

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VIII (NEW) - EXAMINATION – SUMMER 2017****Subject Code: 2182004****Date: 09/05/2017****Subject Name: Design of Mechanisms - II****Time: 10:30 AM to 01:00 PM****Total Marks: 70****Instructions:**

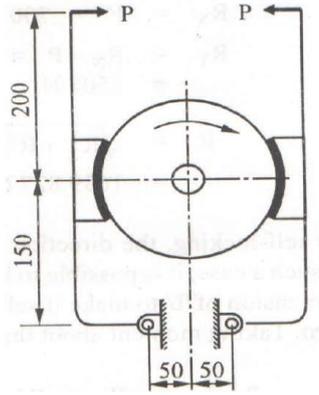
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use of PSG design data book is permitted.

- Q.1 (a)** Suggests a most suitable power transmission mechanism to transmit power between two shafts. Assume the center distance between two shafts is 10 m. Also discuss all the necessary design steps for the suggested mechanism. **07**
- (b)** Answer the following questions **07**
1. The stresses induced in a key of coupling are
    - (a) Shear and bending stress
    - (b) Crushing and bending stress
    - (c) Bending and bearing stress
    - (d) Shear and crushing stress
  2. The resistance to fatigue of material is measured by
    - (a) Elastic limit
    - (b) Young's modulus
    - (c) Ultimate tensile strength
    - (d) Endurance limit
  3. A brake commonly used in railway is
    - (a) Shoe brake
    - (b) Band brake
    - (c) Band and Block brake
    - (d) Internal expanding brake
  4. Lewis equation in spur gear is used to find the
    - (a) Wear strength
    - (b) Shear strength
    - (c) Beam strength
    - (d) Fatigue strength
  5. The width of the pulley should be
    - (a) Equal to the width of the belt
    - (b) Less than the width of the belt
    - (c) Greater than the width of belt
    - (d) Does not depend on belt width
  6. The design of the crane hook is
    - (a) Based on curved beam
    - (b) Based on endurance limit
    - (c) Based on straight beam
    - (d) Based on torsional shear
  7. The tapered roller bearings can take
    - (a) Radial load only
    - (b) Both axial and radial load
    - (c) Axial load only
    - (d) None of the above
- Q.2 (a)** Discuss the design considerations for finite and infinite life of a machine component subjected to (a) complete reversed stresses and (b) fluctuate stresses. Mention all necessary diagrams and equations. **07**
- (b)** Prove that a differential band brake can never be self-locking for both direction of rotations of the drum. **07**

**OR**

- (b)** A double shoe brake is shown in following figure. The braking torque required is 1200 Nm. The brake drum diameter is 200 mm and coefficient of friction between the shoe and drum is 0.3. Find the operating force P and the size of the shoe if the permissible pressure does not exceed 1.5 MPa. Assume the length of

the shoe to be twice that of its width. The analysis may be made considering it as a short shoe.



- Q.3 (a)** Calculate the power transmitting capacity of the rigid flange coupling from the following data: **07**

Diameter of the shaft = 32 mm, Diameter of the hub = 64 mm, Thickness of the flange = 15 mm, PCD of the bolts = 96 mm, Bolt size = M8, Outer diameter of the flange = 128 mm, Permissible shear stress for the shaft, bolt and key materials = 40 MPa, No of bolts are 3, Speed of the shaft = 800 rpm, Shear stress for cast iron = 9 MPa, Crushing stress for key material = 100 MPa. The service factor may be assumed as 1.35.

- (b)** Single row deep groove ball bearing 6010 is subjected to an axial thrust of 1200 N and radial load of 2400 N. Find the expected life that 50% of the bearings will complete under this condition.  $C_0 = 13200$  N,  $C = 21600$  N. **07**

$F_a/C_0$	$F_a/F_r > e$		e	$F_a/F_r < e$	
	X	Y		X	Y
0.07	0.56	1.6	0.27	1	0
0.13	0.56	1.4	0.31	1	0

**OR**

- Q.3 (a)**
1. What do you understand by static load carrying and dynamic load carrying capacity of ball bearing? Explain the criterion for static load carrying capacity and dynamic load carrying capacity of ball bearing. **04**
  2. What is  $L_{10}$  life of bearing? What is  $L_{50}$  life of bearing? **02**
  3. Name the various types of rolling contact bearings. **01**

