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Mass and heat transfer of modified second-grade fluid flow through a porous media over a linearly stretching sheet

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In this research, we have developed a mathematical model to describe a boundary layer approximation of modified second-grade fluid flow over a linearly stretching sheet with mass and heat transfer in a porous medium. The purpose of the model is to study the qualitative impact of buoyancy parameter, second-grade fluid parameter, magnetic parameters, porous parameter, power-law index, and chemical reaction parameter on the flow profiles, the radial and axial velocities, temperature, and concentration. The analysis has been started with the steady state governing equations derived from the conservation of mass, momentum, heat, and concentration of the fluid flow. The boundary layer approximations have been obtained on the fluid flow near the stretching sheet with the no-slip condition. The system of partial differential equations has been transformed into a system of nonlinear ordinary differential equations using similarity transformations. The resulting system of ordinary differential equations has been solved numerically and obtain the radial and velocities, temperature, and concentration profiles. The qualitative influence of the above flow parameters on the flow variables has been simulated and graphically presented for comparison. The study reveals that in the shear-thinning fluids, radial and axial velocities increase with solutal Grashoff number, thermal Grashoff number buoyancy parameters, and second-grade fluid parameters. In contrast, the temperature and concentration decrease with the above flow parameters. The Magnetic, Chemical reaction, and porous parameters suppress both radial and axial velocities but enhance the temperature and concentration. A similar impact on flow variables can also be observed for the shear-thinning fluids.

Keywords: Modified second-grade fluid, Similarity transformations, Radial and axial velocities, Mass and heat transfer, Porous media