

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEMESTER-VIII(OLD) • EXAMINATION – WINTER 2017

Subject Code: 182004
Date: 18/11/2017
Subject Name: Design of Mechanisms II
Time: 02.30 PM TO 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 steel spur gear is transmitting 7.5KW power running at 1440 rpm to a machine running at 480 rpm. Approximate centre distance is 240 mm. Allowable bending stress for pinion and gear are 200 MPa and 160MPa respectively. Surface hardness is 450 BHN. Tooth system is 20 degree full depth involute. Design a spur gear drive for above application. **14**

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

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

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

$$C = 11860 \times e$$

$$e = 0.025$$

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

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

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

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

- Q.2 (a)** A belt pulley made of grey cast iron FG150 has four arms of elliptical cross-section in which the major axis is twice the of the minor axis. The tensions on the tight and slack side of belt are 750 and 250 N respectively. The mean diameter of the pulley is 300 mm while the hub diameter is 60 mm. The factor of safety is 5. Determine the dimensions of the cross-section of the pulley arm near the hub. **07**
- (b)** With neat sketches explain how the pin of bush pin type flexible coupling is designed. Assume suitable data if required. The design steps are to be mentioned in sequence with related equations. The other parts are not to be designed. **07**

OR

- (b)** Briefly discuss the fluctuating stresses with neat sketches and related equations. What considerations are made for designing against fluctuating stresses? **07**
- Q.3 (a)** What are the ergonomic considerations for a product design ? Explain giving examples. **07**
- (b)** A C-frame subjected to a force of 15 KN is shown in Fig.1. It is made of grey cast iron FG 300 and factor of safety is 2.5. Determine the dimensions of cross- **07**

section of the frame. Refer following relations for rectangular section having cross section as $t \times 5t$.

$$R_N = h/(\log_e(R_o/R_i))$$

$$R = R_i + (h/2)$$

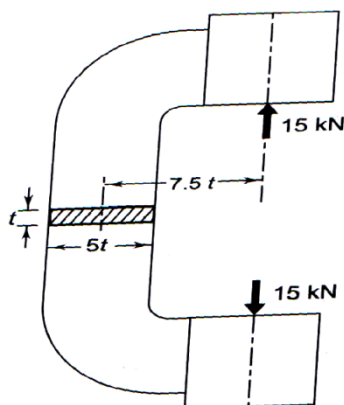


Fig. 1 ,Q. 3 (b)

OR

- Q.3 (a)** A single row deep groove ball bearing is subjected to a 30 second work cycle that consists of the following two parts: **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

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. Following table may be used as reference.

(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)** Explain meaning of 6 x 19 wire rope giving neat sketch. How a wire rope is designed for given load to be lifted with given lift ? State the procedure with related equations. **07**

- Q.4 (a)** A rigid coupling is used to transmit 50 KW power at 300 rpm. There are six bolts. The outer diameter of the flanges is 200 mm. The recess diameter is 150 mm. The coefficient of friction between the flanges is 0.15 . The bolts are made of steel 45C8 ($S_{yt} = 380 \text{ N/mm}^2$) and the factor of safety is 3. Determine the diameter of the bolts. Assume that the bolts are fitted in large clearance holes. Also state if the bolts are fitted in reamed and ground holes , what change in design of bolt will be followed. **07**

- (b)** Distinguish stress distribution in curved and straight beams with neat sketches and related equations. **07**

OR

Q.4 (a) Design a full hydrodynamic journal bearing with the following specification for machine tool application. Refer following table. **07**

Journal diameter = 75 mm, Radial load = 10 KN, Journal speed = 1440 rpm,
 Minimum oil film thickness = 22.5 microns, Inlet temperature = 40°C, Bearing
 pressure = 2 N/mm²

Determine the length of the bearing and calculate temperature rise.

If an oil is to be selected based on above calculations, what procedure is to be followed?

$\left(\frac{l}{d}\right)$	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 self-locking condition in single short shoe brake giving neat sketch and related equations. **07**

Q.5 A pulley tackle having 3 pulleys in each block is to be designed for lifting 10 KN load. Assume all data are available. State the steps of designing sheave, wire rope, central pin, side links etc. Give sketches and related equations. **14**

OR

Q.5 (a) Explain (i) Endurance limit (ii) S-N curve (iii) cumulative damage in fatigue loading with neat sketches and related equations. **10**

(b) What are the energy considerations for brake design? Explain. **04**
