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Effect of Rotation Under the Influence of Gravity Due to Various Sources in a Generalized Thermoelastic Medium

Praveen Ailawalia[1,*] and Naib Singh Narah[2]

[1] *Department of Mathematics, M.M. Engineering College, Maharishi, Markandeshwar University, Mullana, District Ambala, Haryana, India*
[2] *Department of Mathematics, D.A.V College, Ambala City, Haryana, India*

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Abstract. The present problem is concerned with the study of deformation of a rotating generalized thermoelastic medium under the influence of gravity. The components of displacement, force stress and temperature distribution are obtained in Laplace and Fourier domain by applying integral transforms. These components are then obtained in the physical domain by applying a numerical inversion method. Some particular cases are also discussed in context of the problem. The results are also presented graphically to show the effect of rotation and gravity in the medium.

AMS subject classifications: 74F05

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1 Introduction

Generalized thermoelasticity theories have been developed with the objective of removing the paradox of infinite speed of heat propagation inherent in the conventional coupled dynamical theory of thermoelasticity in which the parabolic type heat conduction equation is based on fourier's law of heat conduction. This newly emerged theory which admits finite speed of heat propagation is now referred to as the hyperbolic thermoelasticity theory [9], since the heat equation for rigid conductor is hyperbolic-type differential equation.

There are two important generalized theories of thermoelasticity. The first is due to [23]. The second one is known as the theory with two relaxation times or the theory

*Corresponding author.
Email: praveen_2117@rediffmail.com (P. Ailawalia), naibsinghnehra@yahoo.co.in (N. S. Narah)

of temperature-rate-dependent thermoelasticity. [26], in a review of the thermodynamics of thermoelastic solid, proposed an entropy production inequality, with the help of which he considered restrictions on a class of constitutive equations. A generalization of this inequality was proposed in [21]. Green and Lindsay (G-L) obtained another version of the constitutive equations. These equations were also obtained independently and more explicitly by Suhubi in [42]. This theory contains two constants that act as relaxation times and modify all the equations of the coupled theory, not only the heat equations. The classical Fourier law violated if the medium under consideration has a centre symmetry.

Barber and Martin-Moran in [5] discussed Green's functions for transient thermoelastic contact problems for the half-plane. Barber in [6] studied thermoelastic displacements and stresses due to a heat source moving over the surface of a half plane. Sherief in [41] obtained components of stress and temperature distributions in a thermoelastic medium due to a continuous source. Dhaliwal et al. [20] investigated thermoelastic interactions caused by a continuous line heat source in a homogeneous isotropic unbounded solid. Chandrasekharaiah and Srinath in [10] studied thermoelastic interactions due to a continous point heat source in a homogeneous and isotropic unbounded body. Sharma et al. [33] investigated the disturbance due to a time-harmonic normal point load in a homogeneous isotropic thermoelastic half-space. Sharma and Chauhan [34] discussed mechanical and thermal sources in a generalised thermoelastic half-space. Sharma et al. [37] investigated the steady-state response of an applied load moving with constant speed for infinite long time over the top surface of a homogeneous thermoelastic layer lying over an infinite half-space. Deswal and Choudhary [18] studied a two-dimensional problem due to moving load in generalized thermoelastic solid with diffusion. The dynamic interaction of thermal and mechanical fields in solids has great practical applications in modern aeronautics, astronautics, nuclear reactors and high-energy particle accelerators, for example.

Some researchers in the past have investigated different problem of rotating media. Chand et al. [11] presented an investigation on the distribution of deformation, stresses and magnetic field in a uniformly rotating homogeneous isotropic, thermally and electrically conducting elastic half space. Many authors [12, 17, 31] studied the effect of rotation on elastic waves. [30] studied the effect of rotation and relaxation times on plane waves in generalized thermo-visco-elasticity. [43] investigated the interfacial waves in a rotating anisotropic elastic half space. Sharma and his coworkers [36,38–40] discussed effect of rotation on different type of waves propagating in a thermoelastic medium. Othman and Song [28, 29] discussed the effect of rotation in magneto-thermoelastic medium. Othman in [28] investigated plane waves in generalized thermo-elasticity with two relaxation times under the effect of rotation.

In classical theory of elasticity the gravity effect is generally neglected. The effect of gravity in the problem of propagation of waves in solids, in particular on an elastic globe, was first studied by Bromwich in [8]. Subsequently, investigation of the effect of gravity was considered by Love in [24] who showed that the velocity of Rayleigh waves is increased to a significant extent by the gravitational field when wavelengths