Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII (old) - EXAMINATION – SUMMER 2017

Subject Code:182004 **Date:09/05/2017**

Subject Name: Design of Mechanisms II

Time:10:30 AM to 01:00 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)** A crane hook having an approximate trapezoidal cross-section is shown in Fig.1 .It is made of plain carbon steel 45C8 (S_{yt} = 380 N/mm^2)and the factor of safety is 3.5.Determine the load carrying capacity of the hook. **07**

(b) What is design synthesis? Explain with example and related equations. **07**

Q.2 **(a)** Design a muff coupling to connect two steel shafts transmitting 25KW power at 360rpm.The shafts and key are made of plain carbon steel 30C8 (S_{yt}=S_{yc}=400N/mm^2) .The sleeve is made of grey cast iron FG200(S_{ut}=200 N/mm^2).The factor of safety for the shafts and key is 4.For the sleeve the factor of safety is 6 based on ultimate strength. **07**

(b) A transmission shaft rotating at 720rpm and transmitting power from the pulley P to the spur gear G is shown in the Fig.2.The belt tensions and the gear tooth forces are as follows :P_1=498 N, P_2=166N,P_t=497 N,P_r=181N.The weight of the pulley is 100N.The diameter of the shaft at bearings B_1 and B_2 is 10mm and 20mm respectively.The load factor is 2.5 and the expected life for 90% of the bearings is 8000h.Calculate the dynamic load capacities of the single row deep groove ball bearings at B_1 and B_2. **07**

OR

(b) Differentiate between simple and band brake giving neat sketches and related equations.How self locking conditions are checked? **07**

Q.3 **(a)** The following data is given for a full hydrodynamic bearing.Radial load=3.2 KN.Journal speed =1490 rpm,journal diameter=50mm,radial clearance=0.05 mm,viscosity of lubricant=25 centipoise.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 the friction(iii)minimum oil film thickness(iv)flow requirement in 1 litres/min and temperature rise.Use following table for reference. **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) Explain how the arms of pulley is designed .Give required sketch and equations. **07**

OR

Q.3 **(a)** A component machined from a plate made of steel 45C8(S_{yt}=630 N/mm^2) is shown in Fig. 3.It is subjected to a completely reversed axial force of 50 KN.The expected reliability is 90% and the factor of safety is 2.The size factor is 0.85.Determine the plate thickness t for infinite life,if the notch sensitivity factor **07**

is 0.8.Take K_a=0.76,K_c=0.897 ,$(S_e)_a$=0.8S_e,S_e'=0.5 S_{ut},K_t=2.27.The plate is having rectangle cross section of t x 100.

(b) Explain repeated,reversed and fluctuating stresses with neat sketches and equations. **07**

Q.4 **(a)** A single block brake with a torque capacity of 250 Nm is shown in Fig.4.The brake drum rotates at 100rpm and the coefficient of friction is 0.35.Calculate (i)the actuating force and the hinge pin reaction for clockwise rotation of the drum(ii) the actuating force and the hinge pin reaction for anticlockwise rotation of the drum(iii)the rate of heat generated during the braking action and(iv)the dimensions of the block if the intensity of pressure between the block and brake drum is 1 N/mm^2.The length of the block is twice its width.State whether the brake is self locking.Show free body diagram for both clockwise and anticlockwise rotation. **10**

(b) Differentiate between rolling element bearings and journal bearings. **04**

OR

Q.4 **(a)** A single row deep groove ball bearing is subjected to a 30 second work cycle that consists of the following two parts.The static and dynamic load capacities of the ball bearing are 50 and 68 KN respectively.Calculate the expected life of the bearing in hours. **07**

	Part I	Part II
Duration (s)	10	20
Radial load(KN)	45	15
Axial load(KN)	12.5	6.25
Speed(rpm)	720	1440

Following table can be referred.

(F_a/C_0)	$(F_a/F_r)\leq e$		$(F_a/F_r)>e$		e
	X	Y	X	Y	
0.070	1	0	0.56	1.6	0.27
0.130	1	0	0.56	1.4	0.31
0.250	1	0	0.56	1.2	0.37

(b) Describe the procedure of designing spur gear based on beam strength and wear strength. **07**

Q.5 **(a)** Explain (i)bend(ii)strand with reference to steel wire rope giving sketch and example.Sketch 6 x 7 wire rope construction. **07**

(b) A pulley made of grey cast iron FG 150 transmits 10 KW power at 720 rpm.The diameter of the pulley is 500mm.The pulley has four arms of elliptical croos-section in which the major axis is twice of minor axis.Determine the dimensions of cross-section of the arm,if the factor of safety is 5.Sketch the pulley with dimensions mentioned on it. **07**

