The word "Tribology" was introduced when the "Department of Education and Science Report", known as "Jost Report" published in England in 1966. Tribology is defined as the science and technology of interacting surfaces in relative motion. It is an integrated study of lubrication, friction and wear of moving or stationary parts. It is the friction developed due to the interaction between opposing surfaces, resists the relative motion of the surfaces. Friction causes unsmooth relative motion of the surfaces and wear. It may result in reduction of the machine life. Therefore, various investigations have been launched to minimize this friction. In order to minimize friction and wear between moving machine elements a foreign substance, known as lubricant is introduced in between them. This lubricant keeps the machine elements apart and allows them to slide on each other with minimum efforts.

Presence of a lubricant film between two mating parts greatly reduces surface wear and consequently deformation, loss of energy, expansion of material by local surface heat, seizure of surfaces, unsmooth relative motion and maintenance or running cost of machines. When two surfaces of a machine are moving relative to each other, their lubrication depends upon a number of factors like load on the surfaces, relative velocity of the surfaces, geometry of the
surfaces, the type of materials out of which the surfaces are made and physical and chemical properties of the lubricants etc.

The contamination of lubricant is basically responsible for making a bearing surfaces rough through chemical degradation. In some cases bearing surfaces after having some run-in and wear develop roughness. Surface roughness of the bearing significantly affects the bearing performance. Hence the surface roughness has been a subject of discussion in many recent investigations.

The roughness has three different structures:

(1) Transverse roughness: a 1-dimensional disturbance with the furrows across the sliding direction

(2) Longitudinal roughness: a 1-dimensional disturbance consisting of grooves and ridges in the sliding/rolling direction

(3) Uniform roughness: a 2-dimensional disturbance distributed uniformly over the surface.

The effect of roughness on the performance of the bearing may be different for different structures. The present dissertation is centered around the study of the effect of surface roughness (i.e. transverse and longitudinal) on the performance of the bearing system.

The content of this dissertation is designed in six chapters. The first chapter is introductory in nature. It deals with the role of the bearings in machines and the factors that are important for the process of lubrication; such as types of lubricants,
types of bearings, geometry of surfaces, types of loading etc. It follows by a discussion on bearing design characteristics. Lastly, the review of the related literature is presented in this chapter.

In the second chapter of this dissertation mathematical modelling of the bearing system is discussed in details. This chapter also deals with the effects of various factors like inertia, turbulent, thermal and surface roughness in lubrication. Efforts have been made to focus particularly, on the surface roughness effects. Besides, the modified Reynolds equation for incompressible fluid is obtained in this chapter.

The third chapter presents the surface roughness effect on hydrodynamic lubrication of slider bearings. This chapter consists of two sections. The first section is concerned with the analysis of one-dimensional slider bearing with transverse surface roughness. The second section considers one-dimensional slider bearing with longitudinal surface roughness. In these investigations the probability density function for the random variable characterizing the surface roughness is considered to be assymetrical with non-zero mean. In both the cases four different lubricant film shapes such as plane slider, exponential, secant and hyperbolic are taken into consideration. Results are numerically computed and presented graphically as well as in tabular form. The analyses discuss the variation of the pressure and the performance characteristics such as load carrying capacity, frictional force, centre of pressure and temperature rise for different values of
roughness parameters. It is found that all the three roughness parameters affect the bearing performance characteristics; however, the effect of the parameter describing symmetricity seems more sharp. While in the case of transverse surface roughness the bearing suffers mostly, sometimes positively skewed roughness marginally betters the performance. It is interesting to note that sometimes longitudinal roughness enhances the performance of the bearing.

The fourth chapter describes the analysis of an optimum film profile of a rough slider bearing. The study has been made for both the one-dimensional structures of roughness; namely, transverse and longitudinal. An attempt has been made to find the shape of the lubricant film profile for a rough slider bearing such that the load carrying capacity of the bearing is optimum (maximum). It is observed that the optimum film profile for such a bearing is a step function. All the three parameters characterizing the roughness are taken into consideration. The step location and the step height ratio are calculated for various values of roughness parameters, and in turn, these results are used to compute load carrying capacity, frictional force and the centre of pressure. All the results are presented in tabular form and graphically as well. The results show that negatively skewed asymmetric surface roughness enhances the performance.

In the fifth chapter effect of surface roughness on the behaviour of squeeze film spherical bearing is analysed. Both the structures of roughness; transverse and longitudinal; are considered. In these discussions the probability density function
for the random variable characterizing the surface roughness is taken to be symmetric with non-zero mean. The study reveals that while mostly the surface roughness adversely affects the load carrying capacity of the bearing and causes the reduction of the response time for the rotor to attain a given film thickness; the standard deviation increases the load carrying capacity in the case of longitudinal surface roughness.

Towards the second half of this chapter the effect of surface roughness on the behaviour of slider bearing with squeeze film formed by a magnetic fluid is discussed. Both the structures, namely: transverse and longitudinal are taken into consideration. The findings say that the use of magnetic fluid as lubricant can reduce the adverse effect of the surface roughness in the performance of the bearing.

In the last chapter of this dissertation a brief summary and general conclusions of the present study are outlined. The scope for further investigations and future works is also suggested in the same chapter.

The findings of this dissertation tend to suggest that there is a possibility of the load carrying capacity being increased in the case of longitudinal roughness while the bearing suffers mostly in the case of transverse roughness. Further, the use of magnetic fluid as lubricant can reduce the adverse impact of the roughness on slider.
The investigation carried out in this dissertation establishes firmly that the effect of roughness on the performance characteristics is considerably significant and hence it must be accounted for in the bearing design.

Substantial portion of the work incorporated in this dissertation has been published in various research journals of national and international repute and also presented at national and international conferences. One of the articles was adjudged to be the best research paper in Gujarat Science Academy. Another paper was chosen for Hari Ohm Ashram award for the year 1997 - 98 in the field of Mechanical Engineering. Details of the papers incorporated in this thesis are listed below:


   This paper was presented at 10th International Conference on Surface Modification Technologies held in Singapore Sept. 2-4, 1996.

   This paper was also chosen for Hari Ohm Ashram award for the year 1997-98.

   (Incorporated here as a part of section 3.3)
   (Incorporated here as a part of section 3.3)

   > This paper was presented at 12th Gujarat Science Congress held on 15-16 February, 1997 at Vallabh Vidyanagar.
   (Incorporated here as section 4.3)

   > This paper was presented at 14th Gujarat Science Congress held on 10-11 October, 1998 at Palitana. This paper was selected for the award of Best Research Paper.
   (Incorporated here as section 5.2)

This paper was presented at 12th Gujarat Science Congress held on 15-16 February, 1997 at Vallabh Vidyanagar.

(Incorporated here as section 4.2)


(Incorporated here as section 3.2)

7. On the Shape of the Lubricant Film for the Optimum Performance of a Longitudinal Rough Slider Bearing, accepted for publication in Industrial Lubrication Tribology (West Yorkshire, U.K.).

(Incorporated here as section 4.3)

8. Effect of Longitudinal Surface Roughness on the Behaviour of Squeeze Film in a Spherical Bearing, communicated to Applied Mechanics and Engineering, Poland.

(Incorporated here as section 5.3)