UNIVERSITI TEKNOLOGI MARA

LINEAR AND NONLINEAR THERMAL CONVECTION IN NON-NEWTONIAN FLUIDS/NANOFLUIDS WITH MAGNETIC FIELD

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Convective flows are common phenomena occurring in geophysical systems and sand have fundamental and practical importance in engineering and technological processes. The onset of convective flow either stationary or oscillatory is known to cause imperfection such as striations, dendrites and bubbles in the manufactured products. This study considers the non-Newtonian of fluids/nanofluids and analyze the influences of thermophysical parameters and several internal and external forces to gain theoretical perspectives of their effects on the convective instabilities in non-Newtonian fluids/nanofluids. The objectives of this study is to analyze mathematical models of magneto convection in a horizontal non-Newtonian fluids/nanofluids layer. The effects of magnetic field and other physical parameters on convective instabilities in viscoelastic nanofluid layer, viscoelastic nanofluid saturated porous layer and Maxwell nanofluid saturated porous layer with salt are considered. The effects of uniform and convective boundary conditions for temperature and nanoparticle volume fractions are also examined. The linear stability analysis and Galerkin-type weighted residuals method are used to obtain the closed form solutions of the Rayleigh number. The stationary convection are found to be independent of the stress relaxation and strain retardation parameters. The presence of magnetic field leads to the increased strength of Lorentz force and gives stabilizing effects for both viscoelastic nanofluid and viscoelastic nanofluid saturated porous layer. The system with uniform boundary condition is more stable than the system with convective boundary condition for the convective instabilities in viscoelastic nanofluid layer. However, the system with convective boundary condition is more stable than the system with uniform boundary condition in viscoelastic nanofluid saturated porous layer. In the presence of salt with the applied and induced magnetic field, there exists a minimum wave number for the oscillatory convection to occur. This study also consider the weakly nonlinear stability analysis for the onset of convection in a viscoelastic fluid layer under gravity modulation and magnetic field. The amplitude of convection is obtained by deriving the Ginzburg-Landau equation and solved numerically. The effects of the physical parameters on the heat transport are examined. Lastly, the chaotic behavior of a Lorentz-like system in a viscoelastic nanofluid of Oldroyd-B type including modulated gravity is studied. The minimal Fourier series and scaling quantities are used to transform the system of partial differential equations into a system of ordinary differential equations. The chaotic system is found to be sensitive to physical parameters. The amplitude and frequency of the gravity modulation delay the onset of convection thus puts the system into its stable form. The findings suggest several possible mechanisms to delay or promote stationary or oscillatory instability in order to control or maintain either stationary or oscillatory convection for better processes.

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Verily! In the creation of the heavens and the earth and in the alternation of night and day are indeed Ayat (proofs, evidences, signs etc.) for people of understanding.
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