Magnetic Field and Hall Effects onFlow Pasta Parabolic Accelerated Vertical Plate With Differing Temperature and Mass Diffusion in the Existence of Thermal Radiation

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Abstract— The dissertation aims to discover the heat and mass transport impact on stream gone a parabolical accelerating isotherm immeasurable perpendicular panel in the existence of hall effects, magnet field effects and thermal radiation. The three-dimensional joined PDEs for impulse, varying quantity diffusion equation and power conjoint from precondition be depleted for non-dimensional format. The lateral resolutions from regulating mathematical problems are acquired utilizing marquis de Laplace transmute procedure. The statistical solution for the speed, the heat and the absorption biographies were exhibited diagrammatically. The stream occurrence has seen depicted through the aid of stream variables such as rotation variable Ω, hall parameter (m), Hartmann number (M), Prandtl number (Pr), Schmidt number (Sc), Grshof numbers for reheat and quantity transport (Gr & Gc). The fined rotation parameter Ω is fulfilling $\Omega = \frac{M^2 m}{1+m^2}$, the transverse motion vanishes also the liquid runs inside the path from that panel only. The outcomes form that parameters on the primary and secondary velocity biographies are manifested diagrammatically.

Key words: Magnetic field effect, Temperature, Thermal radiation, vertical plate, Isothermal.

1. Introduction

The analysis of exchange of thermal energy with heat radiation on convection stream is pivotal due its remarkable quota on the exterior thermal conduction. Current evaluation in vapor turbines, space vehicles, nuclear plants, hypersonic flights and gas cooled nuclear reactors have captivated survey in that area. Temperature and quantity convey appear simultaneously in fore coming procedures for example vaporization on the exterior to a body of water, dewatering, the stream within a desert cooler and wet chilling loom. Attainable application of this kind of stream can be executed in several enterprises. For instance, in the power industries amidst the way of creating electrical energy is one in which electric power is removed straight from a going directing fluid. The research of magneto hydro dynamic (MHD) acts an influential part in engineering, petroleum enterprises and agriculture. The MHD also has their individual realistic appeals. For cite, it is possible to handle with difficulties for example induction stream meter and the chilling of nuclear power plants by watery sodium, whatever relies on the potential variance in the liquid along a direction vertical to the electromagnetic area and to the move. In contemporary periods, the survey of MHD stream in the attendance of heat radiation including warm and heap shift possesses captivated the consideration of several research workers due to their attainable application within various area of sciencesand technology for example geography, astrography, nuclear reactor plant, soil sciences etc. MHD acts a crucial part in fluid-metallic chilling of nuclear power plant, Magnetic Drug Targeting also additionally electromagnetic casting.

Hall impact acts a crucial part in the area of sciences and technology for example hall impact detectors are utilized in fluid sensors, turning race detector, stress sensors and current detectors. Carbon Brushes direct

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current based on move detecting applications the concept of hall impact. Hall impact control sticks discover its utilization in scissor lifts, diggers, lifts, mining trucks. Hall impact engines is utilized to push space vehicles. Applying the rules of electromagnetic field outflow, inspect pipelines, hall explorations are utilized to evaluate electromagnetic area.Lakshmi [9] have analyzed hall impact and electromagnetic area impact on stream gone a parabolical hastened isothermal perpendicular panel about changeable quantity dispersion in the existence of heat emanation. Balamurugan [3] studied magneto hydro dynamics release transfer stream gone a perpendicular porous panel in a slide stream procedure with radiation alchemical responds and temperature gradient reliant thermal source in appearance of Dufour impact. Vijayaragavan, Karthikeyan and Jothi [20] presented temperature and quantity move on unstable magneto hydro dynamics stream of Jeffery liquid through a irradiating parallel thin stirring panel inserted in a material with pores with effect of the Dufour impact and thermal sink/sources. Raju, Varma and Reddy [12] studied emanation and quantity exchange impacts on a relieve conduction stream throw away a spongy material restricted by a perpendicular exterior. Sudhakar Reddy [19] studied the impact of slide position, Radiation and chemical change on unstable magneto hydro dynamics cyclical stream of a sticky liquid along soaked material containing voids in a two-dimensional waterway. Aarti Mangalesh [1] discussed magneto hydro dynamics release convective stream over porous material in the appearance of radiation, heat dispersion and hall flow.

