Tribology
VTU CBCS Question Paper Set
2018

USN ☐☐☐☐☐☐☐☐☐☐ 　　　　　　**10ME831**

Eighth Semester B.E. Degree Examination, June/July 2015
Tribology

Time: 3 hrs.　　　　　　　　　　　　　　　　　　　Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting*
　　　　　at least TWO questions from each part.
　　　　2. *Use of machine design data hand book is permitted.*
　　　　3. *Assume missing data suitably.*

PART – A

1　a. State Hagen-Poiseuille law and derive an expression for velocity distribution across the capillary tube. **(10 Marks)**

　b. Explain with a neat sketch construction and working of Ostwald viscometer and Saybolt viscometer. **(10 Marks)**

2　a. Derive an expression for friction force and coefficient of friction for lightly Loaded Journal bearing stating the assumption. **(10 Marks)**

　b. Explain with a neat sketch Tower's experiment. **(10 Marks)**

3　a. Explain with a neat sketch mechanism of pressure development in an oil film. **(10 Marks)**

　b. The following specification refers to a full journal bearing,
　Journal diameter = 60 mm, Bearing length = 75 mm, Journal speed = 2000 rpm,
　Radial clearance = 0.04 mm, Viscosity of lubricant = 0.01 PaSec,
　Eccentricity ratio = 0.8, Inlet pressure = 0.3 MPa, Location of inlet hole = 300°. Determine maximum and minimum pressure and their location. **(10 Marks)**

4　a. Derive an expression for load carrying capacity of an idealized plane slider bearing. **(10 Marks)**

　b. The following data refers to a slider bearing with pivoted shoe:
　Length of the bearing = 500 mm, Width of the bearing = 500 mm, Velocity of runner = 8 m/sec, Oil viscosity = 0.054 PaSec, Maximum and minimum film thickness = 0.15 mm and 0.075 mm. Determine (i) Load that may be carried by the bearing. (ii) Coefficient of friction (iii) Power loss. **(10 Marks)**

PART – B

5　a. Explain the importance of oil flow through journal bearing and typical designs of oil grooves in journal bearing. **(10 Marks)**

　b. A partial self contained 120° journal bearing has following specification,
　Journal diameter=87.5 mm, Bearing length=112.5 mm, Speed=480 rpm,
　Load on bearing = 31.78 kN, Diametrial clearance = 0.0875 mm,
　Ambient temperature = 32.2°C, Minimum oil film thickness = 0.013 mm,
　Lubricating oil = SAE40.
　Assuming that entire heat generated in the bearing is dissipated from bearing surface to the surrounding air. Determine i) Expected mean oil film temperature ii) Temperature of the bearing surface with average ventilation iii) Power loss. **(10 Marks)**

6 a. Derive an expression for load carrying capcity of hydrostatic step bearing. **(10 Marks)**

   b. A hydro static step bearing has following specification:
Shaft diameter = 130 mm, Pocket diameter = 55 mm, Shaft speed = 1800 rpm,
Inlet pressure = 3.75 MPa, External pressure = 0, Expected oil temperature = 50°C
Desirable oil film thickness = 0.00875 mm, Lubricating oil used = SAE60
Determine : i) Load the bearing can support   ii)   The rate of flow through bearing
iii) Power loss. **(10 Marks)**

7 a. Mention desirable properties of bearing material and explain any four commonly used
bearing materials. **(10 Marks)**

   b. Classify wear. Explain wear of polymer and ceramic materials. **(10 Marks)**

8 a. Explain the three tribological measures to reduce friction and wear. **(10 Marks)**

   b. Explain with graphs the influence of speed, temperature and pressure on wear. **(10 Marks)**

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Note: 1. *Answer FIVE full questions, selecting*
at least TWO questions from each part.
2. *Use of tribology data handbook is permitted.*

PART – A

1 a. Distinguish between:
   i) Dynamic and kinematic viscosity
   ii) Fluidity and viscosity
   iii) Newtonian and non-Newtonian fluid
   iv) Mineral oil and vegetable oil (for lubrication)
   v) Full and partial journal bearing.   **(10 Marks)**

   b. Sketch and explain working of any two viscosity measuring apparatus types. Add a note on
      the effect of temperature and pressure on viscosity of a fluid.   **(10 Marks)**

