Title of PhD thesis: **Tribodynamics of Powder Lubricated Journal Bearings**  
Candidate: **Faisal Rahmani** (Entry No: 2012MEZ8249)  
Supervisors: **Prof. J. K. Dutt & Prof. R. K. Pandey, Dept. of Mech. Engg.**

**Abstract**

Journal bearings operating in hot environments and at high temperatures experience accelerated degradation of lubricating oils. It becomes impossible to use conventional journal bearings in the hot working environments (above 500°C) due to rapid thermal degradation of lubricating oils. Under such circumstances, dry granular particulates are potential media for lubrication of journal bearings as an alternative to conventional lubricating oils. These dry particulates do not degrade thermally, even at considerably high temperatures. The primary objective of this thesis is to study the static and dynamic characteristics of powder lubricated journal bearings.

The circular bore of the journal bearing is modified to an elliptical shape, as a result of wear, misalignment, and deformation issues during use. The static and dynamic performance characteristics of elliptical-bore journal bearings lubricated with granular particulates are studied. The influence of particle size and bore ellipticity are investigated. It is found that a bearing lubricated with larger size particles offers better performance compared with that of smaller size particles. Bore ellipticity reduces the load-carrying capacity and increases side leakage and the coefficient of friction. However, rotor stability has a significant improvement at high eccentricity ratios (>0.6).

Investigations are carried out to explore the reduction of coefficient of friction in a powder lubricated journal bearing employing different pocket shapes (elliptical, parabolic, rectangular, and trapezoidal) placed at bore’s inner surface. Based on the investigations reported herein, it is found that the journal bearing having rectangular pocket yields least friction coefficient among all the cases. A sudden change in film thickness caused by the presence of pocket in the bearing will generate hydrodynamic pressure which will support the external load and may influence the stability of rotor supported on such bearings. The stability characteristics of powder lubricated journal bearings employing pockets of different shapes (rectangular, trapezoidal, elliptical, and parabolic) is explored herein. It is observed that though pocket of all shapes increases the whirl stability of a rotor shaft system, the rectangular shape is the most effective among all. Therefore, such bearings may be given a rectangular pocket to increase the stability of rotors.

An experimental investigation for studying the frictional and vibrational behaviour of powder lubricated journal bearing is also carried out in the present work. A test rig has been designed and fabricated to carry out the experiments. Three types of bearings, (a) conventional, (b) bearing with elliptical pocket, and (c) bearing with rectangular pockets are tested. Molybdenum disulphide (MoS₂) is used as a lubricant. Tests are carried out for different speeds of shaft and external loadings. It is found that pocketed bearings reduce the frictional torque as compared with conventional bearing. Vibration of bearing housing is also found to reduce with pocketed bearings.