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The effect of temperature-dependent viscosity and thermal conductivity on velocity and temperature field: an analytical solution using the perturbation technique. (English)

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Summary: This paper proposes a general form of the perturbation expansion method for the governing equations of viscous flow coupled to the temperature evolution. The effect of the variations of viscosity and thermal conductivity with temperature on the temperature and velocity fields in a steady two-dimensional Couette-Poiseuille flow is examined. The presented analytical solution by the perturbation method is validated against a finite difference solution of the governing equations. The numerical and analytical solutions are in good agreement.

MSC:

76D05 Navier-Stokes equations for incompressible viscous fluids
76M45 Asymptotic methods, singular perturbations applied to problems in fluid mechanics
76M20 Finite difference methods applied to problems in fluid mechanics
80A19 Diffusive and convective heat and mass transfer, heat flow

Keywords:

temperature-dependent material properties; laminar channel flow; analytical solution; perturbation technique

Full Text: DOI

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