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Convective heat transfer in a vertical rectangular ductawith temper ture dependent viscosity and temperature-dependent thermal conductivity
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Abstract
Background: The present paper is focused on the numerical investigation of the effects of temperature dependent viscosity and temperature-dependent thermal conductivity on steady, free convection flow of a viscous incompressible fluid in a vertical rectangular duct. Objectives: The purpose of this study was to provide an overview of the flow field if one assumes that viscosity and thermal conductivity parameters are not constant but they depend on the temperature. Methods: Finite difference scheme of second order accuracy was applied to solve the two dimensional coupled nonlinear equations. Validity of the obtained results was justified with the literature. Results: The effects of the non-dimensional parameters such as variable viscosity, variable thermal conductivity, Grashof number, Brinkman number and aspect ratio on the velocity, temperature, shear stress, volumetric flow rate and heat transfer rate were evaluated and depicted pictorially and also in the form of tables. It was observed that the effects of variable viscosity and thermal conductivity on the velocity and temperature fields were significant. Conclusion: It has been concluded that for positive values of the viscosity and conductivity variation parameters, the viscous fluid flows in the upward direction and for negative values, the fluid flows in the downward direction of the duct. Increase in the viscosity variation parameter, the thermal conductivity variation parameter, Grashof number, Brinkman number and the aspect ratio resulted in the improvement of the volumetric flow rate. © 2017 Bentham Science Publishers.

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