Sarada and Shankar [15] established the impact of Dufour and Soret on unstable magneto hydro dynamics release convection stream gone a perpendicular permeable panel in the appearance of suck and shot. The mass and heat effects of rotation on parabolic flow across a vertical plate were studied by Selvaraj et al. [7.] Balamurugan and Gopikrishnan [2] rendered Radiation impact of magneto hydro dynamics vibrating stream ahead a permeable medium limited by two perpendicular porous panels in appearance of Dufour effect and hall current about chemical change.MHD Parabolic flow across an accelerating isothermal vertical plate with mass as well as heat diffusion was studied by Selvaraj et al. [17] in the presence of rotation. Singh and Singh [18] studied magneto hydro dynamics release convection temperature and quantity move stream gone a smooth panel. Kuznetsov [8] discussed Natural convective barrier coating stream of a nanotech liquid gone a perpendicular panel. Release convection with a perpendicular smooth panel included in a permeable medium through utilization to temperature move from a ditch was studied by Cheng and Minkowycz [6]. Unstable magneto hydro dynamics release convection stream a proportionally accelerating perpendicular panel about chemical change, thermal radiation and heat irradiation has been conveyed by Chamkha,Raju and Sundhakar Reddy [5]. Muthucumarasamy et al and Visalakshi [10] depicted radiative stream gone a proportionally accelerating perpendicular panel about changeable heat and mass dispersion. Raju and Rao Raman [13] analyzes Hall impact in the sticky flow of an ionized babble among two equivalent barriers over transversal magnetic area in a spin approach.

The goal of the current journal is to survey the accurate result of hall impact and electromagnetic area impact on stream gone an allegorical accelerated isothermal perpendicular panel about unstable heat and varying quantity dispersion in MHD and hall currents. This type of problem has some relevance on astrophysical, space vehicle re-entry and geophysical etc.

2. Mathematical Analysis

At the beginning, the liquid and the panel are in stable medium and with similar temperature. Present x'-axis is captured ahead the perpendicular panel in the perpendicularly ascending instruction and the y'-axis is captured regular to the panel. Primarily the panel and the stream were spin with a stable rotational velocity Ω' about the z'-axis regular to the panel, that is vertical to x'-axis and y' axis. At this point the unstable stream of a sticky impenetrable liquid gone an allegorical accelerated isotherm perpendicular panel with varying mass diffusion is examined. An electromagnetic area of unvarying power B_0 is used diagonally to the panel. At time $t' \leq 0$, the liquid and the panel are retained at the similar stable temperature T'_∞ and absorption of the liquid is C'_∞. At time $t' > 0$, the panel is allegorical accelerate with a speed $u = u_0 t'^2$ according to its own flat opposed attraction area. At time $t' > 0$, heat of the panel and the absorption grade close the panel is increased rectilinearly with reference to hour. Namely the heat of the panel is increased to T'_w and the absorption grade is increased to C'_w.

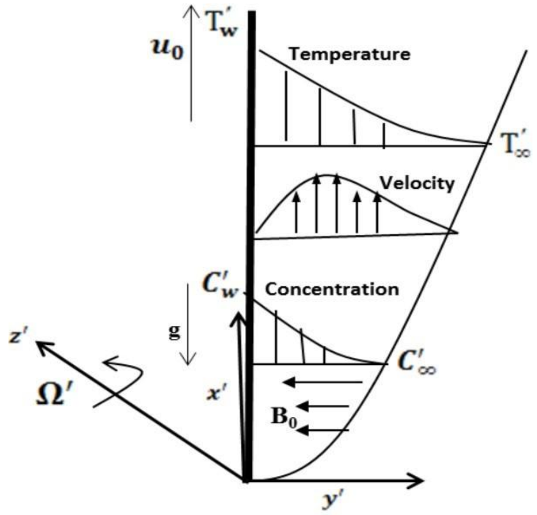

Fig.1 Flow model of the problem

By the way of Boussinesq's estimation, the unstable stream is regulated by the succeeding:

Momentum Equation:

$$\frac{\partial u}{\partial t'} = V\frac{\partial^2 u}{\partial y^2} + 2\Omega' v - \frac{\sigma \mu_e{}^2 B_0{}^2}{\rho(1+m^2)}(u+mv) + g\beta(T' - T'_\infty) + g\beta^*(C' - C'_\infty)(2.1)$$

$$\frac{\partial v}{\partial t'} = V\frac{\partial^2 v}{\partial y^2} - 2\Omega' u + \frac{\sigma \mu_e{}^2 B_0{}^2}{\rho(1+m^2)}(mu+v)\ (2.2)$$

Energy Equation:

$$\rho c_p \frac{\partial T'}{\partial t'} = k\frac{\partial^2 T'}{\partial z^2} - \frac{\partial q_r}{\partial z}\ (2.3)$$

Equation of mass diffusion:

$$\frac{\partial C'}{\partial t'} = D\frac{\partial^2 C'}{\partial z^2}\ (2.4)$$

Where u is the primary velocity and v is the secondary velocity. The primary and edge preconditions are

$$t' \le 0 : u = 0, v = 0, T' = T_\infty{}', C' = C_\infty{}' \ \textit{for all } z$$

$$t' > 0 : u = u_0 t'^2, v = 0, T' = T'_\infty + (T_w{}' - T'_\infty)At', C' = C'_\infty + (C_w{}' - C'_\infty)At' \ \textit{at } z=0$$

$$t' > 0 : u \to 0, v \to 0, T' \to T_\infty{}', C' \to C_\infty{}' \ \textit{as } z \to \infty\ (2.5)$$

