Eur. Phys. J. Plus (2016) **131**: 424
DOI 10.1140/epjp/i2016-16424-8

THE EUROPEAN PHYSICAL JOURNAL PLUS

Regular Article

Analytical solution of magnetothermoelastic interaction in a fiber-reinforced anisotropic material

Aatef D. Hobiny[1,3,a] and Ibrahim A. Abbas[2,3,4,b]

[1] Department of Mathematics, Faculty of Science, King Abdulaziz University P.O. Box. 80203, Jeddah 21589, Saudi Arabia
[2] Department of Mathematics, Faculty of Science and Arts - Khulais, University of Jeddah, Jeddah, Saudi Arabia
[3] Nonlinear Analysis and Applied Mathematics Research Group (NAAM), Department of Mathematics, King Abdulaziz University, Jeddah, Saudi Arabia
[4] Department of mathematics, Faculty of Science, Sohag University, Sohag, Egypt

Received: 26 September 2016 / Revised: 24 October 2016
Published online: 8 December 2016 –

Abstract. The present paper is concerned with the investigation of the analytical solution of a fiber-reinforced anisotropic material under generalized magnetothermoelastic theory using the eigenvalue approach. Based on the Lord-Shulman theory, the formulation is applied to generalized magnetothermoelasticity with one relaxation time. Based on eigenvalue approach, exponential Fourier transform and Laplace techniques, the analytical solutions has been obtained. The inverses of Fourier transforms are obtained analytically. Numerical computations for a fiber-reinforced–like material have been performed and the results are presented graphically. The results of the temperature, displacement components and stress components have been verified numerically and are represented graphically. Comparisons are made with the results predicted by the presence and absence of reinforcement.

1 Introduction

Fiber-reinforced thermoelastic materials are composite materials which show a highly anisotropic elastic behavior, such that the elastic parameters have an extension in the fiber direction which is of the order of 50 or more times larger than that of the parameters in the transverse direction. These composite materials have light weight, and high resistance, strength and stiffness at a high temperature. Due to the theoretical and practical importance, many problems on waves and vibrations in fiber-thermoelastic materials have been investigated. Sengupta and Nath [1] studied the surface waves problem in an elastic fiber-reinforced anisotropic medium. By the introduction of the displacement potentials, decoupling cannot be achieved for wave propagation in fiber-reinforced anisotropic media, as presented by Singh [2], who observed that this decoupling cannot be obtained by the establishment of potential displacement for the wave propagation in a fiber-reinforced anisotropic medium. Fiber-reinforced elastic moduli were studied by Hashin and Rosen [3].

The mechanical and thermal waves propagate with infinite speed in the theory of classical coupled thermoelasticity, which is not physically admissible. Two well-established and well-investigated generalized thermoelasticity theories, replacing the classical Fourier law by postulating a new law of heat conduction, are the generalized thermoelastic theory with one relaxation time been proposed by Lord and Shulman [4], and that by Green and Lindsay [5] who established a generalized thermoelasticity theory with two relaxation times. Sherief and Dhaliwal [6] extended the theories of generalized thermoelasticity for an anisotropic body.

Many previous works on the development of the interaction of elastic and thermal fields on a fiber-reinforced anisotropic medium are available. Verma [7] studied the magnetoelastic shear waves problem in a self-reinforced medium. Abbas and Abd-Alla [8] discussed the effect of thermal relaxation time in an infinite fiber-reinforced anisotropic plate with cylindrical cavity. Abbas [9] investigated the effect of the magnetic field in a fiber-reinforced

[a] e-mail: ahobany@kau.edu.sa
[b] e-mail: ibrabbas7@yahoo.com