Amplitude equation and heat transport for Rayleigh-Bénard convection in Newtonian nanoliquids with rigid isothermal boundaries

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1. INTRODUCTION

Nanoliquid comprises of a base liquid(water) and nanoparticle(Cu). The thermal conductivity of nanoparticle is greater than the thermal conductivity of the base liquid. Thus the presence of nanoparticle enhances the thermal conductivity of the nanoliquid. This is one of the modern methods of application involving thermal constants. The notable works on Rayleigh-Bénard convection in a nanoliquid are [1], [2], [3], [4], [5]. Most of the works consider free isothermal boundaries. In this paper we consider rough boundaries with general boundary conditions on temperature. A power series solution is presented for the eigen function and an accuracy of four decimal digits is achieved by considering fifteen terms in the power series. Help is sought from the Newton-Raphson method to improve a rough estimate of the eigenvalue.

2. RESULTS & HIGHLIGHTS OF IMPORTANT POINTS

Rayleigh-Bénard convection in nanoliquid (water-Cu) is modelled as a single phase system with Boussinesq approximation and small scale convective motion. Expressions for the thermophysical properties are chosen from earlier works. Stuart-Landau equation is arrived at from the tri-modal Lorenz model. The amplitudes of convective modes required for estimating the heat transport are determined analytically. Enhanced thermal conductivity being the reason for the enhancement of heat transport due to the presence of the nanoparticles is shown.

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