The regional radiant for the case if a visually slim gas is stated by

$$\frac{\partial q_r}{\partial z} = -4a^* \sigma(T'^4{}_\infty - T'^4) \quad (2.6)$$

That is assumed that the change of heat during the stream are adequately tiny in such a way that T'^4 perhaps stated as a one-dimensional function of the heat. In the case under consideration consummate by developing T'^4 in a Taylor series with T'_∞ and omitting greater degree expressions, Hence

$$T'^4 \cong 4T'^3{}_\infty - 3T'^4{}_\infty \quad (2.7)$$

By utilizing equations (2.6) and (2.7), equation (2.3) decreases for

$$\rho C_\rho \frac{\partial T'}{\partial t'} = k\frac{\partial^2 T'}{\partial y^2} + 16\, a^*\, \sigma T'^3{}_\infty (T'_\infty - T') \quad (2.8)$$

Let's inserting the succeeding dimensionless abundance:

$$U = u\left(\frac{u_0}{v^2}\right)^{\frac{1}{3}}, \quad t = \left(\frac{u_0{}^2}{v}\right)^{\frac{1}{3}} t', Z = z'\left(\frac{u_0}{v^2}\right)^{\frac{1}{3}}, M = \frac{\sigma B_0{}^2}{\rho}\left(\frac{v}{u_0{}^2}\right)^{\frac{1}{3}}, Gc = \frac{g\beta\,(C' - C'_\infty)}{(v.u_0)^{\frac{1}{3}}},$$

$$Gr = \frac{g\beta\,(T' - T'_\infty)}{(v.u_0)^{\frac{1}{3}}} R = \frac{16\, a^*\, \sigma T'^3{}_\infty}{k}\left(\frac{v^2}{u_0}\right)^{\frac{2}{3}}, C = \frac{C' - C'_\infty}{C'_w - C'_\infty}, T = \frac{T' - T'_\infty}{T'_w - T'_\infty}, Pr = \frac{\mu C_p}{K}, Sc = \frac{v}{D}, \quad \Omega = \Omega'\left(\frac{v}{u_0{}^2}\right)^{\frac{1}{3}}$$

Calculations (2.1) to (2.5) are decreased to the dimensionless frame as:

$$\frac{\partial U}{\partial t} = \frac{\partial^2 U}{\partial Z^2} + 2\Omega V - \frac{2M^2}{1+m^2}\,(U - mV) + G_r\theta + G_c C (2.9)$$

$$\frac{\partial V}{\partial t} = \frac{\partial^2 u}{\partial Z^2} - 2\Omega U + \frac{2M^2}{1+m^2}\,(mU - V) (2.10)$$

$$\frac{\partial \theta}{\partial t} = \frac{1}{Pr}\frac{\partial^2 \theta}{\partial z^2} - \frac{R}{Pr}\theta (2.11)$$

$$\frac{\partial C}{\partial t} = \frac{1}{Sc}\frac{\partial^2 C}{\partial z^2} (2.12)$$

The primary and edge requirements in dimensionless frame are

$$t \leq 0 : \ U = 0, V = 0, \theta = 0, C = 0 \quad for\ all\ z$$

$$t > 0 : U = t^2, V = 0, \theta = t,\ C = t \quad at \quad Z = 0 (2.13)$$

$$t > 0 : U \to 0, V \to 0, \theta \to 0, \qquad C \to 0 \quad as \quad Z \to \infty$$

The above-mentioned calculations (2.9) to (2.12) and the boundary requirements (2.13) may be

joined as

$$\frac{\partial F}{\partial t} = \frac{\partial^2 F}{\partial Z^2} - aF + G_r\theta + G_c C (2.14)$$

$\frac{\partial\theta}{\partial t} = \frac{1}{Pr}\frac{\partial^2\theta}{\partial z^2} - \frac{R}{Pr}\theta$(2.15)

$\frac{\partial C}{\partial t} = \frac{1}{Sc}\frac{\partial^2 C}{\partial z^2}$(2.16)

Where$a = \frac{2M^2}{1+m^2} + 2i\left[\Omega - \frac{M^2 m}{1+m^2}\right]$

Along with edge requirements

$t' \le 0: \ F = 0, \theta = 0, C = 0$ for all z
$t' > 0: \ F = t^2, \ \theta = t, \ C = t \ \ at \ \ Z = 0$(2.17)
$t' > 0: \ F \to 0, \quad \theta \to 0, \quad C \to 0 \ \ as \ \ Z \to \infty$

Where $F = U + iV, U$ denotes the primary velocity, V denotes the secondary velocity.

