Exam Seat No:_____ **Enrollment No:**_____

C.U.SHAH UNIVERSITY

WADHWAN CITY

University (Winter) Examination -2013

Course Name :M.Tech(CAD/CAM) Sem-I **Subject Name: Tribology in Design and Surface Engineering** **Duration :- 2:30 Hours**

Date : 17/1/2014 **Marks : 70**

Instructions:-

(1) Attempt all Questions of both sections in same answer book / Supplementary.
(2) Use of Programmable calculator & any other electronic instrument is prohibited.
(3) Instructions written on main answer Book are strictly to be obeyed.
(4) Draw neat diagrams & figures (If necessary) at right places.
(5) Assume suitable & Perfect data if needed.

SECTION-I

Q-1 (a) With neat sketch show the surface texture and surface layers. 02

(b) Write the limitations of Bowden and Tabor's theory of simple adhesion. 02

(c) Enlist four desirable properties of lubricant. 02

(d) Define 'absolute viscosity'. Also give its two different units. 01

Q-2 (a) Discuss in detail different criteria for selection of Lubricants. 05

(b) Give the role of Additives in lubricants. Also explain various types of additives generally used according to their functions. 05

(c) Explain duty and responsibilities of 'Tribologist' working in xyz manufacturing industry. 04

OR

Q-2 (a) Draw bearing characteristic number with its regimes and give your comments. Also explain bearing modulus and its varies relation with bearing characteristic number. 05

(b) Explain in brief following theory of friction. 05

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

(c) State the lows for volume of wear. 04

Q-3 (a) Write disadvantages of Mechanical Stylus method for surface roughness measurement. Explain with neat sketch 'Laser Method' for measurement of surface roughness. 07

(b) 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

OR

Q-3 (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 short note on – 'Wear Measurements'. 07

SECTION-II

Q-4 (a) Explain the basic principal of EHD lubrication. 02

(b) Write Hertz's equations used to determine the half contact length for, 02
1. Spherical contact
2. Cylindrical contact

(c) Explain the basic need of endurance testing of rolling element bearing. 02

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

Q-5 (a) Write short note on – Slider bearings. 05

(b) Calculate the power loss for a Petroff bearing 80 mm diameter and 80 mm long. The radial clearance is 0.04 mm and shaft speed is 900 rpm. A SAE 10 oil is used, with mean temperature of 80 °C. Take dynamic viscosity of oil at this temperature as 8 cP. 05

(c) Give difference between hydrodynamic and hydrostatic journal bearing. 04

OR

Q-5 (a) State the assumptions made while deriving, 05
1. Petroff's equation and
2. Reynold's equation

for hydrodynamic journal bearing.

(b) Explain in details the major types of rolling element bearing failure. 05

(c) Explain Raimondi and Boyd method used for the design and analysis of hydrodynamic journal bearings. 04

Q-6 (a) The 2206 cylindrical roller bearing supports a radial load of 20090 N. Determine the loading at each roller location and the extent of the load zone. Use following data for 2206 bearing. 07

Roller diameter = 7.5 mm
Length of roller = 12 mm
Number of rollers = 13
Diametral clearance = 0.041 mm

Take reference of below table to determine the value of load distribution integral.

$\in$	$J_r(\in)$
0	1/Z
0.1	0.1268
0.2	0.1737
0.3	0.2055
0.4	0.2286
0.5	0.2453
0.6	0.2568
0.7	0.2636

(b) Derive the Reynold's equation in two dimensional flows for hydrodynamic lubrication. 07

OR

Q-6 (a) 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

(b) Derive the equation to evaluate the load carrying capacity of Hydrostatic step bearing. Also draw the pressure distribution diagram within annular ring. 07

*******17***14*****