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Combined effect of variable viscosity and thermal conductivity on free convection flow of a viscous fluid in a vertical channel
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Abstract
Purpose - The purpose of this paper is to investigate the effect of exponential viscosity-temperature relation, exponential thermal conductivity-temperature relation and the combined effects of variable viscosity and variable thermal conductivity on steady free convection flow of viscous incompressible fluid in a vertical channel. Design/methodology/approach - The governing equations are solved analytically using regular perturbation method. The analytical solutions are valid for small variations of buoyancy parameter and the solutions are found up to first order for variable viscosity. Since the analytical solutions have a restriction on the values of perturbation parameter and also on the higher order solutions, the authors resort to numerical method which is Runge-Kutta fourth order method. Findings - The skin friction coefficient and the Nusselt number at both the plates are derived, discussed and their numerical values for various values of physical parameters are presented in tables. It is found that an increase in the variable viscosity enhances the flow and heat transfer, whereas an increase in the variable thermal conductivity suppresses the flow and heat transfer for variable viscosity, variable thermal conductivity and their combined effect. Originality/value - This research is relatively original as, to the best of the authors' knowledge, not much work is done on the considered problem with variable properties. © Emerald Group Publishing Limited.

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