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Analytical Solution for a Free Vibration of a Thermoelastic Hollow Sphere

Ibrahim A. Abbas [a] [b]

[a] Department of Mathematics, Faculty of Science and Arts - Khulais , King Abdulaziz University , Jeddah , Saudi Arabia

[b] Department of Mathematics, Faculty of Science , Sohag University , Sohag , Egypt

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ANALYTICAL SOLUTION FOR A FREE VIBRATION OF A THERMOELASTIC HOLLOW SPHERE#

Ibrahim A. Abbas[1,2]

[1]*Department of Mathematics, Faculty of Science and Arts - Khulais, King Abdulaziz University, Jeddah, Saudi Arabia*
[2]*Department of Mathematics, Faculty of Science, Sohag University, Sohag, Egypt*

For a free vibration problem of a thermoelastic hollow sphere into the context of the generalized thermoelasticity theory with one relaxation time, exact analytic solutions are obtained with the use of eigenvalue approach. Both the inner and outer curved surfaces of the sphere are considered stress-free and isothermal surfaces. The dispersion relations for the existence of various types of possible modes of vibrations in the considered hollow sphere are derived. The numerical results have been presented graphically in respect of natural frequencies, thermoelastic damping, and frequency shift.

Keywords: Eigenvalue approach; Free vibrations; Lord and Shulman theory.

INTRODUCTION

The generalized thermoelasticity theories are a series of theoretical models capable of predicting a finite speed of heat conduction in thermoelastic media. The first of such modeling is the extended thermoelasticity theory (LS) of Lord and Shulman (1967), who introduced the concept of thermal relaxation time into the classical Fourier Law of heat conduction. Subsequently, modifying the stress versus strain relationship as well as the entropy relationship with relaxation time, Green and Lindsay (1972) proposed the temperature rate dependent thermoelasticity (GL) theory. The anisotropic case was later developed by Dhaliwal and Sherief (1980). During the past years, different problems have been considered by using the generalized thermoelasticity theories as in Sherief and Ezzat (1998), Abd-alla and Abbas (2002a), Elhagary (2011), Othman and Abbas (2011), Abbas and Othman (2012), Abbas and Youssef (2012), Elhagary (2012), Hosseini and Abolbashari (2012), Othman and Abbas (2012), Zenkour et al. (2012), Abbas (2013), Abbas and Zenkour (2013), Zenkour and Abouelregal (2013), Abbas (2014). A survey article

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Correspondence: Ibrahim A. Abbas, Department of Mathematics, Faculty of Science and Arts - Khulais, King Abdulaziz University, Jeddah, Saudi Arabia; E-mail: aabbas5@kau.edu.sa
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