ABSTRACT

Studies on buoyant convection in a square cavity with partial heating and cooling are carried out. A two-dimensional cavity is considered and numerical investigations are performed to understand the effects of partially active thermal zones. To investigate this location effect, the study is performed by placing the thermally active zones in five different relative positions along the vertical sidewalls. The governing equations framed are solved using finite volume method and the numerical coding is done through the FORTRAN 95 programming. The effect of magnetic field and density inversion on the buoyancy driven convection of cold water near its maximum density under the influence of uniform magnetic field inside a square cavity is studied, both in presence and absence of internal heat generation. In the study, the partially heated or cooled zones are placed along the vertical sidewalls of the cavity while the other inactive portions of the walls are considered to be adiabatic and thermally insulated. In the absence of internal heat generation, the numerically simulated results attained are represented graphically in the form of flow field and temperature distribution for various positions of thermal zones, values of density inversion parameter, Hartmann number. In the presence of heat generation, a detailed study on transient and steady state analysis is performed for heat generation values varying between -10 and 10. The best possible location of thermal zone and internal heat generation value for which maximum heat transfer rate takes place is identified and suggested. The study on the heat transfer enhancement due to thermal radiation effects and the buoyancy driven convection flow in a square cavity with partial heating and cooling is carried out and in the numerical analysis, the behavior of fluid flow and the temperature distribution is obtained and presented graphically for different positions of partially thermally active zones and thermal radiation parameter. The radiation parameter is taken between 0 and 10 and Grashof number takes the values $Gr = 10^3$ and $Gr = 10^6$. The

results revealed that middle-middle location of the partial heater/cooler produce enhanced heat transfer. However, for $Gr = 10^3$, average Nusselt number with radiation parameter increases linearly and a non-linear increase in average Nusselt number with radiation parameter is observed when Grashof number is increased to 10^6. A numerical study on the pooled effect of buoyancy-driven flow and thermal radiation in the presence of constant magnetic field in a square cavity with active thermal zones placed partly on the side walls of the cavity is executed. The governing equations describing the natural convection and radiation for the incompressible flow are functions of thermal conductivity, electrical conductivity, and radiation parameter. It is observed from the graphical results that, increase in the magnetic field and radiation value produces optimal heat transfer rate and it happens when the partial walls are placed in the middle-middle position. The minimum heat transfer is observed when the partially active walls are placed along the top-bottom position of the cavity.