN of pinion and gear are 350 and 300 respectively.

$$Yp = 0.154 - \frac{0.912}{Z_p}$$

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

$$C = 11860 \times e$$

$$e = 0.025$$

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

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

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

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

OR

Q:3 **(a)** Design a simple band brake to be operated by a lever 500 mm long. The brake drum is 500 mm diameter and the brake band embraces five eighth of the circumference. One end of the band is attached to the fulcrum of the lever, while the other end is attached to the pin on the lever 100 mm from the fulcrum. The coefficient of friction is 0.25 and the brake actuating force is 500 N. Choose your own values for the stresses. **07**

(b) Design a belt pulley having six elliptical sectioned arms, transmitting 10 kW, when running at 200 rpm. The maximum tension in the belt is not to exceed 15 N/mm width of the belt. The ratio of tensions on the two sides of the belt is to be 2.5. The bending stress in the arms should not exceed 15 N//mm^2. The maximum shear stress in shaft and key may be taken as 60 N/mm^2. The centrifugal stress in the rim is to be limited to 3.5 N/mm^2. Taken diameter of the pulley as one meter. Assume density of pulley material is 7300 kg/mm^3. **07**

Q:4 **(a)** Calculate the power transmitting capacity of the rigid flange coupling from the following data:- **07**

Diameter of shaft = 32 mm, Diameter of hub = 64 mm,
Length of hub = 50 mm, Width and thickness of key = 12 mm,
Thickness of flange = 15 mm, P.C.D. of bolts = 96 mm,
Bolt size = M 8, Outer diameter of the flange = 128 mm,
Number of bolts = 4
Permissible shear stress for shaft and key materials = 40 MPa

Shear stress for cast iron =9 MPa, Speed of the shaft = 800 rpm
Crushing stress for key material = 100 MPa
The service factor may be assumed as 1.35

(b) A cast iron pulley transmits 7.5 kW at 400 rpm. The diameter of the shaft on which the pulley is key is 30 mm. Calculate:- **07**

1. Diameter of the pulley if the hoop stress in the rim is not to exceed 4.5 MPa if the density of C.I. is 7000 kg/m^3.
2. Dimensions for the elliptical arms, allowing a bending stress of 15 MPa.
3. The thickness of rim and diameter and length of hub.
   The width of the rim is 150 mm.

OR

Q:4 **(a)** Find the life of 96% of a deep groove ball bearing if the bearing used is 6207 (dynamic load carrying capacity, 19.60kN and static load carrying capacity 13.70 kN) for the following load cycle. **07**
The loads act for 15 %, 20 %, 30 % and 35 % time respectively.

	Radial load	Axial load	Speed rpm	X	Y
1	3000 N	1000 N	600	1	0
2	2500 N	1000 N	800	1	0
3	2000 N	500 N	900	0.56	1.4
4	900 N	700 N	1200	0.56	1.4

(b) A hand operated wire hoist lift a load of 2 kN by applying an effort of 180 N at the end of lever arm of 350 mm. The diameter of drum is 260 mm on which 12 mm diameter of rope of 6X19 used for operating drum. Determine number of ropes and factor of safety required taking pulley factor 1.09 and ultimate breaking strength of $510d^2$ N, where d is the rope size. Take diameter of wire = 0.063d, area of wires in rope = $0.38d^2$ and modulus of elasticity of wire rope material = $84X10^3$MPa. **07**

Q:5 **(a)** A full journal bearing has a diameter of 75 mm and an l/d ratio of unity and runs at a journal speed of 400 rpm. The oil supply is SAE 40 at an inlet temperature of 60^0 C. The radial load is 3500 N, and the radial clearance is 0.040 mm. Determine the temperature rise, the minimum oil film thickness and the power loss. **07**

$\left(\frac{l}{d}\right)$	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) Write the various steps for selection of the rolling element bearing (mention all necessary equations). **07**

OR

Q:5 **(a)** What are the different type of the gear failures and discuss their remedies. **07**

(b) Derive the Lewis equation for design a spur gear. **07**

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