Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. SEMESTER I (old course)–EXAMINATION (Remedial) – WINTER 2015

Subject code: 710801N **Date: 08/12/2015**

Subject Name: Advanced Machine Design

Time: 10:30 AM to 1:00 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)** State and explain in brief the applications of ñTheory of Rotating discsò in design of machine components. **04**

(b) A disc of uniform thickness, 450 mm diameter rotates at 6000 rpm. Determine the maximum hoop stress and radial stress. Draw the curves showing their variations, if **10**

(i) If the disc is solid

(ii) If the disc has a central hole of 50 mm diameter.

Assume Density of disc material, ρ = 7.86 gm/cm^3 ,

ε = 0.3, Modulus of elasticity, E = 2 x 10^5 N/mm^2.

Q.2 **(a)** Explain (i) Autofrettage **07**

(ii) Prestressing of thick cylinder (with wire and tape wound)

(b) What should be the radial shrinkage pressure at the common surface of 120 mm diameter, if the resultant stress at the inner peripheries of the inner and outer cylinder is to be same? The internal diameter of the inner cylinder is 80 mm and external diameter of the outer cylinder is 150 mm and the compound cylinder in addition is subjected to internal pressure of 70 N/mm^2. Hence find what should be the initial difference in diameter at the common surface in order to have the above radial shrinkage pressure? Also compare its weight with that of single thick cylinder in order to withstand this pressure with the same maximum hoop tension. Take E = 2 x 10^5 N/mm^2. **07**

OR

(b) A pressure vessel working at maximum temperature of 400^{0}C uses the steel bolts for joining the end covers. The test result for the bolts at this temperature shows the strain rate of 3.5 x 10^{-18} /hr. and 2 x 10^{-18}/hr. at 40 MPa and 25 MPa stress levels respectively. If the bolts are initially tightened to stress level of 70 MPa. Calculate in what time the stress will be reduced to 60 % of this value. Assume that the vessel is made of same material and flanges are very rigid. Modulus of elasticity, E at 400^0 C is equal to 1.8 x 10^5 MPa.. **07**

Q.3 **(a)** Explain prediction of fatigue life of a ball bearing. **04**

(b) A journal bearing 60 mm diameter and 75 mm length operates at 2000 rpm. The radial clearance is 0.04 mm. Mean viscosity of the lubricant used in the bearing is 10 CP. If the bearing operates at an eccentricity ratio 0.8 with an inlet pressure 0.3 MPa at 300^0, determine the pressure distribution around the journal. Is the pressure distribution obtained for this bearing satisfactory? If not what modifications are required? What is the load carried by the bearing? **10**

[P.T.O.

OR

Q.3 **(a)** Explain ñPorous Bearingò. **04**

(b) The following data is given for a hydrostatic thrust bearing: **10**

Shaft speed = 720 rpm Viscosity of lubricant = 30 CP

Shaft diameter = 400 mm | Specific gravity = 0.86
Recess diameter = 250 mm | Specific heat = 1.75 kJ/kg^{0}C
Film thickness = 0.15 mm | Supply pressure = 5 MPa

Calculate: (i) Load carrying capacity of the bearing.
(ii) Flow requirement
(iii) Pumping power loss
(iv) Frictional power loss
(v) Temperature rise.

Note: Assume that the total power loss in the bearing is converted in to frictional heat.

Q.4 (a) Explain the following terms related to Machine Design. **07**
(i) Product life cycle
(ii) Ethics in design
(iii) Brain storming

(b) Discuss on ñDesign for rigidityò. **07**

OR

Q.4 (a) Discuss on ñDesign for strengthò. **07**

Q.4 (b) What do you mean by corrected gearing? In which situation such gears are used? Why? **07**

Q.5 (a) Compare the concurrent engineering with traditional engineering. **07**

(b) Discuss on ñQuality function deploymentò with reference to product design. **07**

OR

Q.5 (a) Explain design procedure for the design of crane trolley wheels with necessary design equations. **07**

(b) Explain safe life v/s fail safe design criteria with suitable examples. **07**