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Fibre-Reinforced Generalized Anisotropic Thick Plate with Initial Stress under the Influence of Fractional Thermoelasticity Theory

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Abstract. In the present work concentrated on the two-dimensional problem of generalized thermoelasticity for a fiber-reinforced anisotropic thick plate under initial stress. Using generalized thermoelasticity theory with fractional order heat conduction, the problem has been solved by a normal mode analysis. The effect of hydrostatic initial stresses and fractional order parameter is shown graphically on the distributions of the temperature, displacement and thermal stress components. It is found from the graphs that the initial stress and the fractional parameter significantly influences the varieties of field amounts.

AMS subject classifications: 74K25, 74G60

Key words: Fiber-reinforced, anisotropy, fractional thermoelasticity initial stress, thick plate.

1 Introduction

In the recent, consideration has been given to the problems of generation and propagation of elastic waves in an anisotropic elastic solids or layers of various configurations as the propagation of elastic waves in anisotropic media is fundamentally not the same as their propagation in isotropic media. The data obtained from such study is essential to seismologists and geophysicists to find the location of the earthquakes and additionally their energy, mechanism etc. and thereby gives vsignificant knowledge into the global tectonics. Accessible data recommends that the layered media, crystals and different materials, for example, fiber reinforced materials, fluid saturated porous materials etc. exhibits anisotropy. Some hard and soft rocks underneath the earth surface show the

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reinforcement properties, i.e., the diverse components goes about as a single anisotropic unit. These rocks when come in the method of seismic waves do influence their spread and such seismic signals are always influenced by the elastic properties of the media through which they travel.

The mechanical behavior of many fibre-reinforced composite materials is sufficiently shown by the theory of linear elasticity for transversely isotropic materials, with the favored direction coinciding with the fibre direction. In such composites the fibres are usually arranged in parallel straight lines. Nonetheless, different designs are utilized. An illustration is that of circumferential reinforcement, for which the fibres are arranged in concentric circles, giving strength and stiffness in the tangential (or hoop) direction. Fibre-reinforced composites are utilized as a part of an assortment of structures because of their low weight and high strength. A continuum model is utilized to clarify the mechanical properties of such materials. On account of an elastic solid reinforced by a series of parallel fibres it is usual to assume transverse isotropy. In the linear case, the related constitutive relations, relating infinitesimal stress and strain components, have five materials constants. The investigation of stress and deformation of fibre-reinforced composite materials has been an imperative subject of solid mechanics for most recent three decades.

The idea of presenting a continuous self reinforcement at each point of elastic solids was given by Belfied et al. [1]. Verma and Rana [2] applied this model to the rotation of a tube. Sengupta and Nath [3] investigated a problem of the surface waves in fiber-reinforced anisotropic elastic media. Hashin and Rosen [4] gave the elastic moduli for fiber-reinforced materials. The problem of reflection of plane waves at the free surface of a fiber-reinforced elastic half-space was discussed by Singh and Singh [5]. Singh [6] discussed the wave propagation in an incompressible transversely isotropic fibre-reinforced elastic media. Singh [7] studied the effects of anisotropy on reflection coefficients of plane waves in fibre-reinforced thermoelastic solid. Kumar and Gupta [8] investigated a source problem in fibre-reinforced anisotropic generalized thermoelastic solid under acoustic fluid layer. Ailawalia and Budhiraja [9] discussed the the effect of hydrostatic initial stress on fibre-reinforced generalized thermoelastic medium. Abbas and Abd-Alla [10] studied the effect of initial stress on a fiberreinforced anisotropic thermoelastic thick plate. Kumar anf Gupta [11] investigated with the propagation of waves in the layer of an anisotropic fibre reinforced thermoelastic solid. Abouelregala and Zenkour [12] studied the effect of rotation on the general model of the equations of the generalized thermoelasticity with fractional order for a homogeneous isotropic elastic half-space solid, whose surface is subjected to a Mode-I crack problem. Abouelregala and Zenkour, [13] investigated the generalized thermoelasticity problem for an infinite fiber-reinforced thick plate under initial stress.

The theory to include the effect of temperature change, known as the theory of thermoelasticity, has also been well established. According to the theory, the temperature field is coupled with the elastic strain field. In thermoelasticity, classical heat transfer, Fourier's conduction equation is extensively used in many engineering applications. The classical theory of thermoelasticity Nowacki, [14, 15] rests upon the hypothesis of the