Register No.: …… Name: ……..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SECOND SEMESTER M.TECH DEGREE EXAMINATION (Regular), JULY 2022

MACHINE DESIGN

(2021 Scheme)

Course Code: **21MD205-A**

Course Name: **Industrial Tribology**

Max. Marks: **60** **Duration: 3 Hours**

Use of approved design data handbooks are permitted

PART A

(Answer all questions. Each question carries 3 marks)

1. State the assumptions made in Hertzian contact theory.
2. Explain the different ways of quantifying wear.
3. Explain the mechanism of hydrodynamic pressure development in a plane slider bearing with neat sketches.
4. Distinguish between Full-Sommerfeld, Half-Sommerfeld and Reynolds boundary conditions.
5. Explain the function of compensating element or restrictor in hydrostatic lubrication system.
6. Write down the applications of gas lubricated bearings.
7. Explain the geometrical construction of a ball bearing with a neat sketch.
8. Write short notes on selection of rolling contact bearings.

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. From first principles, estimate the coefficient of friction due to ploughing component of friction alone. (6)

OR

10. Explain any THREE theories of friction. (6)

MODULE II

11. Explain with neat sketches the mechanism of adhesive wear. (6)

OR

12. Explain boundary lubrication and its mechanisms. (6)

MODULE III

13. For an infinitely long plane slider bearing, obtain the expression for pressure distribution if inlet and outlet film thicknesses are h_1 and h_2 respectively. Draw the pressure distribution curve also. (6)

OR

14. A fixed inclination slider bearing of length 100 mm and width 600 mm, with a minimum film thickness of 40 μm, operates at a sliding velocity of 1 m/s with a mineral oil of absolute viscosity of 35 cP. Film thickness ratio is adjusted to have maximum load capacity. Calculate: (a.) the normal load capacity, (b.) the shear force experienced by the sliding surface, (c.) the coefficient of friction, (d.) maximum pressure, (e.) location of maximum pressure, (f.) volumetric flow rate, (g.) power loss due to viscous friction, and (h.) average temperature rise of the lubricant. Take mass density and specific heat of oil as 880 kg/m^3 and 1.88 kJ/kg-K, respectively. (6)

MODULE IV

15. Derive an expression for pressure distribution and load carrying capacity for an infinitely short journal bearing using half Sommerfeld boundary conditions. (6)

OR

16. The following data is given for a 360° hydrodynamic bearing: Radial load = 10 kN, Journal speed = 1440 rpm, Unit bearing pressure = 1000 kPa, Clearance ratio (r/c) = 800, Viscosity of the lubricant = 30 mPaS. Assuming that the total heat generated in the bearing is carried by the oil flow in the bearing, calculate (a.) Dimensions of the bearing, (b.) Coefficient of friction, (c.) Power lost in friction, (d.) Total flow of oil, (e.) Side leakage, (f.) Temperature rise. (6)

MODULE V

17. A hydrostatic square thrust bearing having a shoe dimensions of 250 mm and the square is subjected to a load of 120 kN. The ratio of the sides of the shoe and the recess is 2. SAE 30 oil is used at a temperature of 45 °C. Film thickness is 60 μm. Determine the linear velocity of the runner, recess pressure, flow required and pumping power. (6)

OR

18. For a circular step hydrostatic bearing, derive an expression for pressure distribution and flow rate of lubricant using neat sketches. (6)

MODULE VI

19. A rolling contact bearing is subjected to the following work cycle:
    i. Radial load of 6000 N at 150 rpm for 25% of the time,
    ii. Radial load of 7500 N at 600 rpm for 20% of the time,
    iii. Radial load of 2000 N at 300 rpm for 55% of the time.
    The inner ring rotates and loads are steady. Select a bearing for an expected average life of 2500 hours. (6)

OR

20. Explain the concept of Bio-tribology and Green tribology. (6)

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