$\theta(z,t) =$
$\frac{t}{2}\left[\exp\left(2\eta\sqrt{Rt}\right) erfc\left(\eta\sqrt{Pr} + \sqrt{bt}\right) + \exp\left(-2\eta\sqrt{Rt}\right) erfc\left(\eta\sqrt{Pr} + \sqrt{bt}\right)\right] -$
$\frac{\eta\sqrt{Prt}}{2\sqrt{b}}\left[\exp\left(-2\eta\sqrt{Rt}\right) erfc\left(\eta\sqrt{Pr} - \sqrt{bt}\right) - \exp\left(2\eta\sqrt{Rt}\right) erfc\left(\eta\sqrt{Pr} + \sqrt{bt}\right)\right]$(2.18)

$C(z,t) = \frac{t}{2}\left[\exp\left(-2\eta\sqrt{Sc.t}\right) erfc\left(\eta\sqrt{Sc} - \sqrt{t}\right) + \exp\left(2\eta\sqrt{Sct}\right) erfc\left(\eta\sqrt{Sc} + \sqrt{t}\right)\right]$(2.19)

$F = \left\{\left(\frac{\eta^2 t}{a} + t^2\right) S + \left(\frac{1}{4a} - t\right)\eta\sqrt{t}\, T - \frac{\eta t}{a\sqrt{\pi}} e^{-\eta^2 - at} + (e-f)(A_1 - A_2) + (g-h)A_3\ g.\exp(ct)\, A_4 +\right.$
$\left. h.\exp(dt)\, A_5 - g.A_6 - e(A_7 - A_8) + g.\exp(ct)\, A_9 + h\, A_{10}. + f.A_{11} - h.\exp(dt) A_{12}\right\}$(2.20)

Where

$$S = \frac{1}{2}\left[\exp(2\eta\sqrt{at})\, erfc(\eta + \sqrt{at}) + \exp(-2\eta\sqrt{at})\, erfc(\eta - \sqrt{at})\right]$$

$$T = \frac{1}{2\sqrt{a}}\left[\exp\left(-2\eta\sqrt{at}\right) erfc\left(\eta - \sqrt{at}\right) - \exp(2\eta\sqrt{at})\, erfc(\eta + \sqrt{at})\right]$$

$$A_1 = t\left[\exp(2\eta\sqrt{at})\, erfc(\eta + \sqrt{at}) + \exp(-2\eta\sqrt{at})\, erfc(\eta - \sqrt{at})\right]$$

$$A_2 = \frac{\eta\sqrt{t}}{\sqrt{a}}\left[\exp\left(-2\eta\sqrt{at}\right) erfc\left(\eta - \sqrt{at}\right) - \exp(2\eta\sqrt{at})\, erfc(\eta + \sqrt{at})\right]$$

$$A_3 = \exp(2\eta\sqrt{at})\, erfc(\eta + \sqrt{at}) + \exp(-2\eta\sqrt{at})\, erfc(\eta - \sqrt{at})$$

$$A_4 = \exp(2\eta\sqrt{(a+c)t})\, erfc(\eta + \sqrt{(a+c)t}) + \exp(-2\eta\sqrt{(a+c)t})\, erfc(\eta - \sqrt{(a+c)t}$$

$$A_5 = \exp(2\eta\sqrt{(a+d)t})\, erfc(\eta + \sqrt{(a+d)t}) + \exp(-2\eta\sqrt{(a+d)t})\, erfc(\eta - \sqrt{(a+d)t}$$

$$A_6 = \exp(2\eta\sqrt{Rt})\, erfc(\eta\sqrt{Pr} + \sqrt{bt}) + \exp(-2\eta\sqrt{Rt})\, erfc(\eta\sqrt{Pr} - \sqrt{bt})$$

$$A_7 = t\left[\exp(2\eta\sqrt{Rt})\, erfc(\eta\sqrt{Pr} + \sqrt{bt}) + \exp(-2\eta\sqrt{Rt})\, erfc(\eta\sqrt{Pr} - \sqrt{bt})\right]$$

$$A_8 = \frac{\eta\sqrt{Prt}}{\sqrt{b}}\left[\exp(-2\eta\sqrt{Rt})\, erfc(\eta\sqrt{Pr} - \sqrt{bt}) + \exp(2\eta\sqrt{Rt})\, erfc(\eta\sqrt{Pr} + \sqrt{bt})\right]$$

$$A_9 = (\exp(2\eta\sqrt{Pr}\sqrt{(b+c)t})\, erfc(\eta\sqrt{Pr} + \sqrt{(b+c)t}) + \exp(-2\eta\sqrt{Pr}\sqrt{(b+c)t})\, erfc(\eta\sqrt{Pr} - \sqrt{(b+c)t})$$

$$A_{10} = \exp(-2\eta\sqrt{Sct})\, erfc(\eta\sqrt{Sc} - \sqrt{t}) + \exp(2\eta\sqrt{Sct})\, erfc(\eta\sqrt{Sc} + \sqrt{t})$$

$$A_{11} = t\left[\exp(-2\eta\sqrt{Sct})\, erfc(\eta\sqrt{Sc} - \sqrt{t}) + \exp(2\eta\sqrt{Sct})\, erfc(\eta\sqrt{Sc} + \sqrt{t})\right]$$

$$A_{12} = \exp(-2\eta\sqrt{Sc.d.t})\, erfc(\eta\sqrt{Sc} - \sqrt{dt}) + \exp(2\eta\sqrt{Scd.t})\, erfc(\eta\sqrt{Sc} + \sqrt{dt})$$

