ABSTRACT

Lubrication is the art of reducing frictional resistance by means of some kind of substance introduced between two surfaces in relative motion. The function of the lubricant is to hold the moving surfaces apart allowing them to slide on each other with minimum effort.

The squeeze film behaviour arises from the phenomenon of two lubricated surfaces approaching each other with a normal velocity. Because the viscous lubricant contained between these two surfaces cannot be instantaneously squeezed out, it takes a certain time for these surfaces to come into contact. Hence the viscous lubricant has a resistance to extrusion, a pressure is built up during that interval and the lubricant film then supports the load.

In chapter 1, the basic concepts of lubrication and the equations governing the flow of hydrodynamic lubrication are discussed.

In chapter 2, the squeeze film characteristics between two closely spaced parallel triangular plates are analysed. The upper triangular plate moves slowly towards the stationary lower plate. The gap in between the plates is filled with couple stress fluid. The modified Reynolds equation governing the film pressure is obtained from Stokes equations of motion. The squeeze film pressure $p$ is numerically solved using Composite Integration Methods. An expression for squeeze time is obtained by using numerical integration and the values of the dimensionless time $T$ are investigated for triangular plates. The influence of couple stresses resulting from the lubricant have been analysed and the results are discussed.
In chapter 3, a theoretical study of the steady flow of an incompressible micropolar fluid between two parallel porous plates is considered. The velocities are expressed in terms of a stream function. A similarity transformation is employed to solve the resulting system of differential equations. The results for velocity, microrotation and skin friction are studied and profiles for velocity, microrotation and skin friction are presented.

In chapter 4, a theoretical study of hydrodynamic squeeze film behaviour for porous triangular plates is analysed. The upper nonporous triangular plate is approaching the homogenous and isotropic lower porous triangular plate. The lubricant between the plates is a couple stress fluid with no body forces and body couples. On the basis of microcontinuum theory, the Stokes constitutive equations are solved and the modified Reynolds equation is derived. It is assumed that the polymer additives present in the lubricant do not percolate in the lower porous plate. An expression for squeeze film pressure is obtained. The load carrying capacity of the squeeze film is obtained by using the squeeze film pressure. The bearing characteristics of the couple stress lubricant are then obtained and the results are compared to the Newtonian Fluid. Researchers so far have analysed these characteristics only for porous rectangular plates. Here an attempt has been made to study these characteristics for porous triangular plates. The results reveal that the presence of micro structures in the fluid film cause an enhancement of squeeze film characteristics.

In chapter 5, a squeeze film between two closely spaced parallel elliptic plates is considered. The lower plate is stationary and the upper plate moves slowly towards the lower plate. The fluid in the film region is considered to be
filled with a Stokes couple stress fluid. It is assumed that the fluid flow is incompressible with no body forces or body couples.

The objective of this chapter is to study the influence of couple stresses resulting from the lubricant blended with additives for elliptic plates as only few investigations are available so far. The squeeze film pressure is solved and the dimensionless parameter D is numerically obtained. The dimensionless squeeze time T is investigated by varying the eccentricities of the elliptic plates for different values of the couple stress parameter. Similar studies are also examined for circular plates.

In Chapter 6, the squeeze film characteristics between closely spaced parallel rectangular plates of dimensions 2a and 2b are analysed. The lower plate is stationary and the upper plate moves slowly towards the lower plate. The lubricant is assumed to be an incompressible fluid with no body forces or couples. An attempt here has been made to solve the squeeze film pressure p by weighted residual methods. An expression for squeeze time is obtained by using numerical integration and the values of the dimensionless time T is investigated and the results are presented.

Chapter 7 gives the conclusion and lists the various applications of squeeze films in our daytoday life.