FREE VIBRATION ANALYSIS OF A RIGIDLY FIXED VISCOThERMoELASTIC HOLLOW SPHERE

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In this paper an exact analysis of homogenous rigidly fixed vibrations of viscothermoelastic hollow sphere is presented. The basic governing partial differential equations have been reduced to ordinary differential equations by using Helmholtz decomposition equations. The uncoupled equation is taken for first class vibrations and remains independent of temperature variations, while coupled system of equations are taken for second class vibrations. Matrix Fröbenious method of extended power series has been applied in the coupled system of differential equations to get displacements and temperature. Numerical results have been presented, giving lowest frequency, dissipation factor, displacements and temperature change.

Key words: Toroidal; spheroidal; stresses; vibratios; Fröbenius method; spherical structures.
1. Introduction

The classical theory of thermoelasticity involving infinite speed of propagation of thermal signals, contradicts the physical facts. During the last three decades, non-classical theories involving finite speed of heat transportation in elastic solids have been developed to remove this paradox of infinite speed of propagation of thermal signals, but these theories contradict the physical facts of thermoelasticity. The extended thermoelasticity theory proposed by Lord and Shulman [1], incorporates a flux-rate term into Fourier's law of heat conduction, and formulates a generalized form that involves a hyperbolic-type heat transport equation admitting finite speed of thermal signals. However, Green and Lindsay [2] formulated temperature rate dependent thermoelasticity theory by introducing relaxation time factors that does not violate the classical Fourier law of heat conduction and this theory also predicts a finite speed for heat propagation. Hetnarski and Ignaczak [3] studied the response of semi-space to a short laser pulse in the context of generalized thermo-elasticity. Chen [4] reviewed the research history of spherically isotropic bodies. Lapwood and Usami [5] named the first class of vibrations as "torsional or toroidal" and the second class as "spheroidal or poloidal". Sano and Usami [6] computed the natural frequency parameters for an extensive set of modes of vibration for the solid sphere. Shah et al. [7] investigated the vibrations of hollow spheres by using two-dimensional theory of elasticity to obtain natural frequency parameters. Chen and Ding [8] reviewed the problem of multilayered three isotropic hollow spheres with the help of state space approach and obtained two classes of vibrations. Cohen et al. [9] obtained non-axisymmetric free vibrations of a spherically isotropic hollow sphere. Butler [10] developed a rational method for analysis of an arbitrary laminated elastic, isotropic hollow sphere under internal or external pressure. Sharma and Sharma [11] investigated the vibrations of a transradially isotropic coupled thermoelastic solid sphere by using Matrix Fröbenius method. Neuringer [12] developed the procedure of Fröbenius method when the roots of indicial equation are complex numbers. Several mathematical models [13-14] have been used to accommodate the energy dissipation due to internal friction in vibrating viscoelastic solids. Sharma [15] investigated the propagation of waves in an infinite Kelvin-Voigt type viscoelastic plate in the context of coupled ther-