Where

$$\eta = \frac{z}{2\sqrt{t}}, b = \frac{R}{Pr}, c = \frac{R-a}{1-Pr}, d = \frac{a}{Sc-1}, e = \frac{Gr}{2c(1-pr)}, f = \frac{Gc}{2d(Sc-1)}, g = \frac{Gr}{2c^2(1-pr)}, h = \frac{Gc}{2d^2(Sc-1)}$$

Here Erfc is known as the complementary error function.

For the purpose of obtain the material perception within the question, the numeral quantities of F has calculated from (2.20). Although measuring that aspect, it has been noted such dispute from failing operation is complex and because, we shall isolate this with real and imaginary portions by utilizing the succeeding rule:

$$\mathrm{erfc}(a+ib) = \mathrm{erfc}(a) + \frac{\exp(-a^2)}{2a\pi}[1 - \cos(2ab) + \mathrm{i}\sin(2ab)] + \frac{2\exp(-a^2)}{\pi}\sum_{n=1}^{\infty}\frac{\exp(-\frac{n^2}{4})}{n^2 + 4a^2}[\mathrm{f_n}(a,b) + i\mathrm{g_n}(a,b)]$$

Where

$$f_n = 2a - 2a\cosh(nb)\cos(2ab) + n\sinh(nab)\sin(2ab) \quad and$$

$$g_n = 2a\cosh(nb)\sin(2ab) + n\sinh(nab)\cos(2ab)$$

$$|\in(a,b)| \approx 10^{-16}|erfc(a+ib)|$$

3. Result And Discussions

The outcomes are handled for the dimensionless temperature θ, concentration C and the relevance of primary velocity U and secondary velocity V are obtained for distinct relevance from that irradiation variable R, rotation parameter Ω, time t, thermal and mass Grashof numbers (Gr, Gc), Schmidt number Sc, Hartmann no M and hall parameter m and this numeral relevance be portrayed through method of distinct charts. In sort to know the real occurrence to the question and because the revealment from those distinct substantial boundaries incoming the question we must estimate the digital values with aid of the "Mat lab coding software. The relevance from that Prandtl number Pr is picked to denote air (Pr = 0.7). The relevance of Schmidt number is denoted water vapor (Sc=0.16) and change the relevance of time t=0.2

3.1 Concentration Profiles

The concentration biographies of the stream are initiate to alter further or fewer with alternative Schmidt number (Sc). These alternatives are graphically displayed in figure 1 for distinct Schmidt numbers Sc =0.16, 0.6, 2.01 and time t=0.2. The numeral relevance of the Schmidt number Sc is chosen to denotes an actuality in event of air. The solution of Schmidt number raises down the concentration biographies. It is found that the raise down relevance of the absorption edge coating of the liquid stream is more significant in the appearance of heavier diffusing species is shown in figure 1 proves that the concentration raises when the time raises.

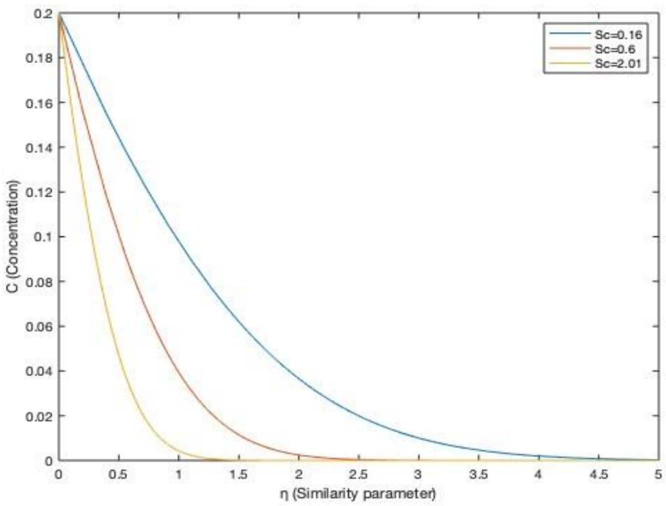

Fig.2.Theconcentration profile for distinct entries of Sc

3.2 Temperature Profile

Figure2 and figure 3 proves that the temperature of the liquid stream varies hugely with the change of time (t) and the radiation parameter (R), and this change is indicated in below figures. The heat biographies are premeditated for distinct relevance of time t=0.2,0.4,0.6 and heat irradiation variable is shown in figure2. R = 2 ,5,10 is shown in figure 3, For air Pr = 0.7. The result of time T and the heat irradiation variable R is essential in heat biographies. It should be noted that the heat biographies raise down about raising relevance of t and R.

