Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEM-VIII Examination May 2012

Subject code: 182004

Subject Name: Design of Mechanisms II

Date: 16/05/2012 **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)** Design a bush pin type flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 rpm considering 20% overload. The material properties are as follows: **10**

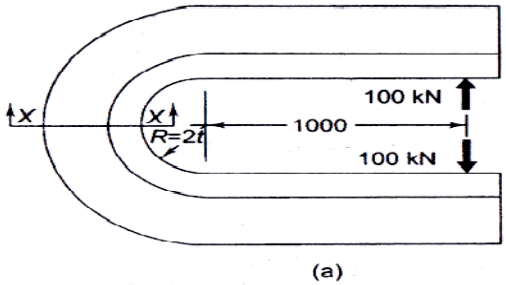
(a) Allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively.
(b) The allowable shear stress for cast iron is 15 MPa.
(c) The allowable bearing pressure for rubber bush is 0.8 MPa.
(d) The material for pin is same as that of the shaft.

(b) I. Differentiate the Rigid and Flexible couplings. **02**

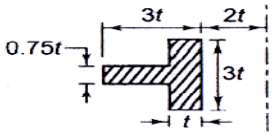
II. Explain the stress distribution of straight beam and curved beam. **02**

Q:2 **(a)** The frame of a 100 kN punch press is shown in the following Fig. The material of the frame is Gray cast iron (S_{ut} = 200 MPa) and the factor of safety is 3. Determine the dimensions of the frame. **07**

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



(a)



(b) Section at XX

(b) I. Explain clearly completely reversed stress, repeated stress and fluctuating stress cycles with neat sketches. **03**

II. Define endurance limit and explain the miscellaneous factors which governs the design. **02**

III. What is stress concentration? How do we control in designing various components. **02**

OR

(b) Explain the single shoe brake arrangement with neat sketch. Explain the terms self energizing and self locking of the brake. How the direction rotation of the brake drum changes the analysis of the operating force of the brake. **07**

Q:3 A pair of mating carefully cut spur gears has 20° full depth of 4 mm module. The number of teeth on pinion and gears are 38 and 115, respectively. The face width is 40 mm. If the pinion and gear are made of steel with $f_{bstatic}$ =233 MPa and surface hardness of 300. Calculate the safe power that can be transmitted when pinion is run at 1200 rpm. Take service factor = 1.25. **14**

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

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

$$C = 11860 \times e$$

$$e = 0.025$$

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

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

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

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

OR

Q:3 Design a crane hook (triangular cross section) and wire rope for 50 kN crane. Take 50% over load. The bed diameter is 110 mm. Allowable tensile stress for forged hook is 200 MPa. Select the suitable wire rope and number of sheeves. For triangular section **14**

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

Q:4 **(a)** A differential band brake is to be designed to support a load of 400 kN around a barrel of 450 mm diameter. The brake is to be mounted on a drum of 800 mm diameter. The two ends of the band are attached to pins on opposite sides of the fulcrum of the brake lever at distances of 40 mm and 120 mm. The length of the lever is 900 mm. The angle of lap may be taken as 240° and the coefficient of friction is 0.3. Give the main design calculations for the lever, the band and the fulcrum pin. **07**

Take permissible tensile stress in lever and band material is 70 MPa. Permissible bearing pressure in pin material is 20 MPa and in shears 45 MPa.

(b) Determine the suitable size of 6 X 19 wire rope to lift a vertical load of 35 kN from 600 m deep mine. The load is being lifted with speed of 15 m/sec. which is to be attained in 12 seconds. Take breaking load $510d^2$, Area of wire rope = $0.38d^2$ mm^2, diameter of wire = 0.063 d, mass of rope per 100 m = $0.36d^2$ kg, diameter of sheave is 40 d, modulus of elasticity of wire rope = 0.8 X 10^5 MPa and factor of safety is 5, where d is wire rope diameter in mm. **07**

OR

Q:4 **(a)** A overhung cast iron pulley transmits 7.5 kW at 400 rpm. The angle of wrap may be taken as 180°. Find: **07**

I. Diameter of the pulley, if the density of the CI is 7200 kg/m^3.
II. Width of the belt if the coefficient of the friction is 0.25.
III. Size of the arms.

The section of the arms may be taken as elliptical, the major axis being twice the minor axis. The following stresses may be taken for design purpose:
For belt tensile stress = 2.5 MPa; For pulley rim tensile stress = 4.5 MPa, For pulley arm tensile stress = 15 MPa.

(b)

1. Why the system design approach is important in Machine design? **01**
2. Explain the importance of Ergonomics, Aesthetic consideration and reliability in Design of mechanisms. **06**

Q:5 **(a)** 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 bearing is 150.2 mm. A minimum oil film thickness of 0.035 mm is to be maintained. Determine (use the table given below): **07**

1. The viscosity of oil.
2. The co-efficient of friction.
3. The power lost in friction.
4. The magnitude and location of maximum oil film pressure.

$\left(\frac{l}{d}\right)$	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) Draw the flow chart diagram for the various steps involve in selection of the rolling elements bearing for a shaft supported in two bearings. **07**

OR

Q:5 **(a)** A 6316 deep groove ball bearing with inner race rotating has 20 seconds work cycle as follows: **07**

	For 12 Sec	For 8 Sec
Radial Load	8000 N	5000 N
Axial load	4400 N	2600 N
Speed	900 rpm	1440 rpm
Nature of load	Moderate load (ks =2)	Light shock load (ks = 1.5)

Determine: (a) the expected life of the bearing if C = 95 kN, C_0 = 80 kN, X = 0.56 and Y = 1.7 for both cases. (b) Life of the bearing at 94% reliability.

(b) A cantilever beam of circular cross section is fixed at one end and subjected to a completely reversed load of 100 N at the free end. The force is perpendicular to the axis of the beam. The distance between the fixed and free end is 400 mm. There is no stress concentration in the beam. The beam is made of steel with ultimate tensile strength of 1300 MPa. The surface finish factor is 0.87 and the size factor is 0.85 respectively. The reliability factor is 0.868. Determine the diameter of the beam for a life 47500 cycles. **07**

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