Abstract

The mixed convection flow and heat transfer in square lid-driven cavities filled with an electrically conducting fluid in the presence of a uniform magnetic field are numerically investigated. The top and bottom walls of the cavity are adiabatic. The top wall of the cavity is allowed to move at a constant speed in its own plane. The various boundary conditions are imposed on vertical walls, namely, sinusoidal temperature profiles, discrete heating, partially thermally active walls with uniform temperature and corner heating. The remaining portions on horizontal/vertical walls of the cavity are kept adiabatic when one of the boundary conditions such as discrete heating, corner heating and partially thermally active walls having uniform temperature is considered. An electrically conducting fluid of low Prandtl number 0.054 is chosen as the working fluid. The unsteady governing equations together with the initial and boundary conditions are discretized by the finite volume method. The upwind difference scheme and the central difference scheme are employed for the convective terms and the diffusion terms, respectively. A computational code is developed for the present studies and it is verified against the available numerical solutions. A good agreement exists between the results of the present code and the available results. The investigations are carried out for the variations of the parameters such as Richardson numbers, Hartmann numbers, heater sizes, heater locations, amplitude ratios, phase deviations, locations of the heating and cooling regions, and the cavity inclination angles. The obtained results are presented in the form of isotherms, streamlines and velocity profiles. The heat transfer rate is calculated in terms of Nusselt number.