ABSTRACT

In the present scenario of Science and Technology, materials play the most significant role in different types of mathematical applications to develop different mathematical models. There exist an infinite number of very minute particles which possesses space and dimensions in static and dynamic bodies. By virtue of intermolecular forces, these particles occupy shape and size due to action of forces. Hence, a large number of particles exist in a body, if there is a very small distance between the two neighboring particles as compared to the total dimension of the body, known as continuum body state. In engineering, the materials used are single crystals and polycrystalline type solids, having controlled purity. In last decade, very important solutions were obtained from thermoelastic and generalized thermoelastic contact problems, where the distribution of the stresses has been improved which is caused by the frictional heat generation. In most structural components, different types of engineering materials and their vibrations have many practical applications such as in geophysics, aerospace and navigations.

Present Work

The present thesis titled "**Analysis of Vibrations of Electro-Magneto Transversely Isotropic Thermoelastic Materials with Voids**" is a study the vibration analysis of transversely isotropic, thermoelastic cylindrical and spherical structures with local/non-local materials in presence of voids under the impact of electro-magnetic field, subjected to two different types of boundary conditions namely:

(i) Stress free, thermally insulated conditions.

(ii) Stress free, isothermal conditions.

The problems have been modeled with lend a hand of non-classical theories of thermoelasticity developed by Lord and Shulman (1967) (LS), Green and Lindsay (1972) (GL), Chandrasekharaiah (1998a) and Tzou (1995) and three-phase-lag (TPL) model of Roychaudhary (2007), subjected to nonlocal thermoelastic spherical and cylindrical structures with voids under different boundary conditions discussed above. The governing equations have been solved analytically to obtain field functions such as: displacement, dilatation, temperature change, equilibrated voids volume fraction and radial and de-hoop stresses. The analytical results are further solved numerically

and computationally by using software tool MATLAB. The computer replicated results in reverence of frequencies; frequency shift and thermoelastic damping have been presented graphically to show the behavior of the material in presence and absence of magnetic field. Here, we have used time harmonic variation technique to transform the governing equations and constitutive relations into ordinary differential technique. Iteration numerical method has been formulated to create numerical data with the help of computational tool MATLAB. Systems of linear equations have been solved by means of matrices method and crammers rule. Numerical data have been computed graphically with the help of computational tools. The graphical representation has been presented with help of numerical results for natural frequencies, frequency shift and thermoelastic damping.

The work reported in this thesis has been distributed in seven chapters as outlined below:

The **First chapter**, being introductory, contains a brief history of the subject and topic under study. In addition to recent developments, literature survey of the research work already carried out in this field has also been reported in this chapter.

The **Second chapter** concentrates on free vibrations of transversely isotropic nonlocal electro-magneto thermoelastic hollow cylinder with voids in the preview of generalized thermoelasticity. The governing equations and the constitutive relations are transformed into coupled ordinary differential equations by applying time harmonic variations. The boundary conditions of the outer and the inner surfaces of the hollow cylinder are considered to be traction free, no change in voids volume fraction and thermally insulated/isothermal temperature field. To explore the free vibration analysis from the considered boundary conditions, the numerical iteration method has been generated to create data by using MATLAB software tool. The obtained analytical results are represented graphically with the assistance of numerical computations and simulations in absence/presence of magnetic field for nonlocal/local thermoelastic materials.

In the **Third chapter**, the nonlocal elasticity together with the electro-magneto thermal dual-phase-lag model to a transversely isotropic generalized thermoelastic hollow sphere with voids has been addressed in radial direction. The elimination technique is employed to resolve the homogeneous equations to find the unknowns.

The unknowns such as dilatation, displacement, voids volume fraction, temperature change and radial/de-hoop stresses have been calculated analytically. The numerical Iteration method has been applied to thermally insulated/isothermal boundary conditions. For computation purpose the software MATLAB tool has been used. The real parts of generated data obtained from the frequency equations have also been shown graphically to frequency shift and natural frequencies. The effects of dual-phase-lag model of the theory of generalized transversely isotropic thermoelasticity with voids have been represented with and without the effects of magnetic field and validated with existing literature.

In the **Fourth chapter**, the stress–strain–temperature relations, strain–displacement relations and governing equations have been addressed for electro-magneto transversely isotropic nonlocal elastic hollow cylinder with voids in the reference of three-phase-lag effect of heat conduction. The simultaneous differential equations have been eliminated by applying elimination technique to obtain unknown field functions such as dilatation, equilibrated voids volume fraction, temperature, displacement and stress. Free vibration analysis has been explored by applying stress free and thermally insulated/isothermal boundaries. Analytical results are verified by employing numerically analyzed results for unknown field functions and presented graphically for the vibrations of stress free field functions such as damping, frequencies and frequency-shift. The results have been authenticated by analyzing analytical and numerical results with existing literature with earlier published work.

The **Fifth chapter** investigates the transversely isotropic electro-magneto nonlocal thermoelastic hollow sphere with voids material which has been addressed for free vibration analysis. By using time harmonics, stress-strain relations and modeling equations have been transformed into ordinary differential equations. The unknown field functions have been eliminated by using matrix elimination technique. In order to investigate the vibration analysis, the relations of frequency equations have been solved for assumed boundary conditions. To authenticate the phase-lag effects on the model of generalized thermoelasticity, the analytical results have been shown graphically in absence/presence of magnetic field.

The purpose of the **Sixth chapter** is to study the vibrations of rigidly fixed electro-magneto nonlocal elastic voids cylinder with generalized thermoelasticity. The surfaces of nonlocal elastic hollow cylinder have been assumed isothermal/thermally

insulated and rigidly fixed. For the investigation of the vibrations of rigidly fixed boundaries, we make use of numerical Iteration method using MATLAB tool. The real parts of generated data have been considered as natural frequencies and numerical computations in local/nonlocal elastic materials for free vibrations have been displayed graphically.

In the last chapter, i.e. the **seventh chapter**, the summary of the thesis, the applications of

the work carried out and the future scope of the work have been listed.

The thesis is appended with a long list of references, which is not claimed to be exhaustive.