Synopsis

In the heated elastic body, the presence of the non-uniform temperature, or external constraints, or a combination of these two, produces what is known as thermal stresses. These are caused by the interaction of mechanical and thermal fields. These stresses, if large, may effect the strength of the structures significantly. Jet engines, high speed airplanes and missiles, and nuclear power plants are the examples of modern devices where the thermal stresses exist due to large temperature differences. The occurrence of thermal stresses, thus, plays an important part in the different phases of modern technology.

The proposed thesis deals with the unsteady problems of thermoelasticity. It is divided into seven chapters. In the first chapter the basic concepts of thermoelasticity are explained and the fundamental equations of coupled linear thermoelasticity are derived. A historical survey of the work done on the subject is also included. It is noted that if the coupling parameter is not very large, the equations become uncoupled. The uncoupled thermoelastic problems are the matter for investigation in the second, third, fourth and fifth chapters. In chapter number six and seven two simple techniques are developed to handle the coupled problems.

The second chapter deals with the problem of thermal stresses in a semi-infinite medium due to constant heat flux at the surface. The problem is solved by reducing it to the

solution of one-dimensional wave equation subject to the given boundary conditions. The results are obtained in the closed forms. Numerical results are also presented. In the third chapter the same method is applied to solve a problem of thermal stresses in an infinite thick plate with a cylindrical circular hole.

The chapter number four concerns with the problem of a rotating cylinder and is devided into two parts. In part one we take a hollow cylinder and in particular consider two cases, in which the angular velocity is (a) periodic and (b) exponentially decaying with time. Part two deals with a solid cylinder, the surface of which is assumed (a) at a constant temperature, or (b) radiating at the constant temperature. The Laplace transform technique and Duhamel's theorem are applied to solve the governing equations. The results are obtained in the closed forms.

In the fifth chapter we discuss a dynamical problem of thermal stresses in a finite solid cylinder due to temperature field applied at one end. Laplace and Hankel transforms are used to solve the basic equations and the results are obtained in the double summation series. Numerical results are also given.

In the sixth chapter a perturbation technique is applied to a coupled problem of thermoelasticity for a plate of an infinite radius. The results are obtained by restricting

the perturbation series to be linear in the coupling parameter and by using the Laplace and Hankel transforms. The expressions for the stress components have been obtained in the series form taking only upto the terms linear in coupling parameter. The various functions introduced in the perturbation series are found. The first term of these series correspond to the solution of the uncoupled transient thermoelastic problem, while the remaining terms give the effect of coupling.

In chapter number seven a coupled problem of thermoelasticity is solved by taking the value of the coefficient of coupling to be one and applying the Laplace transform technique. In particular three different cases (1) strain, (2) velocity impact, and (3) temperature specified at one end of the thin rod, are considered. The results for stresses in each case are obtained as anintegral which are also numerically analysed.