Enrollment No: _____ Exam Seat No:_____

C.U.SHAH UNIVERSITY

Winter Examination-2015

Subject Name : Tribology in Design and Surface Engineering

Subject Code : 5TE01TDS1 **Branch :M. Tech.(CAD/CAM)**

Semester :1 **Date : 02/01/2016** **Time : 10.30 To 1.30** **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. Define 'Waviness'. **(01)**

b. What is the term 'SUS'. **(01)**

c. Explain 'Flaw' with diagram. **(01)**

d. Write two units of Viscosity. **(01)**

e. Draw the diagram for Absolute Viscosity Vs. Pressure **(01)**

f. State the two applications where wear is useful. **(01)**

g. Write name of two additives used in lubricant. **(01)**

Q-2 **Attempt all questions**

a. Explain EHD and PHD lubrication in details. **(05)**

b. Write the purpose of lubrication. **(05)**

c. What do you understand by real and apparent area of contact? **(04)**

OR

Q-2 **Attempt all questions**

a. Explain with neat sketch 'Redwood Viscometer'. Also write the equation which is used to calculate the viscosity through it. **(05)**

b. Explain in details the factors affecting on wear rate. **(05)**

c. Draw the topography of solid surface and indicate typical layers with thickness. **(04)**

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. Write different standards used to designate the viscosity of lubricant with **(07)**

example.

OR

Q-3 **Attempt all questions**

a. Explain the following theories of friction. **(07)**
(1) Junction growth theory
(2) Deformation theory

b. Derive Archard's equation to determine volume of adhesive wear. **(07)**

SECTION – II

Q-4 **Attempt the Following questions**

a. Write down the Hertz equation to determine contact radius when two spheres of different diameters are in contact. **(01)**

b. Draw the pressure distribution diagram in case of Hydrodynamic journal bearing. **(01)**

c. What are the limitations of Hydrostatic bearing? **(01)**

d. What is square bearing? **(01)**

e. Define attitude of the bearing. **(01)**

f. Draw the internal load distribution diagram for cylindrical roller bearing. **(01)**

g. 'Stiffness is high in case of hydrostatic bearing' – Give your comments. **(01)**

Q-5 **Attempt all questions**

a. Give comparison between long journal bearings and short journal bearings. **(05)**

b. Following data refer to a cylindrical roller bearing. **(05)**
Outer diameter of inner ring = 38.5 mm.
Roller diameter = 7.5 mm
Length of roller = 12 mm
Number of rollers = 13
Inner diameter of outer ring = 53.5 mm
Determine the contact width of roller-race interface for 6300 N load on roller. Consider same material with 2.058 x 10^5 N/mm^2 young modulus and 0.3 Poisson's ratio.

c. Write down the assumptions made while deriving Hertz contact stress theory. **(04)**

OR

Q-5 **Attempt all questions**

a. Derive from basic principles the two dimensional Reynold's equation for the hydrodynamic lubrication. **(05)**

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

c. Write down the step by step design procedure for hydrodynamic journal bearing. **(04)**

Q-6 **Attempt all questions**

a. Following date refer to a hydrodynamic full journal bearing: **(07)**
Bearing load = 5 kN
Journal diameter = 50 mm
l/d ratio = 1
Radial clearance = 0.035 mm
RPS = 40

Mean bearing temperature = 60° C
Quality of oil – SAE 30
Find : (1) Power lost in friction
(2) Side flow of oil from the bearing.
(3) Minimum oil film thickness
(4) Attitude of bearing
(5) Inlet temperature of 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	1.0	∞	(85)	∞	π	0	∞	–
0.1	0.9	1.33	79.5	26.4	3.37	0.150	106	0.540
0.2	0.8	0.631	74.02	12.8	3.59	0.280	52.1	0.529
0.4	0.6	0.264	63.10	5.79	3.99	0.497	24.3	0.484

b. Derive the equation to evaluate the pressure distribution on annular area of hydrostatic step bearing in following term. **(07)**

$$P = \frac{P_i \ln\left(\frac{R_o}{r}\right)}{\ln\left(\frac{R_o}{R_i}\right)}$$

Where,
R_o = Outer radius of shaft,
R_i = Radius of recess
P_i = Supply of inlet pressure

OR

Q-6 **Attempt all Questions**

a. The following data refers to a hydrodynamic full journal bearing. **(07)**
Journal diameter = 50 mm
Bearing length = 25 mm
Journal speed = 1500 r.p.m.
Eccentricity = 30 microns
Radial clearance = 40 microns
Viscosity of lubricant = 0.025 Pa-s
Using narrow approximation, calculate :
(1) the load carrying capacity of bearing; and
(2) the flow rate of lubricant in l/min.

b. The following data is given for a hydrostatic thrust bearing. **(07)**
Thrust load = 500 kN
Shaft speed = 720 r.p.m.
Shaft diameter = 500 mm
Recess diameter = 300 mm
Film thickness = 0.15 mm
Viscosity of lubricant = 165 SUS

Specific gravity = 0.86
Calculate : (1) Supply pressure (2) flow requirement in l/mm (3) power loss in pumping (4) frictional power loss