Menoufia University **Faculty of Eng., Shebin El-Kom** **Mechanical Power Eng. Dept.** **Date of Exam: 10/06 / 2017**		**Lubrication Engineering** **Code: *MPE 528*** **Year : *Higher Diploma*** **Time Allowed : 3 hours**

Question (1) *(33 Marks)*

1.1 Show that the development of our modern machines requires a parallel development in lubrication technology? (5 Marks)

1.2 Explain with sketches the mechanism of dry friction between two surfaces? (7 Marks)

1.3 Show only if the following sentences right or wrong: (6 Marks)

a) Where complete separation is attained, the lubricant viscosity becomes the controlling parameter, and the condition is termed *fluid film lubrication.*

b) Where surface interaction continues to exert a significant effect, the term *hydrostatic lubrication* is used.

c) The slide friction coefficient depends to a great extent on time of contact between surfaces.

d) When nonmetals are slid on other materials, either metal or nonmetal, it is found that the frictional properties tend to be those of the softer material.

1.4 Explain the main differences between hydrostatic lubrication and hydrodynamic lubrication? (7 Marks)

1.5 A square cross section body having a weight of 50000 N is sliding over a flat plate surface. The thermal conductivity, density and specific heat of the flat plate surface are 45 W/m°c, 6000 kg/m^3 and 250 W.sec/kg. °c respectively. The corresponding values for the body are 350 W/m°c, 8000 kg/m^3 and 380 W.sec/kg. °c .

The coefficient of friction between the two surfaces can be taken as 0.45 and it is considered constant along the speed range.

If the length of the square is 50 cm, find the rise in temperature of the surface for the following cases:

a) Sliding velocity is 1.5 m/sec
b) Sliding velocity is 10 m/sec
c) Sliding velocity is 50 m/sec
d) Sliding velocity is 150 m/sec

What will be the critical sliding velocity if the temperature of oil must not exceed 200 °c and its initial temperature was 25 °c. (8 Marks)

Question (2) *(33 Marks)*

2.1 Explain the function of lubricants to control temperature? (6 Marks)

2.2 What are the desirable characteristics of insulating oils? (6 Marks)

2.3 What are the important properties of solid lubricant? (6 Marks)

2.4 Explain with sketch one method for measuring compressibility of lubricating oils in direct way? (6 Marks)

2.5 In a thrust bearing for a vertical turbine contains 15 pads and has a radius for pad centers of 55 cm, the dimensions of a pad are 10×25 cm with the large dimension in radial direction. The shaft of turbine rotates with 150 rpm. The viscosity of oil is 0.09 N.s/m^2. Find the maximum pressure and the load capacity of the bearing if the minimum film thickness is 1 mm and the ratio between maximum to minimum film thickness is 1.3. Also find the power loss due to friction and the friction coefficient. (9 Marks)

Question (3) *(34 Marks)*

3.1 Define both flash and pour point of oil? (6 Marks)

3.2 Drive an expression to determine the coefficient of friction in boundary lubrication case? (6 Marks)

3.3 Describe with sketches the components and the operation of both slide, thrust and journal bearings? (6 Marks)

3.4 Show with sketch why it is very important in hydrodynamic bearing that the wedge shaped film must be formed? (7 Marks)

3.5 In a journal bearing the diameter of the journal is 60 mm. The width of bearing 110 mm. The viscosity of the oil used is 50 x 10^{-3} N.S/m^2. The moment due to friction in bearing is found to be 0.384 N.m, the minimum film thickness of oil 0.1 mm and the length of the film is 130°. Determine for the maximum load condition:
a) The friction force. b) The load capacity of bearing. c) The number of revolution of the journal. d) The power loss in friction. (9 Marks).

With best wishes **Prof. Dr. A. A. El-Haroun**

You may use the following relations for hydrodynamic lubrication:

$$Q = \frac{Uh_1h_2b}{h_1 + h_2}$$

$$W = \frac{6\mu UbL^2}{(h_1 - h_2)^2}\left[lin\left(\frac{h_1}{h_2}\right) - \frac{2(h_1 - h_2)}{(h_1 + h_2)}\right]$$

$$F = \frac{\mu UbL}{(h_1 - h_2)}\left[4lin\left(\frac{h_1}{h_2}\right) - \frac{6(h_1 - h_2)}{(h_1 + h_2)}\right]$$

$$P = \frac{6\mu Ux(h - h_2)}{h^2(h_1 + h_2)}$$

$$P_{max} = \frac{\mu UL}{h_2^2}\frac{1.5(\alpha - 1)}{\alpha(\alpha + 1)}$$

This exam measures the following ILOs										
Question Number	Q1-1,2-1,3-1	Q1-3,2-2,3-3	Q1-4,2-2,3-2	Q1-2,2-3	Q2-4,3-1,3-4	Q3-2,3-5	Q1-3,2-5	Q2-3,3-5	Q2-1,2-5	Q3-1,3-5,1-5
Skills	KU1-1	KU1-5	KU4-1	KU 5-1	I1-1	I1-2	I3-1	PP3-1	PP 5-1	PP 5-2
	Knowledge &Understanding Skills				Intellectual Skills			Professional Skills		