Total No. of Questions : 12]

SEAT No. :

P736

[Total No. of Pages : 7

[4659]-38
B.E. (Mech. / Auto.) (Semester - I)
TRIBOLOGY
(Elective - I (b)) (2008 Pattern)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates :

1) ***Write only Exam seat No. on question paper.***
2) ***Attempt one question from each unit.***
3) ***Use of Electronics Calculator, Design Data book is allowed.***
4) ***Draw neat sketches whenever necessary and assume suitable data if necessary.***
5) ***Answer must be written to the points; irrelevant matter will be marked as zero.***

SECTION - I

Unit - I

Q1) a) Discuss Application and Limitation of Extreme Pressure Additives. **[8]**

b) Explain Physical and Chemical properties of lubricant. **[8]**

OR

Q2) a) What is lubricant? Explain basic mode of lubrication. **[8]**

b) Describe Tribology in metal cutting specific reference to coolant, action of coolant, types of coolant. **[8]**

Unit - II

Q3) a) Explain the quantitive law of sliding friction. Explain different methods to measure friction. **[8]**

b) A Hard steel surface consist of an array of conical asperities of an average semi-angle 70° slides on soft lead surface (H=85MPa) under load of 15 N. Calculate Volume of lead displaced in unit slide distance. The volume of lead material is $10^{-6}m^3$ for sliding distance of 1kM. Calculate wear coefficient of Lead. Assume H is Hardness. **[8]**

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OR

Q4) a) Explain 1) Stick slip vibration phenomena. 2) Abrasive wear theory. **[8]**

b) Describe causes of friction. **[2]**

c) A flat strip of 450 mm × 600 mm × 25 mm is rolled between the roll of Diameter 550 mm. If final thickness of strip is 18 mm. Calculate arc length of contact and also Calculate Maximum Possible reduction in single pass. If coefficient of friction is 0.3. **[6]**

Unit - III

Q5) a) What is tilting pad bearing? Compare Tilting pad bearing with fixed pad bearing. **[6]**

b) The following data related to a Hydrodynamic tilting pad bearing.

- Dimension of pad in the direction of motion = 100 mm
- Dimension across the direction of motion = 425 mm
- Minimum oil film thickness = 0.04 mm
- Viscosity of oil = 0.02×10^{-6} N-s/mm^2
- Sliding velocity = 3 m/s.

Calculate at optimum condition:

i) The location of pivot.

ii) Maximum pressure.

iii) Maximum pressure location.

iv) Average pressure.

Assume dW/dn=0 $n=2.18=\frac{hi}{ho}$ **[12]**

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OR

Q6) a) Explain Raimondi and Boyd method used for design Hydrodynamic journal bearing. **[6]**

b) The following data is given for 360° Hydrodynamic bearing.

- Journal Diameter = 100 mm.
- Bearing length = 50 mm.
- Journal speed = 1500 rpm.
- Minimum oil film thickness = 15 microns.
- Viscosity of oil = 30×10^{-9} N-s/mm^2.
- Specific gravity of oil = 0.86.
- Specific heat of oil = 2.09 kj/kg°C

Fit between journal and bearing is normal fit H7e7.

Calculate :

i) Load carrying capacity of bearing.

ii) Co-efficient of friction.

iii) Power lost in friction.

iv) Total flow rate of oil.

v) Side leakage.

vi) Temperature rise. **[12]**

Table No: 1

Diameter, mm	Tolerance, mm	
100	H7	E7
	+0.035	-0.072
	+0.00	-0.107

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SECTION - II

Unit - IV

Q7) a) Derive expression for fluid flow through Annular Area between piston and cylinder. **[8]**

b) What is function of compensator & Explain action of compensator in detail. **[8]**

OR

Q8) a) Derive expression for load carrying capacity and time of approach in case of two parallel square plates separated by a fluid film. **[8]**

b) Design a Hydrostatic squeeze film bearing for constant approach velocity as 0.015 m/s and load to be 4.5 kN. Using lubricating oil having viscosity as 45×10^{-9} N-s/mm^2.

Initial film thickness is uniform = 0.015 mm.

