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Mixed convective heat transfer of immiscible fluids in a vertical channel with boundary conditions of the third kind
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Abstract
The effect of viscous dissipation and boundary conditions of the third kind on fully developed mixed convection for the laminar flow in a parallel plate vertical channel filled with two immiscible viscous fluids is studied analytically. The plate exchanges heat with an external fluid. Both conditions of equal and different reference temperatures of external fluid are considered. Separate solutions are matched at the interface using suitable matching conditions. First, the simple cases of the negligible Brinkman or negligible Grashof numbers are solved. Then, the combined effects of buoyancy forces and viscous dissipation are analyzed by the perturbation series method (PM), valid for small values of the perturbation parameter, and by the differential transform method (DTM), valid for all values of perturbation parameter. Numerical results are presented graphically for the distribution of velocity and temperature fields for varying physical parameters, such as the mixed convection parameter, perturbation parameter, viscosity ratio, width ratio, conductivity ratio, and Biot numbers. The effect of these parameters on the Nusselt number at the walls is also presented graphically. It is found that the mixed convection parameter and perturbation parameter enhance the flow field; whereas, the viscosity ratio, width ratio, and conductivity ratio suppress the flow field. It is also found that both PM and DTM solutions agree very well for small values of the perturbation parameter. © 2017 by Begell House, Inc.

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