INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR
Department of Mechanical Engineering
End-Spring Semester 2017-18

Date of Examination: 20-04-2018 (AN) **Duration: 3 hrs** **Full Marks: 100**

Subject No.: ME60404 **Subject : Lubrication and Rotor Dynamics**

Special Instructions (if any) : Attempt all questions. Symbols have their usual meanings. Please explain your work carefully. Make suitable assumptions wherever necessary. Please state your assumptions clearly.

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1. Derive the expression for squeeze load capacity and time of approach for infinitely long exponential geometry.

2. Explain two main systems of hydrostatic lubrication. Show that for a capillary compensated circular thrust bearing, the maximum stiffness with constant capillary resistance is $K = \frac{W}{h}$.

3. I) Explain in steps how to perform modal analysis of a rotor-bearing-disc system using FEM.

II) Explain the procedure of experimental modal analysis and model updating.

III) Draw 4 lower order mode shapes of (a) a flexible rotor with two stiff end bearings and (b) a stiff rotor with two flexible end bearings.

4. (a) What are the basic assumptions in the theory of lubrication.

(b) What is the mechanism of pressure development in a hydrodynamic bearing? Explain different lubrication regimes during run-up or run-down of a journal bearing.

(c) Explain oil–whirl and –whip mechanisms in hydrodynamic instability.

5. A finite full oil journal bearing ($\frac{L}{D} = 1$) is operating at $\varepsilon = 0.4$, has load capacity (in terms of Sommerfeld number) $S = 0.261$ and friction variable $\mu\left(\frac{R}{C}\right) = 5.8$. What will be the error induced if the load capacity and coefficient of friction are found using narrow bearing approximation.

6. What is cavitation in journal bearing and where it occurs. Explain different types of theories/models available in order to handle cavitation in numerical simulation of the finitely journal bearing using FDM.

Mark Distribution

Q. No.	1	2	3	4	5	6
Mark	16	4+12	8+6+6	6+6+6	18	4+8