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Gaseous slip flow in a porous two-dimensional rectangular microchannel subjected to inclined magnetic field

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Abstract: In this study, two-dimensional, steady, laminar, and compressible gaseous flow of Newtonian fluid in a rectangular porous microchannel affected by an electromagnetic field, and under local thermal equilibrium condition was analytically investigated in the slip flow region (0.001< Kn < 0.1). The porous microchannel is entirely affected by uniform inclined magnetic field with an angle ? from the positive x-axis, the range of this angle is 0 ? ? ? 90?. Also, the porous microchannel effected by uniform electric field which points in the positive z-direction. Thermophysical properties of the fluid were assumed to be constant. The normalized governing equations were asymptotically solved and expressions of the flow velocity components, the pressure, and the temperature were provided using first-order velocity slip and temperature jump boundary conditions. The effects of various parameters on the flow were studied, such as Darcy number, the porosity, the thermal conductivity ratio, the electrical conductivity ratio, Hartmann number, Knudsen number, the electric field to magnetic field ratio (0 ? K ? 1), and the magnetic field inclination angle. It was found that increasing the permeability of the porous medium increases the flow velocity but decreases its temperature. Further, the results reveal that applying a stronger magnetic field in absence of electric field decreases the flow velocity but increases its temperature. On the other hand, the stronger the electric field, the higher the flow velocity and its temperature. Also, as the magnetic field inclination angle increases the flow velocity decreases. The effects of Darcy number and the electrical conductivity ratio on the heat flux were studied as well. A comparison of the analytical solutions with the numerical results were presented as a validation for this study. The comparison showed that the analytical results were in good agreement with the numerical results.