

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

Subject Code: 171905**Date: 03-12-2013****Subject Name: Industrial Tribology****Time: 10:30 TO 01:00****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 the term 'Tribology'. Discuss the application of it in day to day life. **04**
 (b) Define: Viscosity, Viscosity index, Absolute viscosity **03**
 (c) Enlist the different methods of studying the surface. Describe with neat sketch profilometer. **07**
- Q.2** (a) State the laws of friction. Prove that co-efficient of friction during ploughing is **07**

$$\mu_{plough} = \frac{2}{\pi} \tan \theta \text{ where, } \theta = \text{asperity angle}$$

 (b) Classify the types of wear. Derive the equation of volume of wear due to adhesion. **07**
- OR**
- (b) In a pin on disc specimen experiment, the disc is rotating at constant speed of 600rpm. The pin is at the radius of 40mm from the centre of disc and is under constant load of 55N. If the co-efficient of friction is 0.23 then determine the power required to drive the disc. Also find out the average asperity angle and sliding force on the disc. **07**
- Q.3** (a) Derive the equation of pressure distribution in case of infinitely short hydrodynamic journal bearing. State the assumptions made. **07**
 (b) The following data refers to a hydro-static step bearing: **07**
 Thrust Load = 450N, Shaft speed = 725rpm, shaft diameter = 450mm, recess diameter = 250mm, Oil film thickness = 0.15mm, viscosity of oil = $30 \times 10^{-9} \text{ N-s/mm}^2$, specific heat of oil = 1.76 kJ/kg °C, specific gravity of oil = 0.85.
 Calculate: (1) supply pressure (2) flow requirement (3) frictional power loss & (4) pumping power loss
- OR**
- Q.3** (a) Using Reynolds's equation of two dimensional flow, derive the equation of minimum oil film thickness in case of Rayleigh step bearing. **07**
 (b) The following data refers to a hydrodynamic tapered-pad bearing: **07**
 Width of pad : 810mm, length of pad : 200mm, viscosity of oil : 0.045 Pa-s, sliding velocity: 4.5m/s, ratio of oil film thickness = 1.93, taper angle = 3.25×10^{-4} rad. Calculate: (1) load carrying capacity (2) Pressure at a distance of 90mm from leading edge (3) co-efficient of friction
- Q.4** (a) Discuss the different types of power losses in hydrostatic step bearing. **07**

- (b) The following data refers to a full hydrodynamic journal bearing: 07
 l/d ratio = 1, radial load = 9.5 kN, Journal radius = 750 $\times$ radial clearance,
 permissible bearing pressure = 1150 kPa, journal speed = 1440 rpm, Min. oil
 film thickness = 18μ , density of oil = 855 kg/m^3 , specific heat of oil = $2.05 \text{ kJ/kg } ^\circ\text{C}$. Calculate: (1) journal diameter (2) length of bearing (3) flow rate of oil
 (4) side leakage (5) power lost in friction

l/d	h_o/c	ϵ	S	$(r/c)f$	$Q/rcn_s l$	Q_s/Q	$P_{\max}/p$
1	0.2	0.8	0.0446	1.70	4.62	0.842	3.195
	0.4	0.6	0.121	3.22	4.33	0.680	2.40

OR

- Q.4** (a) Enlist different types of lubrication system used in I. C. Engine. Explain pressure lubrication system with neat sketch. 07
 (b) (1) Explain the principle of elasto-hydrodynamic lubrication. 07
 (2) Explain the process of recycling of used oil.

- Q.5** (a) Derive the equation of pressure distribution, load carrying capacity and time of approach in case of two parallel rectangular plates separated by fluid film. 07
 (b) Give the comparison of roller bearings and ball bearings. State the applications of rolling contact bearings. 07

OR

- Q.5** (a) Give the comparison between Oil lubricated bearing and gas lubricated bearings. 07
 (b) State and explain the desirable properties of bearing materials. 07