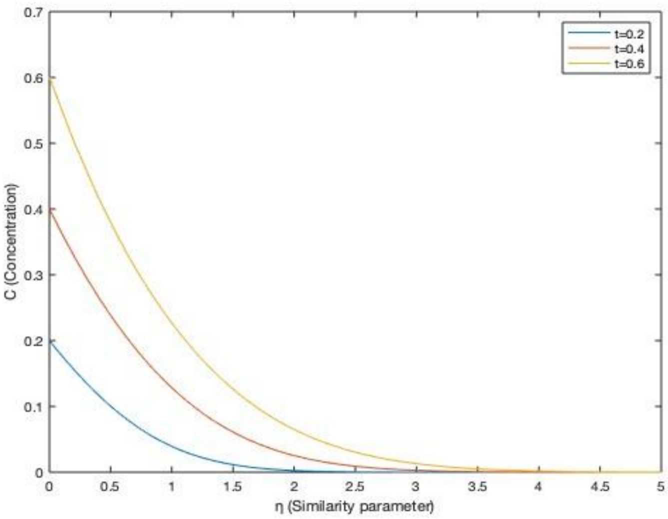

Fig .3.Thetemperature Profile for various entries of t

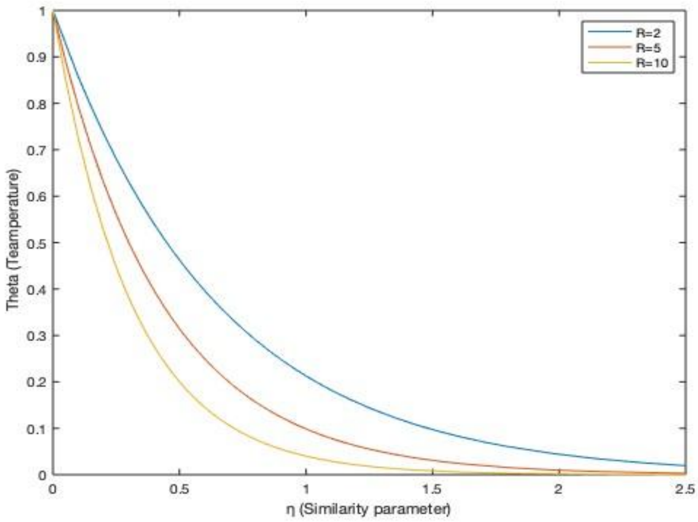

Fig.4.Thetemperature Profile for various entries of R

3.3 Velocity Profiles

The velocity biographies from that liquid steam differ to significant boundary with the effect of steam variables on the steam domain are analyzed with aid of figures 4 to figure 11. The result of Grashof number for heat and mass transfer Gr and Gc upon the velocity from that liquid stream is shown in figure 4 and figure 5. At the moment the velocity of the liquid steam is showed against the similarity variable for three distinct inputs of the Grashof number Gr=Gc= 2,2 ,2,5 and 5,5 and Gr =Gc =2,5 ,5,10 ,10,15. Keeping other variables of the liquid flow are recurrent. The biographies of the prime velocity and second velocity are showed in Figure 4 and figure 5 effect for distinct relevance of Gr, Gc. It should be mentioned that the prime and second velocity increases with raising inputs of the thermal Grashof number Gr and mass Grashof number Gc in diagrammatically.

