Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2014

Subject code: 710905N **Date: 05-12-2014**

Subject Name: Tribology

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)** Define tribology? Discuss the various practical applications of tribology in machine design. **07**

(b) State the different theories of friction. Explain any one of them which is most widely accepted with neat sketch. **07**

Q.2 **(a)** Discuss the lubrication problems faced at certain extreme environmental conditions such as pressure, temperature and vacuum. **07**

(b) Explain the wear particle analysis ferrography. **07**

OR

(b) List the factors affecting wear rate. Explain the different methods used to reduce and control the wear with neat sketches. **07**

Q.3 **(a)** List and explain the bearing materials in detail. Also list the factors affecting selection of it. **07**

(b) A 360^0 hydrodynamic bearing has the following data for centrifugal pump application: **07**

Journal diameter = 100 mm Bearing material - Babbit

Radial load = 20 kN Journal speed = 900 r.p.m.

Operating temp of oil = 55^0 C Ambient temp of oil = 15.5^0 C

Type of oil SAE10 ,has the absolute viscosity at 55^0 C = 0.017 kg/m-sec

Rise in temperature of oil is limited to 10^0 C

Permissible bearing pressure = 1.5 MPa

Heat dissipation coefficient of oil = 1232 W/ m^2/ ^{0} C

Value of $(ZN / p)_{min} = 28$ Correction factor for end leakage = 0.002

Ratio c / d = 0.0013

Find the length of the bearing and mass of the lubricating oil to be circulated for artificial cooling.

OR

Q.3 **(a)** Explain the different configurations (at least four) of hydrodynamic journal bearings with neat sketches. **07**

(b) The following data refers to hydrodynamic journal bearing:- **07**

Journal diameter = 80 mm

Length of bearing = 40 mm

Radial clearance between the journal and bearing = 50 microns

Minimum oil film thickness = 15 microns

Speed of journal = 1800 r.p.m.

Viscosity of lubricating oil = 30 mPa- s

Assuming the narrow approximation (a) plot the pressure distribution in the plane perpendicular to the axis and passing through the midpoint of bearing length (b) find the location and magnitude of maximum pressure.

Q.4	**(a)**	Derive the equation for load carrying capacity of hydrostatic bearing. Also state the assumptions made in derivation.	**07**
	(b)	A hydrodynamic plane slider has the following particulars Length of the slider = 150 mm Width of the slider = 50 mm Maximum oil film thickness = 200 microns Sliding velocity = 10 m/sec Minimum oil film thickness = 100 microns Viscosity of the lubricant = 60 mPa.sec Calculate the maximum pressure and its locations and the average pressure. What is the load carrying capacity? Use the long bearing approximation.	**07**
		OR	
Q.4	**(a)**	The hydrostatic step bearing (circular) of a vertical turbo-generator: Total thrust load = 450 kN Shaft diameter = 400 mm Viscosity of the lubricant = 30 cP Recess diameter =250 mm Shaft speed =750 r.p.m. Specific gravity of the lubricant = 0.86 Specific heat of lubricant = 2 kJ /kg ^{0}C Find (i) supply pressure (ii) the optimum film thickness for minimum power loss (iii) the temperature rise, assuming that the total power loss in bearing is converted into the frictional heat.	**09**
	(b)	Explain the following in respect to surface characteristics: (i) Waviness (ii) Surface roughness (iii) Sampling length (iv) CLA & RMS	**05**
Q.5	**(a)**	Explain the selection procedure of antifriction bearing with a flowchart.	**07**
	(b)	How the lubricants are classified? Explain the different oil lubricants and its selection in detail along with their applications.	**07**
		OR	
Q.5	**(a)**	Explain the EHD lubrication in detail stating its practical examples.	**07**
	(b)	Explain the design of variable speed drive elements.	**07**

****