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. Worm gears, Roller chains, Refrigeration compressors, I.C. Engines	04
		ii) Explain following terms related to used motor oil. Re-refining, Reprocessing, Reconditioning	03

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   07
conical abrasive particles is given by
$Q = [(2K_w \cot \alpha)/\pi](W/P)$
Where, α = Semi-cone angle
Notations carry usual meaning.

OR

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

(b) In a pin on disc experiment the disc specimen constant is made of   07
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.

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

(b) The following data refers to a six-shoe tapered pad thrust bearing No.   07
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.

OR

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

(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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