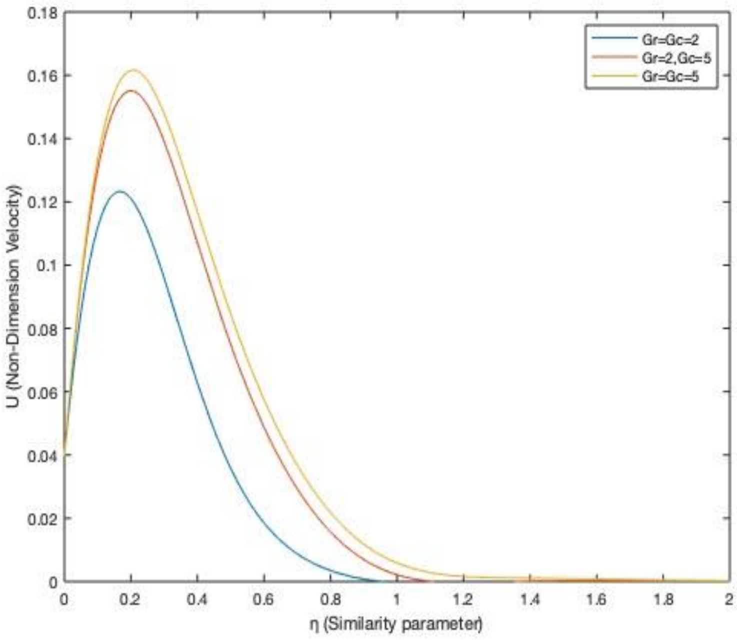

Fig.5.Theprimary velocity profile for distinct entries of Gr and Gc

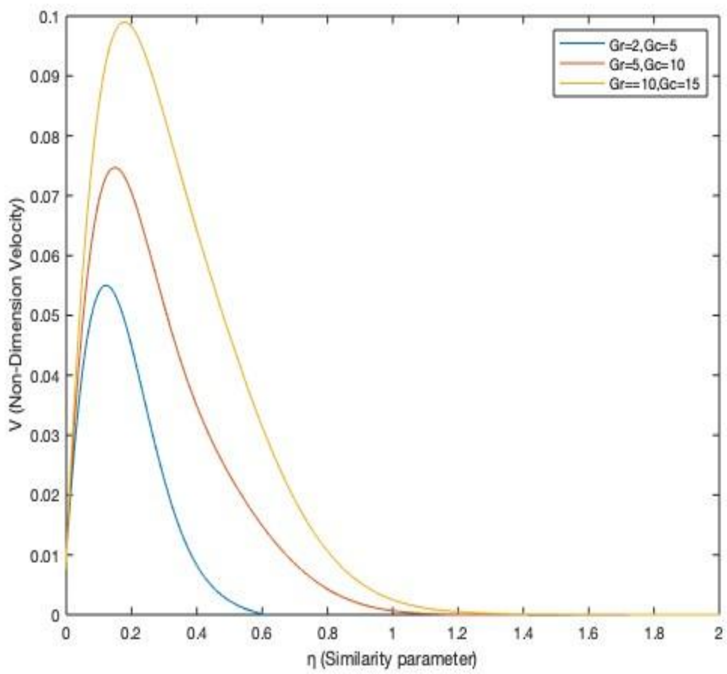

Fig.6.Thesecondary velocity profile for distinct entries of Gr and Gc

Figure 6 and figure 7 indicate the prime momentum U and second momentum V biography for distinct entries of the radiation parameter R= 2, 5 10 increases with step down entries of the thermal irradiation variable R, there exist increase among minor momentum parts, because of a raise in the thermal radiation parameter.

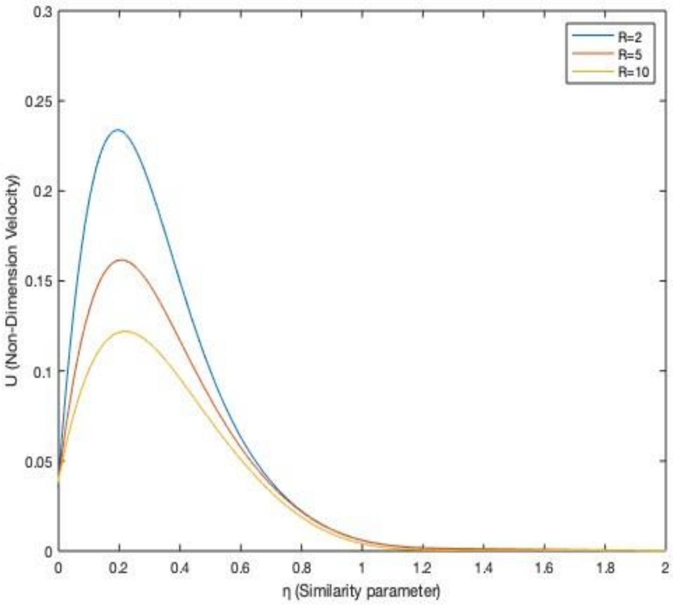

Fig.7.Theprimary velocity profiles for distinct values of R

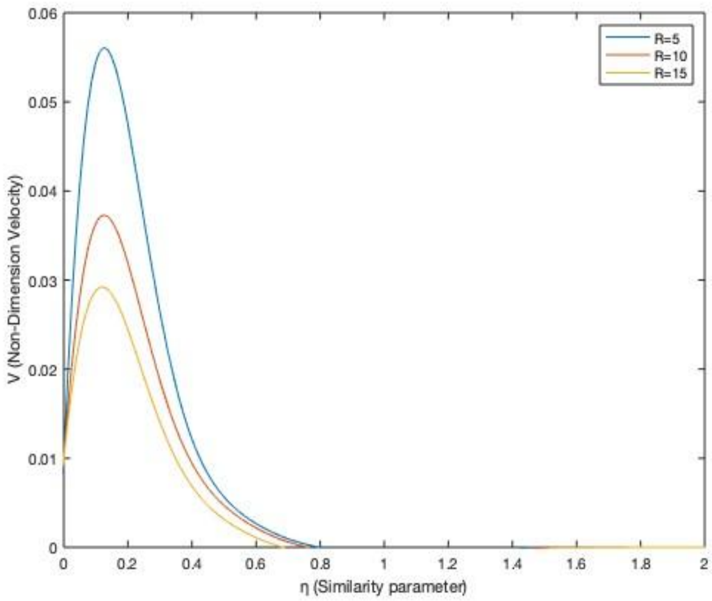

Fig.8.Thesecondary velocity Profile for distinct entries of R

Figure 8 and figure 9 presents the change of the prime momentum U and second momentum V biographies for distinct entries of Hartmann number M =3,4,5, around here the prime momentum raises about raise down entries of M and the second momentum raises with raising entries Hartmann number.