2 a. State Petroft's law and explain its significance.   **(05 Marks)**
   b. Describe Tower's experiments and conclusions drawn.   **(05 Marks)**
   c. A lightly loaded journal bearing has the following specifications:
      Diameter of journal = 50 mm   Bearing length = 80 mm
      Diametral clearance ratio = 0.002   Radial load = 750 N
      Viscosity = 10 cP   Speed = 4000 rpm
      Determine: i) Frictional torque,   ii) Coefficient of friction,   iii) Power loss.   **(10 Marks)**

3 a. Explain the significance of Sommer field number in distinguishing bearings.   **(05 Marks)**
   b. Draw a typical pressure distribution curve for an idealized full journal bearing and explain
      the significance of zones.   **(05 Marks)**
   c. A full journal bearing has the following specifications:
      Diameter of journal = 75 mm   Length of bearing = 60 mm
      Oil film temperature = 96°C   Radial clearance = 0.05 mm
      Oil film thickness = 7.9×10^{-3} mm   Lubricating oil is SAE 20.
      Lubricant is delivered to the bearing under a pressure through a single inlet pressure hole in
      an unloaded bearing region. Determine inlet pressure required if the rate of oil flow through
      the bearing must be 312 mm³/sec in order to control bearing temperature.   **(10 Marks)**

4 a. Distinguish a pivoted shoe slider bearing from a fixed shoe slider bearing.   **(05 Marks)**
   b. Discuss locating centre of pressure in fixed show slider bearing.   **(05 Marks)**
   c. A pivoted shoe of the slider bearing has square shape. The load acting on the bearing is
      13.34 kN velocity of the moving member is 5.08 m/sec. Lubricating oil is SAE 40. The
      expected mean temperature of oil film is 90°C. Permissible minimum oil film thickness is
      1.905×10^{-5} m. Find:
      i) Required dimensions of the shoe
      ii) Coefficient of friction in the bearing under given operating condition
      iii) Power loss.
      Assume that inclination of surface corresponds to maximum load carrying capacity. Neglect
      effect of end flow of oil.   **(10 Marks)**

PART – B

5 a. How do you distinguish between bearings from the standpoint of cooling conditions? Explain the categories with equations that are applicable under each. **(05 Marks)**

b. Write a note on flow of lubricant through a journal bearing having a single hole. **(05 Marks)**

c. The main bearing for a stationary slow speed steam engine has the following data:

Journal dia = 20 cms   Maximum load on the piston = 80 kN,

Engine speed = 200 rpm   Diamteral clearance ratio = 0.0009.

Determine the heat generated and heat dissipated given the operating temperature is 65°C and ambient temperature is 25°C. Take absolute viscosity as 60×10^{-3} PaS, heat capacity = 11.36×10^{-3} KW/m^{2}K, length of the bearing = πx diameter of journal (L = πd). **(10 Marks)**

6 a. State the principles, advantages, disadvantages and applications of hydrostatic lubrication. **(05 Marks)**

b. Explain the two main systems of hydrostatic lubrication. **(05 Marks)**

c. A hydrostatic circular thrust bearing has the following data:

Shaft dia = 300 mm   Dia of pocket = 200 mm

Shaft speed = 100 rpm   Pressure at the pocket = 500 kN/m^2

Film thickness = 0.07 mm   Viscosity of lubricant = 0.05 PaS.

Determine: i) Load carrying capacity, ii) Oil flow rate, iii) Power loss due to friction. **(10 Marks)**

7 a. What properties are expected of bearing materials? List them. **(05 Marks)**

b. What are conformability and embedability with respect to bearing materials? Explain. **(05 Marks)**

c. List the commonly used bearing materials. Explain any five of them with respect to their typical properties and advantages. **(10 Marks)**

8 Write explanatory notes on:

a. Wear of ceramic materials

b. Surface engineering

c. Wear measurements

d. Improved design of a tribological component

e. Advanced material's use in tribology application. **(20 Marks)**

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