For 75% efficiency final film thickness is 0.009 mm. Assume plate is circular.

Whether bearing will support load OR not. **[8]**

Unit - V

Q9) a) Derive expression of Ertel-Grubin equation for Elestohydrodynamic lubrication. **[8]**

b) Briefly explain desirable properties of bearing material. (Minimum 05). **[8]**

OR

Q10) a) Why lubrication is required in metal working? Explain the type of lubrication in metal working. **[8]**

b) State and Discuss the lubricant and lubricating method for following Applications. **[8]**

i) Gears.

ii) Refrigerator Compressor

iii) Gas Turbines

iv) Rope and Chains.

Unit - VI

Q11) a) Explain desired characteristics of surface engineering component in detail. **[6]**

b) Discuss surface treatment/Coating type and their primary benefits (any 4) **[6]**

c) What is tribological surface?. Explain with neat sketches different tribological surface layers. **[6]**

OR

Q12) a) Write short notes on : **[12]**

i) Method to control corrosion

ii) Method to control wear in tribo system

b) Compare plasma Arc Spraying and Flame Spraying. **[6]**

$\frac{l}{d}$	$\frac{h_0}{c}$	ϵ	S	$\left(\frac{r}{c}\right)f$	$\frac{Q}{r\,cn_s\,l}$	$\frac{Q_s}{Q}$	$\frac{p_{max}}{p}$
	0.4	0.6	0.121	3.22	4.33	0.680	2.409
	0.6	0.4	0.264	5.79	3.99	0.497	2.066
	0.8	0.2	0.631	12.8	3.59	0.280	1.890
	0.9	0.1	1.33	26.4	3.37	0.150	1.852
	1.0	0.0	∞	∞	3.142	0	–
1/2	0.0	1.0	0	0	–	1.0	∞
	0.03	0.97	0.0061	0.610	5.88	0.980	7.936
	0.1	0.9	0.0313	1.60	5.69	0.939	4.854
	0.2	0.8	0.0923	3.26	5.41	0.874	3.745
	0.4	0.6	0.319	8.10	4.85	0.730	2.739
	0.6	0.4	0.779	17.0	4.29	0.552	2.267
	0.8	0.2	2.03	40.9	3.72	0.318	1.976
	0.9	0.1	4.31	85.6	3.43	0.173	1.912
	1.0	0.0	∞	∞	3.142	0	–
1/4	0.0	1.0	0	0	–	1.0	∞
	0.03	0.97	0.0101	0.922	6.12	0.984	9.259
	0.1	0.9	0.0736	3.50	5.91	0.945	5.555
	0.2	0.8	0.261	8.8	5.60	0.884	4.166
	0.4	0.6	1.07	26.7	4.99	0.746	2.994
	0.6	0.4	2.83	61.1	4.37	0.567	2.409
	0.8	0.2	7.57	153.0	3.76	0.330	2.045
	0.9	0.1	16.2	322.0	3.45	0.180	1.941
	1.0	0.0	∞	∞	3.142	0	–

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Table 2 : Dimensionless Parameters for Full Journal bearings

$\frac{l}{d}$	$\frac{h_0}{c}$	ϵ	S	$\left(\frac{r}{c}\right)f$	$\frac{Q}{r\,c n_s\,l}$	$\frac{Q_s}{Q}$	$\frac{P_{max}}{p}$
∞	0.0	1.0	0	0	0	0	∞
	0.1	0.9	0.0115	0.756	0.411	0	2.793
	0.2	0.8	0.021	0.961	0.760	0	2.020
	0.4	0.6	0.0389	1.20	1.56	0	1.499
	0.6	0.4	0.0626	1.52	2.26	0	1.309
	0.8	0.2	0.123	2.57	2.83	0	1.228
	0.9	0.1	0.240	4.80	3.03	0	1.210
	1.0	0.0	∞	∞	3.142	0	–
1.	0.0	1.0	0	0	–	1.0	–
	0.03	0.97	0.00474	0.514	4.82	0.973	6.579
	0.1	0.9	0.0188	1.05	4.74	0.919	4.048
	0.2	0.8	0.0446	1.70	4.62	0.842	3.195

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