

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VIII • EXAMINATION – SUMMER • 2015****Subject Code: 182004****Date: 07-05-2015****Subject Name: Design of Mechanisms - II****Time: 10.30 am - 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 spur pinion having 20 teeth to be made up of plain carbon steel 40C8 ( $f_{ut} = 580\text{MPa}$ ) is to be mesh with a gear having 85 teeth to be made up of Grey cast iron FG260. The pinion shaft is connected to 15 kW, 1440 rpm electric motor. The starting torque of motor is approximately twice the rated torque. The tooth system is  $20^\circ$  full depth involute. Calculate the module and hardness required for above gear pair. **14**

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

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

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

$$C = 11860 \times e$$

$$e = 0.025$$

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

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

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

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

- Q:2** **A** Enumerate advantages and disadvantages of rolling contact bearings over sliding contact bearings. **07**
- B** A ball bearing is operating on a work cycle consisting of three parts a radial load of 3000N at 1440 rpm for one quarter cycle, a radial load of 5000 N at 720 rpm for one half cycle, and radial load of 2500 n at 1440 rpm for the remaining cycle. The expected life of the bearing is 10000 h. calculate the dynamic load carrying capacity of the bearing. **07**

**OR**

- B** The following data is given for a  $360^\circ$  hydrodynamic bearing: **07**

$$\text{Radial load} = 3.2 \text{ kN}$$

$$\text{Journal diameter} = 50 \text{ mm}$$

$$\text{Bearing length} = 50 \text{ mm}$$

Journal speed	=	1490 R.P.M
Radial clearance	=	50 microns
Viscosity of lubricant	=	25 cP
Density of lubricant	=	860 kg/m <sup>3</sup>
Specific heat of lubricant	=	1.76 kJ/kg °C

Assuming that the total heat generated in the bearing is carried by the total oil flow in the bearing. Calculate:

- (1) The minimum oil-film thickness;
- (2) The coefficient of friction;
- (3) The power lost in friction;
- (4) The total flow rate of lubricant in l/min;
- (5) The side leakage; and
- (6) The temperature rise.

$\left(\frac{l}{d}\right)$	$\epsilon$	$\left(\frac{h_o}{c}\right)$	$S$	$\phi$	$\left(\frac{r}{c}\right)_f$	$\left(\frac{Q}{rcn_s l}\right)$	$\left(\frac{Q_s}{Q}\right)$	$\left(\frac{P}{P_{max.}}\right)$
1	0	1.0	$\infty$	(85)	$\infty$	$\pi$	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

**Q:3 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 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 is not to exceed 63 MPa. **07**

**B** Explain the design steps to determine power transmission capacity of the flange coupling. **07**

**OR**

**Q:3 A** Explain the Goodman and Modified Goodman criteria for fatigue failure. **07**

**B** The work cycle of mechanical component subjected to completely reserved bending stresses consists of the following three elements: **07**

1.  $\pm 350 \text{ N/mm}^2$  for 85% of time
2.  $\pm 400 \text{ N/mm}^2$  for 12% of time
3.  $\pm 500 \text{ N/mm}^2$  for 3% of time

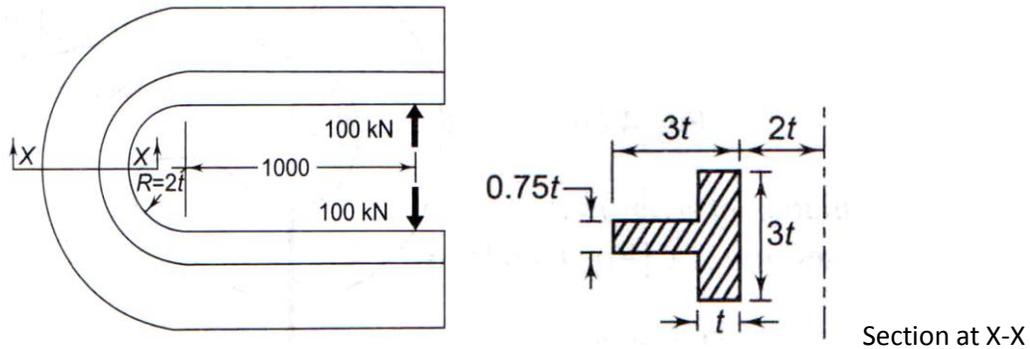
The material for the component is 50C4 ( $S_{ut} = 660 \text{ N/mm}^2$ ) and the corrected endurance limit of the component is  $280 \text{ N/mm}^2$ . Determine the life of the component.

**Q:4** Write the complete design procedure for crane hoisting mechanism. Also draw all necessary diagram and write all necessary equations. **14**

**OR**

**Q:4 A** Write all design steps for cast iron pulley to transmit power P. **07**

- B** The C-frame of 100 kN capacity press is shown in the following figure. The material of the frame is grey cast iron FG200 and the factor of the safety is 3. Determine the dimensions of the frame. **07**



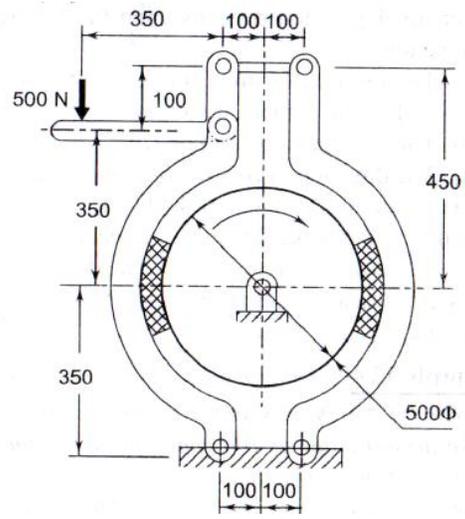
The radius of neutral axis for T section is given by

$$R_N = \frac{t_i(b_i - t) + th}{(b_i - t) \ln\left(\frac{R_i + t_i}{R_i}\right) + t \ln(R_o / R_i)}$$

- Q:5 A** Determine the size 6 X 19 wire rope necessary for mine hoist carrying a load of 69.50 kN to be lifted from depth of 225 meters. A rope speed of 7.9 m/s is to be attained in 10 seconds. The tensile strength of 6 X 19 wire rope is  $59.50 d^2$  kN, weight  $3.75 d^2$  N/m, Area is  $0.38 d^2$ ,  $E = 0.84 \times 10^5$  N/mm<sup>2</sup>, diameter of sheave is  $100 d$ , wire diameter  $d_w = 0.063 d$  where 'd' is rope diameter in cm. Select the factor of safety 15 for this application. **07**
- B**
1. What is difference between rigid and flexible coupling? **02**
  2. What is difference between coupling and clutch? **01**
  3. What is condition for self locking in differential band brake? **02**
  4. What are the advantages and disadvantages of band brakes? **02**

**OR**

- Q:5 A** Explain the importance of ergonomics and aesthetic consideration in machine design. **04**
- B** A double block brake is shown in the following figure. The brake drum rotates in clockwise direction and actuating force is 500 N. The coefficient of friction between the blocks and the drum is 0.35. Calculate the torque absorbing capacity of the brake. **10**



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