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Convective transport in a nanofluid saturated porous layer with cross diffusion and variation of viscosity and conductivity
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Abstract
The effect of thermal conductivity and viscosity on linear and nonlinear stability in a horizontal porous medium saturated by a nanofluid has been investigated. The Darcy model has been used for the porous medium, while nanofluid incorporates the effects of Brownian motion along with thermophoresis. In conjunction with the Brownian motion, the nanoparticle fraction becomes stratified, and hence the viscosity and the conductivity are stratified. The linear stability analysis is based on the normal mode technique, while for nonlinear analysis minimal representation of the truncated Fourier series analysis involving only two terms has been used. It is found that for stationary convection Lewis number, the modified diffusivity ratio, viscosity ratio, and conductivity ratio have a stabilizing effect while nanoparticle concentration Rayleigh number and porosity destabilize the system. For oscillatory convection we observe that the thermal capacity ratio, viscosity ratio, and conductivity ratio stabilize the system whereas nanoparticle concentration Rayleigh number, Lewis number, and porosity destabilize the system. For steady finite amplitude motions, the heat and mass transport increases with increase in the values of nanoparticle concentration Rayleigh number, while the heat and mass transport decreases with increase in the values of nanoparticle concentration Rayleigh number, Lewis number, viscosity ratio, and conductivity ratio. The mass transport increases with increase in modified diffusivity ratio. We also study the effect of time on transient Nusselt number and Sherwood number which are found to be oscillatory when time is small. However, when time becomes very large both the transient Nusselt and Sherwood values approach their steady state values. © 2015 by Begell House, Inc.

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