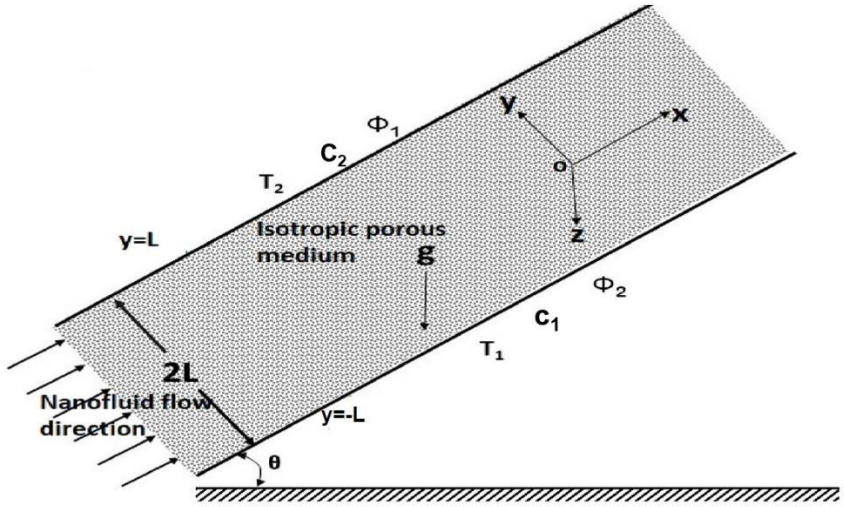
The impact of variable viscosity on the stability of double-diffusive nanofluid convection in an inclined porous channel

Nidhi Humnekar[1a], and D. srinivasacharya[1b]

[a] Department of Mathematics, National Institute of technology Warangal, India
[b] Department of Mathematics, National Institute of Technology Warangal, India Country

1. INTRODUCTION & OBJECTIVE

This study delves into the influence of double-diffusive convection and changing viscosity on the stability of nanofluid flow in an inclined porous cha nnel. The Darcy-Brinkman law is used to construct the momentum equation for the system. The eigenvalue problem for a perturbed state is obtained using a normal mode analysis, and the problem is afterward solved by the utilization of the Chebyshev spectral collocation method. Finally, the critical Rayleigh number with the corresponding wavenumber is evaluated at the assigned values of the other flow governing parameters and is shown graphically. For increasing values of the Darcy number, the Lewis number, Soret, and Dufour parameters increase the stability of the system, whereas the variable viscosity parameter and inclination of the channel destabilize the flow.



2. RESULTS & HIGHLIGHTS OF IMPORTANT POINTS

The Brinkman-extended Darcy model was employed to examine the linear stability of double-diffusive convection in an inclined channel with a porous medium saturated with nanofluid with variable viscosity. The critical Rayleigh number (Ra_c) and critical wavenumber (α_c) were computed and graphically presented for various values of inclination angle (θ), Darcy number (Da), Soret parameter (Sr), thermo solutal Lewis number (Ln), and Dufour parameter (D_f) versus variable viscosity parameter (k), and we observed that:

- The inclination of the channel destabilizes the flow.
- A rise in the value of the variable viscosity parameter (k) emphasizes the stability of the fluid, as a result, the k stabilizes the flow field.

- The flow in an inclined channel is stabilized by the permeability (Da), thermo-solutal Lewis number (Ln), Soret parameter (Sr), and Dufour parameter (D_f). Consequently, a rise in these factors delays the onset of convection.
- The least stable flow occurred when the channel was vertical.

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