



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : Debajit Das

Roll Number : 196103106

Programme of Study : Ph.D.

Thesis Title: Effect of Lubricant Inertia on Textured Hydrodynamic Journal Bearing using Mass Conserving Boundary Conditions

Name of Thesis Supervisor(s) : Prof. S. K. Kakoty

Thesis Submitted to the Academic Division : ME

Date of completion of Thesis Viva-Voce Exam : 24/10/2025

Key words for description of Thesis Work : Textured journal bearings, Lubricant inertia effect, JFO Boundary conditions

SHORT ABSTRACT

This thesis investigates the steady-state and stability performance characteristics of hydrodynamic journal bearings incorporating surface texturing, lubricant inertia, and cavitation effects. A novel modified Reynolds equation is developed to incorporate these combined influences and is implemented under both Reynolds and Jakobsson – Floberg – Olsson (JFO) boundary conditions. Various texture geometries, viz., spherical, cylindrical, and square (protrusions and dimples) are analyzed under different operating conditions, including variations in eccentricity ratio, dimple aspect ratio, texture area density and modified Reynolds number. Results show that protrusion texturing significantly improves load-carrying capacity and frictional performance, particularly when lubricant inertia is included. Cylindrical and square protrusions provide the most favourable performance under Reynolds and JFO boundary conditions, respectively. In contrast, dimple texturing exhibits more complex behaviour, with performance trends highly sensitive to geometric parameters and operating conditions. The flow coefficient is enhanced by lubricant inertia with cylindrical protrusions offering the greatest improvements at high modified Reynolds numbers. However, when JFO boundary conditions are considered the flow coefficient generally reduces. A nonlinear transient stability analysis reveals that protrusion-textured bearings demonstrate superior stability over dimpled and plain configurations. Stability is found to improve with increasing dimple aspect ratio and area density, while it deteriorates with larger non-dimensional clearance. Additionally, the presence of lubricant inertia contributes to improved stability under lightly loaded conditions.