Production

College of Engineering Pune

(An Autonomous Institute of Govt. of Maharashtra)

END Semester Examination

(PE-405 Elective -I) Tribology

Programme: B.Tech. (Production S/W) Year: 2012 - 13

Duration: 3 hrs. Max. Marks: 50

Instructions:

1) Use of non-programmable calculator is allowed.
2) Assume suitable data, if necessary.
3) Attempt all questions.

Q 1 a) Explain the method of friction measurement by Pin-on-Disk apparatus. Also explain conformal and non-conformal geometry friction tests **5**

b) What are the quantitative laws of wear? Derive the wear equation. **5**

Q 2 a) What are desirable properties of lubricating oil? Explain any four. **5**

b) Explain Kinematic & Dynamic viscosity of fluid. **5**

Determine the viscosity of the lubricant in Centi-poise, having viscosity 180 SUS and density of the fluid is 840 kg/m^3.

Q 3 **Answer Any Two**

a) Write all assumption and derive Reynold's equation for 2 dimensional flow. **5**

b) The following data refers to a short hydrodynamic journal bearing: **5**

Radial load = 1500 N; Journal speed =2100 r.p.m.
(l/d) ratio = 0.45
Eccentricity ratio = 0.7
Radial clearance = 0.002 X journal radius
Flow rate of lubricant = 3.55 liter/hour

Calculate:

(i) the diameter of journal;
(ii) the radial clearance;
(iii) the dimensions of bearing;
(iv) the minimum oil-film thickness; and
(v) the absolute viscosity of lubricant.

c) For infinitely short journal bearing derive following equation for pressure distribution: **5**

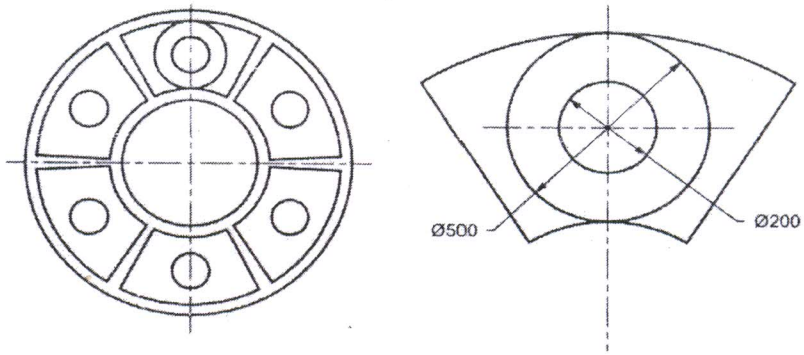
$$p = \frac{3\eta U \in \sin\theta}{r c^2 (1 + \in \cos\theta)^3}\left[\frac{l^2}{4} - z^2\right]$$

Where η - viscosity of oil
$\in$ – eccentricity ratio
U – linear speed of journal
r – radius of journal
c – radial clearance
and l – length of bearing.

Q 4 **Answer Any Two**

a) Derive expression for pressure distribution and load carrying capacity of conical hydrostatic pad bearing. **5**

b) The hydrostatic step bearing of a vertical turbo generator consists of six pads as shown in Fig. below. Each pad can be approximated as a circular area of 500 mm and 200 mm as outer and inner diameters respectively. The total thrust load acting on the bearing is 750 kN and the oil-film thickness is 0.13 mm. The viscosity and density of lubricant are 32 cP and 0.88 gm/cm^3 respectively and the supply pressure is 1.8 N/mm^2. The specific heat of lubricant is 2.19 kJ/ kg°C. If the shaft is rotating at 840 r.p.m., calculate: (i) the flow rate of lubricant; (ii) the frictional power loss, (iii) the pumping power loss, and (iv) the temperature rise, assuming the total power loss in bearing is converted into the frictional heat. **5**



c) A rectangular plate having length to width ratio of 0.25 is approaching towards a fixed plane with an initial oil-film thickness between the plate and plane as 0.06 mm. Load supported by plate is 15000 N for 5 seconds. The viscosity of oil is 30 cP. Calculate bearing length and width for final oil-film thickness as 0.012 mm. Also find maximum pressure value. **5**

Q 5 **Answer Any Two**

a) What are the different types of hydrodynamic thrust bearings? Derive expression for oil film thickness at maximum pressure for infinite width taper pad bearing. **5**

$$h_m = \frac{2\,h_i\,h_o}{(h_i + h_o)}$$

Where

h_i = thickness of fluid-film at entry

h_o = thickness of fluid-film at exit

b) State advantages and disadvantages of Rayleigh Step bearing. Derive expression for pressure distribution in case of Rayleigh Step bearing. **5**

c) For a tapered-pad bearing operating under hydrodynamic condition, width and length of shoe are 200 mm and 100 mm respectively. The film thicknesses at two ends are 0.08 mm and 0.20 mm respectively. The sliding velocity is 8 m/s, while viscosity of lubricating oil is 30 mPa-s. The effect of side leakage is to lower the load carrying capacity by 25% of ideal value. Calculate the load carrying capacity for the bearing. **5**

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