Enrollment No: _____ Exam Seat No:_____

C.U.SHAH UNIVERSITY

Winter Examination-2018

Subject Name : Tribology in Design and Surface Engineering
Subject Code : 5TE01TDS1 Branch: M.Tech Mechanical (CAD/CAM)
Semester : 1 Date : 07/12/2018 Time : 02:30 To 05:30 Marks : 70

Instructions:

(1) Use of Programmable calculator and any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

SECTION – I

Q-1 Attempt the Following questions

a. Write down the equation to measure kinematic viscosity in the form of SUS. **(01)**
b. Define 'absolute viscosity'. Also give its two different units. **(01)**
c. Enlist four desirable properties of lubricant. **(01)**
d. Write the limitations of Bowden and Tabor's theory of simple adhesion. **(01)**
e. Write down the factors affecting wear rate. **(01)**
f. What do you mean by multigrade oil? Give one example. **(01)**
g. Write down any two advantages of Gas lubricated Bearings. **(01)**

Q-2 Attempt all questions

(a) What is the role of surface finish in improvement of fatigue life of the component? Explain through Tribological aspects. **(05)**
(b) Explain Viscosity Index with neat sketch. **(05)**
(c) Write the difference between contact type and non contact type surface roughness measurement device. **(04)**

OR

Q-2 Attempt all questions

(a) Draw bearing characteristic number with its regimes and give your comments. Also explain bearing modulus and its various relations with bearing characteristic number. **(05)**
(b) Give the role of Additives in lubricants. Also explain various types of additives generally used according to their functions. **(05)**
(c) Explain the following theory of lubrications: **(04)**

1. Boundary Lubrication
2. EHD Lubrication
3. PHD Lubrication

4. EP Lubrication

Q-3 **Attempt all questions**

(a) Prove that the co-efficient of friction during sliding is $\mu_{sld} = \frac{\tau}{H} + \frac{2}{\pi}\tan\theta$, where τ = shear strength, H = hardness and θ = asperity angle. **(07)**

(b) Explain in brief following theory of friction. **(07)**

1. Coulomb's theory
2. Tomlinson's theory

OR

Q-3 **Attempt all questions**

(a) Prove that total volume of wear due to adhesion and abrasion is given by, $V = \left(\frac{K_{ad}}{3} + K_{ab}\right) \bullet \frac{W}{H} L$, where K_{ad} and K_{ab} are the wear coefficient for adhesive and abrasive wear respectively, W is the load, L is the sliding distance and H is the hardness of the softer material. **(07)**

(b) Explain the term wear. Explain in detail different types of wear experienced in mechanical systems. **(07)**

SECTION – II

Q-4 **Attempt the Following questions**

a. Draw the pressure distribution diagram in hydrostatic step bearing. **(01)**

b. Write down the equation of coefficient of friction based on Mckee's experimental data. **(01)**

c. Define the term 'attitude' associated with hydrodynamic journal bearing. **(01)**

d. Give applications of hydrodynamic and hydrostatic journal bearings. **(01)**

e. Enlist any two materials which are used for rolling element bearing. **(01)**

f. Give only two applications of sliding contact bearing and rolling contact bearing. **(01)**

g. Explain Hertz equation for spherical contact. **(01)**

Q-5 **Attempt all questions**

(a) What do you mean by bearing load ratings and life prediction? Explain in details. **(05)**

(b) Write down the theory of Hertz contact stress. Also explain its fundamental assumptions. **(05)**

(c) What do you mean by endurance testing of rolling element bearing? Explain. **(04)**

OR

Q-5 **Attempt all questions**

(a) The following data refers to a hydrodynamic full journal bearing: **(05)**
Journal diameter = 50 mm
Bearing length = 25 mm
Journal speed = 1500 rpm
Eccentricity = 30 microns
Radial clearance = 40 microns
Viscosity of lubricant = 0.025 Pa-s

Using narrow approximation (short bearing) calculate:

1. the load carrying capacity of bearing; and
2. the flow rate of lubricant in l/min.

(b) Write short note on – Slider bearings. **(05)**

(c) Explain in details about the investigation and analysis of bearing failures. **(04)**

Q-6 **Attempt all questions**

(a) State the assumptions made while deriving, **(07)**

1. Petroff's equation and
2. Reynold's equation

for hydrodynamic journal bearing.

(b) A full journal bearing is rotating at 1200 rpm, and supporting a load of 6.5 kN. The shaft diameter is 60 mm and bearing diameter is 60.09 mm. l/d ratio is 1. If a minimum film thickness of 0.009 mm is to be maintained, find **(07)**

1. required viscosity of oil,
2. amount of oil flow rate through the bearing,
3. power lost in friction,
4. temperature rise in oil.

ε	$\frac{h_o}{c_r}$	S	ϕ	$\frac{r}{c_r}f$	$\frac{q}{rc_r n_s L}$	$\frac{q_s}{q}$	$\frac{\gamma . c \Delta t_o}{p}$	$\frac{p}{p_{max}}$
0.6	0.4	0.121	50.58	3.22	4.33	0.680	14.2	0.415
0.8	0.2	0.0446	36.24	1.70	4.62	0.842	8.00	0.313
0.9	0.1	0.0188	26.45	1.05	4.74	0.919	5.16	0.247

OR

Q-6 **Attempt all Questions**

(a) Derive the equation to evaluate the load carrying capacity of Hydrostatic step bearing. **(07)**

(b) Following data refers to a hydrodynamic journal bearing : **(07)**

Journal diameter = 40 mm

Length of bearing = 100 mm

Bearing load = 10 kN

Radial clearance = 0.04mm

Absolute viscosity of oil = 21 x 10^{-3} PaS at 70 °.

Room temperature = 33°C

Sp. Heat of oil 1760 J/kg °C

Speed of shaft = 750 rpm.

Heat dissipation coefficient C = 350 w/m^2 °C

Find : (i) Co-efficient of friction

(ii) power lost in friction

(iii) heat dissipated & give comments on requirement of artificial cooling

(iv) Attitude of bearing