Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER 2014

Subject Code: 171905 **Date: 31-05-2014**

Subject Name: Industrial Tribology

Time:02:30 pm to 05:00 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)** **i)** Define 'Tribology'? How the study on 'Tribology' is useful in day to day life. **03**

ii) What are the types of surface irregularities? States the methods of improving the surface finish. **04**

(b) **i)** What do you mean by lubricants? State the properties of a liquid lubricants. **04**

ii) Define: Viscosity index ,Efflux viscometer, Profilometry **03**

Q.2 **(a)** Explain principle of working of hydrostatic step bearing and state assumptions made for the analysis of hydrostatic step bearing. **07**

(b) The following data refers to a hydrostatic step bearing **07**

- Shaft diameter =500 mm
- Recess diameter = 250 mm
- Thrust load = 450 KN
- Shaft speed = 720 r. p. m
- Oil film thickness = 0.16 mm
- Viscosity of lubricant = 170 SUS
- Specific heat of lubricant = 1.76 KJ/Kg °C
- Specific gravity of lubricant = 0.86

Calculate: **i)** supply pressure **ii)** oil flow rate in l/min **iii)** frictional power loss **iv)** pumping power loss and **v)** Temperature rise in bearing. Assume that the total power loss is converted into frictional heat.

OR

(b) What do you mean by 'Optimum design of hydrostatic step bearing'. For given fixed outside diameter of the shaft and neglecting frictional power loss, show that the condition for minimum power loss is $\ln(R_o/R_i)=1/4[(R_o^2/R_i^2)-1]$. **07**

Q.3 **(a)** Explain in brief practical situations where hydrostatic squeeze film lubrication can be observed. **07**

(b) **i)** State and discuss the lubricants and lubrication methods used in following applications. **04**

Worm gears, Roller chains, Refrigeration compressors, I.C. Engines

ii) Explain following terms related to used motor oil. **03**

Re-refining, Reprocessing, Reconditioning

OR

Q.3 **(a)** Explain EHD (Elasto hydrodynamic) lubrication in detail. State the different examples of it. **07**

(b) Attempt following: 07

i) Explain merits and demerits of gas bearings.

ii) Write short note on oil-seals.

Q.4 (a) i) What is wear debris analysis? State its importance. 03

ii) Write short note on Pin on disc wear measurement. 04

(b) Show that the volume of abrasive wear per unit sliding distance with conical abrasive particles is given by 07

$Q=[(2K_w \cot \alpha)/\pi](W/P)$

Where, α = Semi-cone angle

Notations carry usual meaning.

OR

Q.4 (a) State different theories of friction. Explain Coulomb's classical theory. 07

(b) In a pin on disc experiment the disc specimen constant is made of steel and pin specimen is made of brass, the disc is rotating at constant speed of 700 r.p.m at the radius of contact of pin at 50 mm from centre. The pin is under constant load of 60N.If the co-efficient of friction is 0.2 than determine the power required to drive the disc. Also find out the average asperity angle on disc surface considering only ploughing friction. 07

Q.5 (a) Explain the working principle of Rayleigh step bearing? State advantages, limitations and applications of it. 07

(b) The following data refers to a six-shoe tapered pad thrust bearing No. of pads = 6, outer diameter of the pads = 1000 mm, Inner diameter of the pads = 600 mm, Rotational speed = 240 r.p.m, Angle subtended by each pad = 55°, Minimum oil film thickness =0.12 mm, Attitude = 2.5,Viscosity of oil = 30cP. Using the narrow approximation Calculate: **i)** The load carrying capacity **ii)** The power lost in bearing **iii)** The maximum pressure and **iv)** The ratio of maximum pressure to average pressure. 07

OR

Q.5 (a) Derive the Reynolds's equation in two dimensional forms using direct method for hydrodynamic lubrication. 07

(b) The following data is given for a 360° hydrodynamic bearing. 07

Radial load =15KN, Journal speed = 1450 r.p.m , l/d ratio =1,Bearing length = 50 mm, Radial clearance = 20 μm, Eccentricity ratio = 0.75, Specific gravity of oil = 0.86, specific heat of oil = 2.09 KJ/Kg °C.

Evaluate: **i)** Probable co-efficient of friction **ii)** Viscosity of oil **iii)** Minimum oil film thickness **iv)** Quantity of oil in circulation **v)** Oil leakage through sides and **vi)** The average oil temperature if the oil is supplied at 28°C.

Use following table. Notations carry usual meaning.

l/d ratio	h_o/c	S	$CFV=f(r_j/c)$	$FV=(Q/r_jcN_jl)$	$FR=(Q_s/Q)$
1	0.2	0.0446	1.70	4.62	0.842
	0.4	0.121	3.22	4.33	0.680

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