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RADIATION AND MASS TRANSFER EFFECTS ON MHD FREE CONVECTION FLOW PAST AN IMPULSIVELY STARTED ISOTHERMAL VERTICAL PLATE WITH DISSIPATION

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ABSTRACT

This paper is focused on the study of effects of thermal radiation on the natural convective heat and mass transfer of a viscous, incompressible, gray absorbing-emitting fluid flowing past an impulsively started moving vertical plate with viscous dissipation. The governing boundary-layer equations are formulated in an (x, y, t) coordinate system with appropriate boundary conditions. The Rosseland diffusion approximation is used to analyze the radiative heat flux in the energy equation, which is appropriate for non-scattering media. The dimensionless governing equations are solved using an implicit finite-difference method of Crank-Nicolson type. The influence of Prandtl number, radiation-conduction parameter, thermal Grashof number, species Grashof number, Schmidt number, and Eckert number on the dimensionless velocity, temperature and concentration are studied. In addition the variation of the local and average skin-friction, Nusselt number, and Sherwood number for selected thermophysical parameters are computed and shown graphically. Increasing the Eckert number is seen to accelerate the flow. Thermal radiation reduces both velocity and temperature in the boundary layer. This model finds applications in solar energy collection systems, geophysics and astrophysics, aero space and also in the design of high temperature chemical process systems.

KEYWORDS

thermal radiation, mass transfer, MHD, viscous dissipation, finite difference

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