



Reg. No. : .....

Name : .....

**First Semester M.Tech. Degree Examination, March 2014**

**Branch : Mechanical Engineering**

**Stream : Machine Design**

**(2013 Scheme)**

**MDC 1004 : INDUSTRIAL TRIBOLOGY**

Time : 3 Hours

Max. Marks : 60

**Instructions :** 1) Answer **any two** full questions from **each** Module.  
2) **Use** of Design Data Hand Book is **permitted**.

**Module – 1**

1. a) Explain how the physico-chemical characteristics of surface layers affect the tribological properties ? 5
- b) How the surface roughness affects the tribological properties of surfaces ?  
Briefly explain a method of measuring surface roughness. 5
2. a) What is static friction ? Explain the mechanism of stick-slip during the contact between two bodies. 5
- b) Describe the laws and theories of friction. 5
3. Mention the various stages of wear. Explain the mechanisms of adhesive wear and abrasive wear with diagrams. 10

**Module – 2**

4. An oil having an absolute viscosity of 120 cP flows through a gap of 190 mm wide and 1.8 m long with a pressure difference of 0.95 MPa. Find out the average and maximum velocities, the temperature rise and the volumetric flow rate. Mass density of oil is  $820 \text{ kg/m}^3$  and specific heat of oil is  $1.80 \text{ J/kg.K}$ . 10



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5. What is journal bearing ? Describe the mechanism of pressure development in hydrodynamic bearing with figure. 10
6. What is the importance of Sommerfeld number ? Derive an expression for the load carrying capacity of Journal bearing. 10

### Module – 3

7. a) Explain the method of elastohydrodynamic lubrication with sketches. 5  
b) Derive an equation for the minimum film thickness during the contact between a cylinder and a rigid plane under lubricated condition. 5
8. A rigid-inclined-pad thrust bearing of length 100 mm and width 500 mm, with a minimum film thickness of 50  $\mu\text{m}$ . operates with a sliding velocity of 1 m/s with a mineral oil of absolute viscosity 30 cP. Film thickness ratio is adjusted to produce the maximum load capacity. Calculate the maximum pressure and the location of the maximum pressure, normal load capacity, film stiffness, the power loss and the average temperature rise of the fluid. The mass density and the specific heat of oil are 880  $\text{kg/m}^3$  and 1.88 J/kg K respectively. 10
9. a) What is the importance of nanotribology ? Explain the working of surface force apparatus. 5  
b) Describe the working of atomic force microscope. 5
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