Hydromagnetic Instability Conditions for Viscoelastic Non-Newtonian Fluids

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The effect of a horizontal magnetic field and a non-Newtonian stress tensor, as described by the Walters B′ model, on the instability of two second order fluids of high kinematic viscosities and viscoelasticities is investigated. For the potentially stable configuration, it is found that the system is stable or unstable for a wavenumber range depending on the kinematic viscoelasticity. For the potentially unstable configuration, it is found that the stability criterion is dependent on orientation and magnitude of the magnetic field which is found to stabilize a certain range of the unstable configuration related to the viscoelasticity values. The behaviour of growth rates with respect to Alfvén velocities are examined analytically, and it is found that the magnetic field has a dual role on the instability problem. For the exponentially varying stratifications, the system is found to be stable or unstable for the stable and unstable stratifications under certain physical conditions, and the growth rates are found to increase or decrease with increasing the stratification parameter values, according to some restrictions satisfied by the chosen wavenumbers range.

Key words: Hydrodynamic Stability; Non-Newtonian Fluid Flows; Magnetohydrodynamics.