Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII(OLD) • EXAMINATION – WINTER 2016

Subject Code: 171905 Date: 18/11/2016

Subject Name: Industrial Tribology (Department Elective - I)

Time: 10:30 AM to 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)**	**(i)** Justify "Tribology is an interdisciplinary science". Explain the importance of 'Tribology' in the design of machine parts.	**03**
		(ii) Define 'Viscosity Index'. Explain how viscosity index of oil can be greater than 100.	**04**
	(b)	What is tribological surface? Explain with neat sketch the different layers of tribological surface	**07**
Q.2	**(a)**	Enlist the methods of studying surface. Describe a profilometer and its typical trace with neat sketch.	**07**
	(b)	State different theories of friction. Explain any one of them which is most widely accepted with neat sketch.	**07**
		OR	
	(b)	In a surface profile measured by the profilometer has given an area above the centre line is 150,60,90,50 mm^2 and below centre line is 190, 40, 50 and 70 mm^2. The sample length is 0.8 mm. If the magnification on X- axis is 100 and Y- axis is 1500 then determine the C. L. A. assume that the surface is irregular in the nature.	**07**
Q.3	**(a)**	Explain 'SAE classification' of lubricating oil. Also enlist the different types of additives in lubricating oil along with their function.	**07**
	(b)	**(i)** Write short note on: Direct reading Ferrograph.	**03**
		(ii) Define with respect to antifriction bearing: Rating life, Median life, Basic dynamic capacity, Equivalent dynamic capacity.	**04**
		OR	
Q.3	**(a)**	**(i)** Explain: (i) Stribeck curve (ii) Sommerfeld number.	**04**
		(ii) Describe "Used oil management diagram".	**03**
	(b)	State assumptions made, prove Archard's equation of adhesive wear $Q = k(W/3P_0)$ and comment about magnitude of wear coefficient 'K'.	**07**
Q.4	**(a)**	What do you understand by gas lubricated bearings? Derive expressions for load carrying capacity and time of approach in case of two parallel square plates separated by fluid film.	**07**
	(b)	The following data refers to a hydrostatic thrust bearing • Shaft diameter = 450 mm , Recess diameter = 250 mm • Thrust load = 850 KN, Shaft speed = 900 r. p. m • Viscosity of lubricant = 30 cP Calculate optimum film thickness for minimum power loss. Show the variation of energy losses against film thickness graphically. Also calculate total power loss.	**07**
		OR	

Q.4 **(a)** Derive an expression for load carrying capacity and oil flow rate for hydrostatic step bearing. State the assumptions made. **07**

(b) A steel disc having 200mm diameter and 10 mm width is required to roll freely on a rigid plane. Find the force required to pull the disc if the density of steel = 8000 kg/m^3, pressure ratio = 0.3, E = 2.1 x 10^{11} N/m^2, **07**
ε = hysteresis loss 25%
Compute the result if the disc is required to slide on plane surface having an average asperity angle =10^0.

Q.5 **(a)** Explain the mechanism of pressure development in hydrodynamic thrust bearing. **07**

(b) The Rayleigh step bearing of length 213 mm and width 860 mm is required to support 150 kN load. The sum of surface roughness on contacting surfaces of bearing is 5 microns. The minimum oil-film thickness required is 20 times the sum of surface roughness on contacting surfaces. The sliding velocity is 8 m/s. Using optimum conditions, calculate: **07**

(i) The location of step.
(ii) The maximum oil-film thickness.
(iii) The viscosity of lubricating oil.
(iv) The maximum pressure and
(v) The ratio of maximum pressure to average pressure.

OR

Q.5 **(a)** Derive Petroff's equation for hydrodynamic journal bearing. State the conditions under which Petroff's equation can be used. What are the limitations? **07**

(b) The following data is given for a 360^o hydrodynamic bearing. **07**

- Radial load =15KN,
- Journal speed = 1200 r.p.m
- Bearing length = 60 mm
- Journal diameter = 60 mm
- Minimum oil-film thickness = 0.009 mm

The class of fit is H_7e_7 (fine) normal running fit. For this fit,

$$\text{Hole limits} = 60^{+0.00}_{+0.03}$$

$$\text{Shaft limits} = 60^{-0.06}_{-0.09}$$

Specify the viscosity of the lubricating oil that you will recommend for this application. 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

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