

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-V • EXAMINATION – WINTER 2013

Subject Code: 151905**Date: 11-12-2013****Subject Name: Machine Design – I****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) What is fatigue strength ? Explain design criteria with Goodman line. **04**
 (b) What is standardization ? Explain role of preferred number in standardization. **04**
 (c) Explain Design consideration for welding. **03**
 (d) Find out series R 20/4 for 100 rpm to 1000 rpm. **03**

- Q.2** (a) Write step by step procedure for design of chain drive. **03**
 (b) What is a condition for maximum power transmission in the belt drive ? **04**
 Derive it for maximum power.
 (c) Following data given for open V belt drive **07**
 Diameter of driving pulley = 100 mm
 Diameter of driven pulley = 200 mm
 Center distance = 1000 mm , Groove angle = 40°
 Mass of belt = 0.2 kg/m , Maximum permissible tension = 700 N
 Coefficient of friction = 0.2
 Plot a graph of maximum tension and power transmitted against belt velocity.
 Calculate maximum power transmitted by belt and corresponding belt velocity. Neglect power losses.

OR

- Q.2** (a) Explain different types of end closure for cylindrical pressure vessel. **03**
 (b) What is compounding of cylinder? Why it is required? **04**
 (c) A Hydraulic press having a working pressure of water as 10 N/mm² and exerting a force of 50 KN is required to press material up to maximum size 400 mm x 400 mm x 40 mm high. Stroke length is 100 mm. Design and draw following parts of press. **07**
 1. Design of Ram 2. Cylinder 3. Pillars 4. Gland.
 Take Plain carbon steel 10C₄ (Ultimate strength = 340 N/mm²) for ram and FG 200 (Ultimate strength = 200 N/mm²) for cylinder. Take F.O.S.= 5. Assume compressive and tensile strength are same.

- Q.3** (a) Explain following terms for the helical spring **07**
 Spring index, Solid Length, Spring Rate, Wahls factor
 (b) A Forged steel bar 60 mm in diameter is subjected to a reversed bending stress of 200 N/ mm². The bar is made of 40C₈ (ultimate stress is 600 MPa) . **07**
 Calculate the life of bar for a reliability of 90 %
 Take surface finish factor = 0.44, Size factor = 0.85, Reliability factor = 0.897.

OR

- Q.3** (a) Discuss various methods for reducing stress concentration. **07**
 (b) Design a helical compression spring for maximum load of 1200 N for a deflection of 20 mm using the value of spring index as 5. **07**
 Permissible shear stress for spring wire 420MPa. Modulus of rigidity 80 KN/mm²

- Q.4** (a) Define dynamic load capacity of rolling contact bearing. **04**
 (b) Explain Equivalent bearing load for rolling contact bearing. **03**
 (c) For a 360° hydrodynamic bearing having following data. **07**

Radial load 3 kN, Journal Diameter 40 mm, Journal Length 40 mm, Viscosity of oil = 20 MPa s. Radial clearance = 0.04 mm, Journal speed = 1500 rpm. Assuming that total heat generated in bearing is carried by total oil flow in the bearing. Calculate: coefficient of friction, Power lost in friction, Minimum oil film thickness, flow requirement in litres/min., Temperature rise.

For $l/d = 1$, $(r/c)f = 1.375$, $h_0/c = 0.15$, $Q/rcnsl = 4.68$

OR

- Q.4** (a) Explain following terms for Journal Bearing **07**
 Bearing Characteristic Number, Viscosity Index, Sommerfeld Number, Bearing Modulus
 (b) Single row deep groove ball bearing 6010 is subjected to an axial thrust of 1200 N and radial load 2400 N. Find the expected life that 50% of the bearing will complete under this condition. **07**
 $C_0 = 13200$ N, $C = 21600$ N

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

- Q.5** (a) What is Self energizing and self locking brake? **03**
 (b) What do you mean by 6x9 rope? Discuss about the stresses acting on wire rope and write its design procedure in brief. **04**
 (c) A cone clutch is used to connect an electric motor running at 1200 rpm with a machine which is stationary. The machine is equivalent to a rotor of 125 kg mass and radius of gyration as 200 mm. The machine has brought to the full speed of 1200 rpm from stationary condition in 30 second. The semi cone angle is 12°. The main radius of the clutch is twice the face width. The coefficient of friction is 0.25 and the normal intensity of pressure between contacting surfaces should not exceed 0.12 N/mm². Assuming uniform wear criteria. **07**
 Calculate: (1) The inner and outer diameter (2) face width and friction lining (3) force required to engage the clutch (4) Amount of heat generated during each engagement of clutch.

OR

- Q.5** (a) Explain in brief design step of centrifugal clutch. **04**
 (b) Which are the qualities of friction lining material used in clutch? Name the friction material used in clutch. **03**
 (c) A Band brake acts on the $\frac{3}{4}$ th of circumference of a drum of 400 mm diameter which is keyed to the shaft. The band brake provides a braking torque of 200 N.m. One end of the band is attached to a fulcrum pin of the lever and other end to a pin 90 mm from the fulcrum. If the operating force applied at 450 mm from fulcrum and coefficient of friction is 0.2, find the operating force when drum rotates in the anticlockwise direction. If the brake levers and pins are to be made of mild steel having permissible stresses for tension and crushing as 80 MPa and Shear 40 MPa. Design shaft, key, lever and pin. The bearing pressure between the pin and lever may be taken as 6 MPa. **07**
