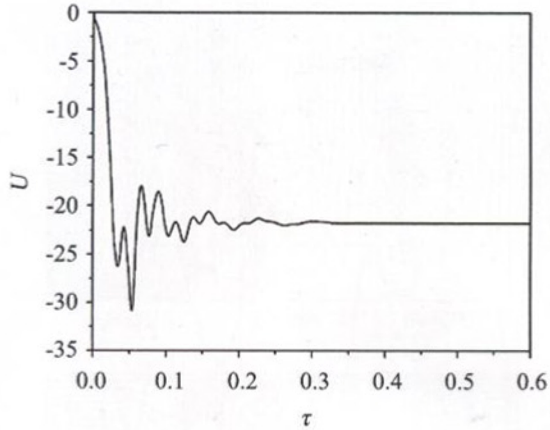
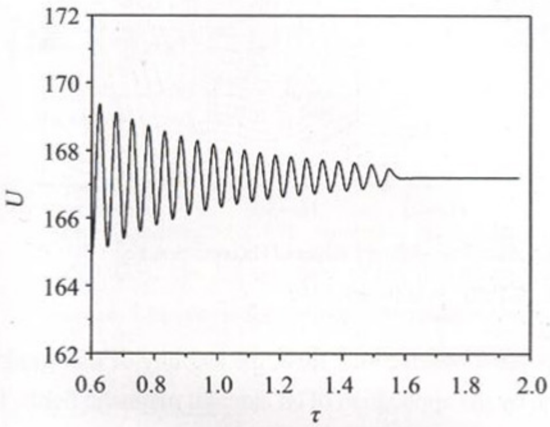
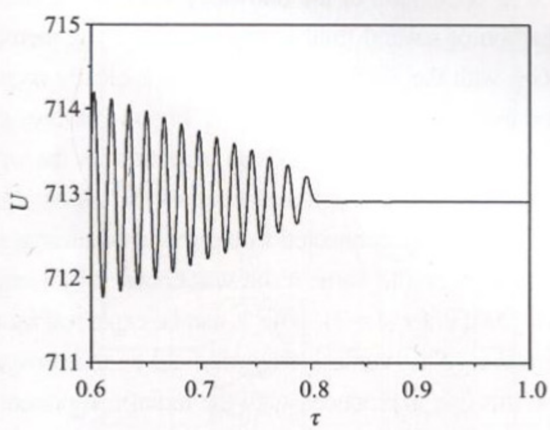


(a) $Ha = 0$ and $G_r = 0.7\times10^6$



(b) $Ha = 20$ and $G_r = 1.9\times10^6$



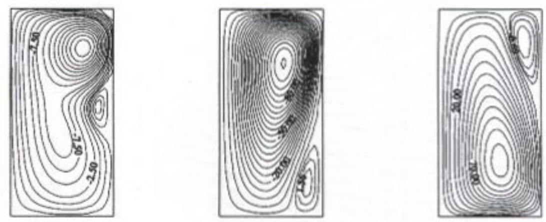
(c) $Ha = 60$ and $G_r = 5.9\times10^6$

Fig. 3. Time evolution of the dimensionless radial velocity U at three monitoring points P_1 (R=0.450, Z=0.288), P_2 (R=0.450, Z=0.529) and P_3 (R=0.450, Z=0.923).

cells. The top cell, turning clockwise, takes a more significant place compared to the bottom cell for the Hartmann number Ha, varying from 10 to 20. However for Ha=30, the predominance of the top cell is clear. The increase of Ha up to 40 creates an another cell.

The isotherms in Figure 5 show the existence and the predominance of the convectif mode compared to the diffusive mode, by showing the deformation of the isotherms. This mode becomes very significant in a similar way to the increase of the magnetic field intensity. That is explained by the growth of the values of Gr, which favourites the convectif flow compared to diffusive flow.

Figure 6 shows the temporal evolutions of the



(a) (b) (c)

Fig. 4. Iso-contours of the dimensionless stream function for different values of Gr and Ha :(a)Gr=0.7×10^6 and Ha=0; (b) Gr =4×10^6 and Ha=50 ; (c) Gr =5.9×10^6 and Ha=60.

dimensional temperature θ at different monitoring points P_1 and P_2 and P_3. We can notice that the amplitudes of the oscillations for various points are different, and therefore, the degree of the instability depends on the position of the particles in the cylinder. We can also notice, that the amplitude of the oscillations for the point P_3, corresponding to the centre of the cylinder is the large one compared to the other points. The effect of the walls stabilisation is shown by the amplitude of the oscillations of the point P_1, which is situated near the hot bottom wall of the cylinder.

In order to see the influence of the Grashof number Gr on the flow structure stability, we gradually increase the value of Gr. While arriving at a value known as, critical Grashof number Gr_{Cr}, the flow becomes oscillatory and periodic (Fig. 6). The reason of these oscillatory instabilities is closely related to the mechanism of production of the secondary cells. This is in good agreement with the results obtained by Gelfgat and Tanasawa (1994), which supposed that instability is caused by the interaction between the central vortex and the smallest vortices.

Also, in order to explain the nature of the flow oscillatory, we connect the temporal evolution of the