Menoufia University Faculty of Eng., Shebin El-Kom Mechanical Power Eng. Dept. Date of Exam: /06 / 2014	جامعة المنوفية	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 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 *boundary lubrication*

b) In boundary lubrication, oiliness property of lubricant becomes most significant.

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

d) *Paraffinic* oils have high pour points because of the asphaltic components they contain

1.3 In rolling friction show with sketch that, the force required to maintain rolling will be lesser than the force required to start rolling? (7 Marks)

1.4 Explain the function of lubricants to control temperature. (7 Marks)

1.5 A slide bearing consists of a two hollow cylinders rotate against each other with 1000 revolution per minute. The inlet and outlet diameters of the cylinders are 100 and 130 cm respectively. If the coefficient of friction between contact surfaces is 0.4 and the cylinders are exposed to a normal load of 1500 N, find the temperature at the surface of contact when the flow of oil is stopped for one hour. Assume that the initial temperature was 20°C.

The first cylinder has density 7900 kg/m^3, thermal conductivity 45.4 W/m °C and specific heat of 460.8 W S/kg°C. The corresponding values of the second cylinder are 8800, 384 and 381.2 respectively. (8 Marks)

Question (2) *(33 Marks)*

2.1 Drive an expression to determine the coefficient of friction in boundary lubrication case? (5 Marks)

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

2.3 Explain why it is very important to use a suitable cooling system especially in hydrodynamic bearing? (6 Marks)

2.4 Drive an expression to determine the velocity distribution along the film height in hydrodynamic bearing? (8 Marks)

2.5 The slider velocity of a fixed bad slide hydrodynamic bearing is 30.5 m/s. Its length and width are the same and equal 7.6 cm. The ratio between maximum to minimum film thickness is h_1/h_2= 2.51, and the viscosity of oil μ= 0.041 N.s/m^2. If the friction coefficient between the slider and oil is 0.0016, find:

a) The minimum film thickness.

b) The load capacity of bearing.

c) The friction force and the power loss due to friction.

d) The flow rate of lubricant. (8 Marks)

Question (3) *(34 Marks)*

3.1 Discuss the effect of oiliness and viscosity on the friction between rubbing surfaces? (6 Marks)

3.2 How can the compressibility of lubricating oil be measured? (7 Marks)

3.3 Clarify the difference between hydrostatic and hydrodynamic lubrication? (5 Marks)

3.4. Drive an expression to determine the pressure distribution along the length of hydrodynamic bearing? (8 Marks)

3.5. The diameter of journal in journal bearing is 10 cm, its width 15 cm and it rotates with 500 rpm. The difference in diameter between the bearing and the journal 0.6 mm and the eccentricity is 0.03 mm. The ratio between the maximum and minimum film thickness α= 1.2.
If the viscosity of oil 1 poise and the film length is 130°, find:
a) Flow rate of oil
b) Maximum pressure and the angle at which maximum pressure occurs.
c) Load capacity of bearing. (8 Marks)

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

You may use the following relations for hydrodynamic lubrication:

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

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

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

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

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

This exam measures the following ILOs										
Question Number	Q1-4,2-1,3-1	Q1-3,2-2,3-3	Q1-5, 2-2, 3-2	Q1-1,2-3	Q2-5, 3-1, 3-4	Q3-2, 3-5	Q1-3, 2-4	Q2-5, 3-5	Q2-1, 2-3	Q3-1, 3-5
Skills	KU1-1	KU1-5	KU4-1	KU5-1	I1-1	I1-2	I3-1	PP3-1	PP 5-1	PP 5-2
	Knowledge &Understanding Skills				Intellectual Skills			Professional Skills		