OR

Q.5 **(a)** A cast steel pinion running at 900 rpm transmits a maximum power of 25 KW to a cast iron gear running at 144rpm.Design a spur gear drive having standard 20 degree stub teeth of involute profile.Check the design for dynamic load and wear.The safe static stress for pinion may be taken as 103 MPa and for gear it may be taken as 55MPa.Assume suitable data if required.The number of teeth for pinion is 16. **10**

(b) Write a short note on ‘Aesthetic considerations in design’. **04**

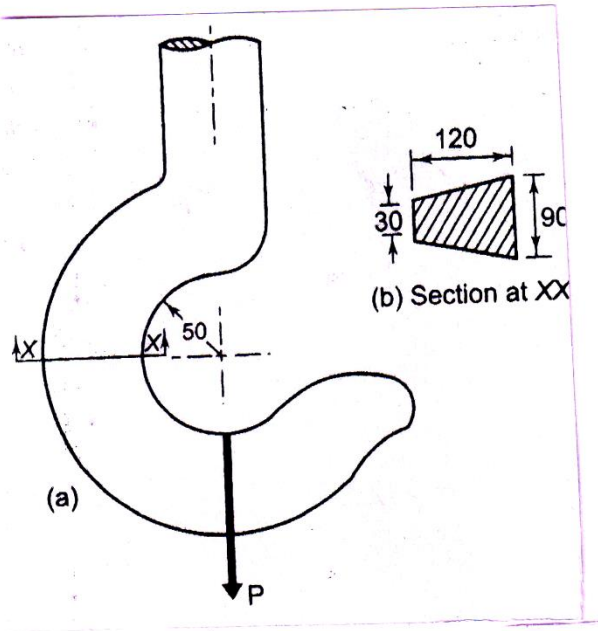

FIG 1, Q 1 (a)

$$R_N = \frac{\left(\frac{b_i + b_o}{2}\right) h}{\left(\frac{b_i R_o - b_o R_i}{h}\right) \log_e \left(\frac{R_o}{R_i}\right) - (b_i - b_o)}$$

$$R = R_i + \frac{h(b_i + 2b_o)}{3(b_i + b_o)}$$

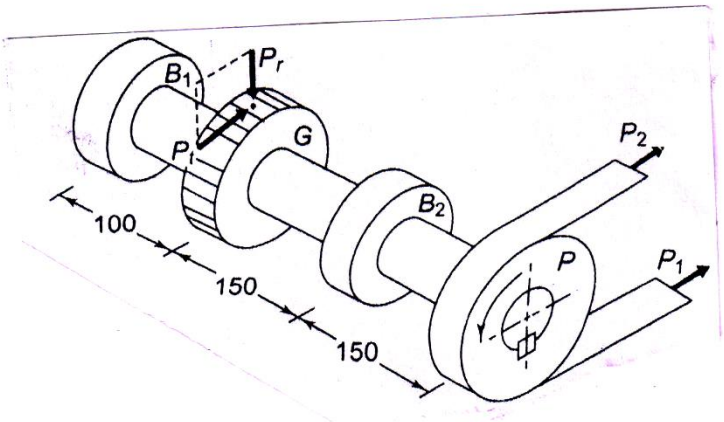

FIG 2, Q 2(b)

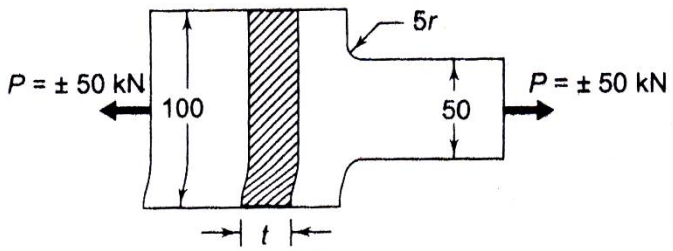

FIG 3, Q 3(a)

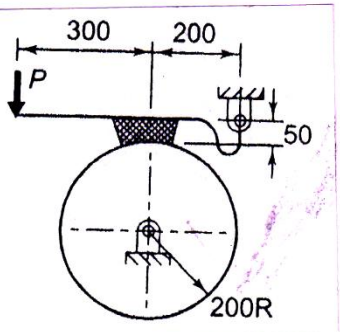

FIG 4, Q 4(a)

$$Y_p = 0.154 - \frac{0.912}{Z_p} \quad (full\ depth)$$

$$Y_p = 0.175 - \frac{0.841}{Z_p} \quad (stub\ gear)$$

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

$$C = 11860 \times e$$

$$e = 0.025$$

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

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

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

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

Gear Design Formulae for Q.5 (a)

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