- (b)** A journal bearing is rotating at 600 rpm and supporting a load of 30 kN. The  $l/d$  ratio is 1, the diameter of the journal is 150 mm and bore of the bearing is 150.2 mm. A minimum oil film thickness of 0.035 mm is to be maintained. Determine **07**
1. The viscosity of the oil
  2. The coefficient of friction
  3. The power lost in friction
  4. The increasing in temperature of the oil
  5. The inlet temperature of the SAE 10 oil
  6. The magnitude and location of maximum oil film pressure
- Mass per unit volume of lubricant =  $861 \text{ kg/m}^3$ , the specific heat of the lubricant =  $1760 \text{ J/Kg } ^\circ\text{C}$ .

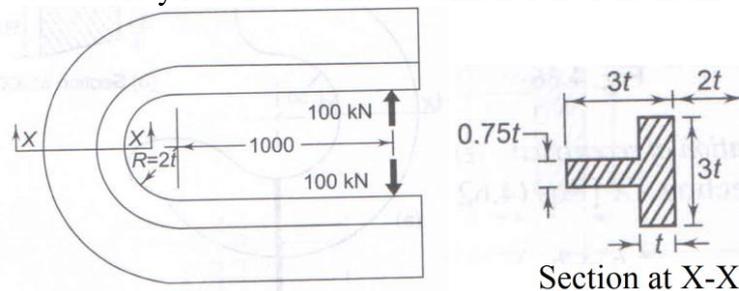
$\left(\frac{l}{d}\right)$	$\epsilon$	$\left(\frac{h_0}{c}\right)$	$S$	$\phi$	$\left(\frac{r}{c}\right)f$	$\left(\frac{Q}{rcn_s l}\right)$	$\left(\frac{Q_s}{Q}\right)$	$\left(\frac{P}{P_{max.}}\right)$
1	0	1.0	$\infty$	(85)	$\infty$	$\pi$	0	-
	0.1	0.9	1.33	79.5	26.4	3.37	0.150	0.540
	0.2	0.8	0.631	74.02	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.4 (a)** Determine the size of the wire rope necessary for mine hoist carrying a load of 70 kN to be lifted from a depth of 225 meter. A rope speed is 7.9 m/s is to be attained in 10 seconds. **07**

Assume : 6 X 19 wire rope with following parameters:

Factor of safety is 7, Ultimate breaking strength of  $510d^2$  N, where d is the rope size. Take diameter of the wire =  $0.063d$ , Area of wires in rope =  $0.38d^2$  mm<sup>2</sup>, Modulus of elasticity of wire rope =  $84 \times 10^3$  MPa, diameter of sheave =  $35d$  mm.

- (b)** 1. A C frame of a 100 kN capacity press is shown in the following figure. The material of the frame is grey cast iron FG200 and the factor of safety is 3. Determine the dimension of the frame. **05**



$$R_n = \frac{t_i (b_i - t) + th}{(b_i - t) \log_e \left( \frac{R_i + t_i}{R_i} \right) + t \log_e \left( \frac{R_o}{R_i} \right)}$$

2. Discuss the importance of ergonomics in mechanism design. **02**

**OR**

- Q.4** A sheave tackle having two pulleys in each block is designed for 10 kN suspended downward load through hook. Design a crane hook, wire rope, central pin and cross block. **14**

Permissible stresses for cross block and central pin in shear and tension are 50 MPa and 100 MPa respectively.

For trapezoidal cross section

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

- Q.5** A spur pinion having 20 teeth to be made up of plain carbon steel 40C8 **14**

( $f_{ut} = 580\text{MPa}$ ) 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.

OR

- Q.5 (a)** Following data is given for a steel spur gear transmitting 7.5 kW power running at 1440 rpm to a machine running at 480 rpm. Approximate center distance = 240 mm, Allowable bending stress for pinion and gear are 200 and 160 respectively. Surface hardness is 450 BHN. Tooth system is  $20^\circ$  full depths involutes. Design a spur gear drive for above application. **11**
- (b)** Derive an equation to determine the beam strength of spur gear. **03**

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

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

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

$$C = 11860 \times e$$

$$e = 0.025$$

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

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

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

$$f_{es} = 2.7459 \times \text{BHN} - 68.65 \text{ MPa}$$

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

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