ABSTRACT

A Finite Element Analysis of Unsteady MHD Convective Nanofluid Flows in Complex Geometries

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In this thesis, numerical investigations are conducted on unsteady magnetohydrodynamic flows and convective heat transfer phenomena of various water-based nanofluids in complex geometries. This class of fluid flow problems may be encountered in many areas of engineering and industry such as the cooling of electronic devices, solar energy technologies, heat exchangers and magnetic refrigeration. Furthermore, potential applications of nanofluids may be found in nanoparticle drug delivery and bio-heat transfer. In many of these applications, the associated fluid flow domains are geometrically complex and their corresponding mathematical models typically involve highly-coupled systems of non-linear partial differential equations. The finite element method is a suitable numerical technique for obtaining solutions to the research problems that are considered in the present study.

The thesis is comprised of six chapters. The first chapter introduces the main research areas associated with the present work and provides information about the mathematical models used herein. The second is a study of MHD natural convection in Al_2O_3-water and SWCNT-water nanofluids that are contained in a wavy trapezoidal enclosure. The third pertains to mixed convection flows of Au-water and SWCNT-water nanofluids through grooved channels with two heat-generating solid cylinders in the presence of an applied magnetic field. Mixed convective flows of Ag-water and Cu-water nanofluids within an L-shaped channel with a porous inner layer and four-heat generating components are investigated in the fourth chapter. In the fifth chapter, convective counter-current flows of Cu-water and CuO-water nanofluids through two coaxial elastic pipes in the presence of a radial magnetic field are examined. Finally, the sixth chapter examines MHD and FHD effects on the mixed convective flow of Fe_3O_4-water nanofluid through a wavy channel that contains two porous blocks.

Keywords: Victor M. Job; V. M. Job; Nanofluid; Magnetohydrodynamics; Ferrohydrodynamics; Convective Heat Transfer; Porous Media; Elastic Pipes; Complex Geometries; Finite Element Method.