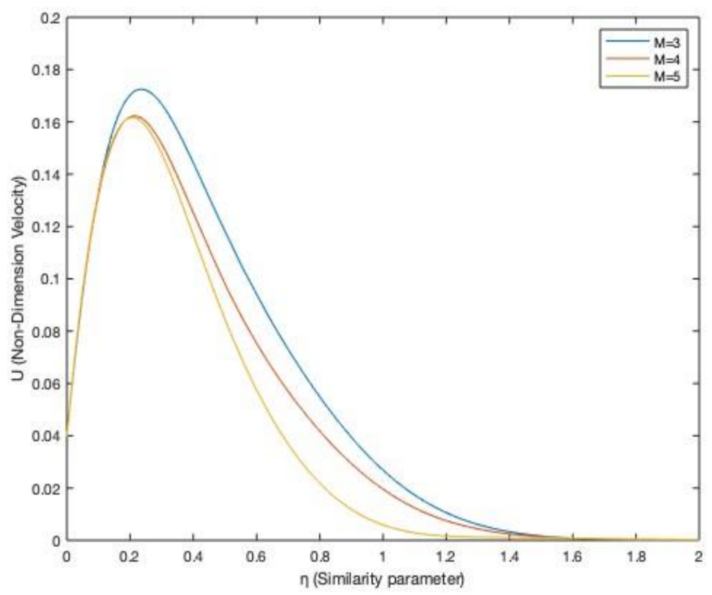

Fig.9.Theprimary velocity for distinct entries of M

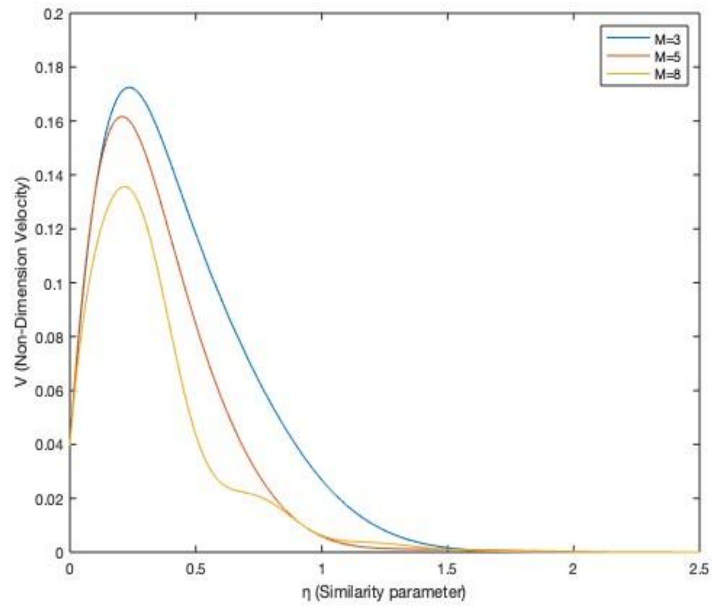

Fig .10. Thesecondary velocity profile for distinct entries of M

Figure 10 and figure 11 it is watched that the prime momentum U and the second momentum V ups because of raising entries from that hall parameter m

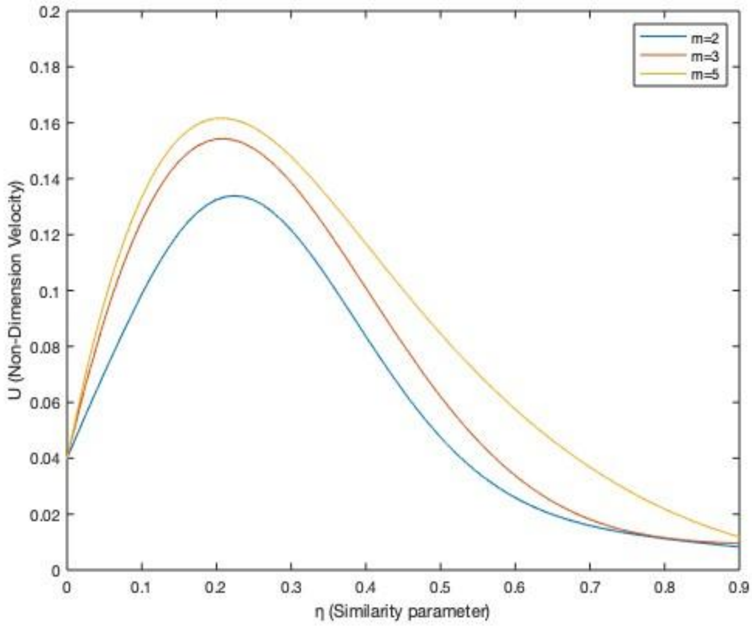

Fig.11.Theprimary velocity for distinct entries of m

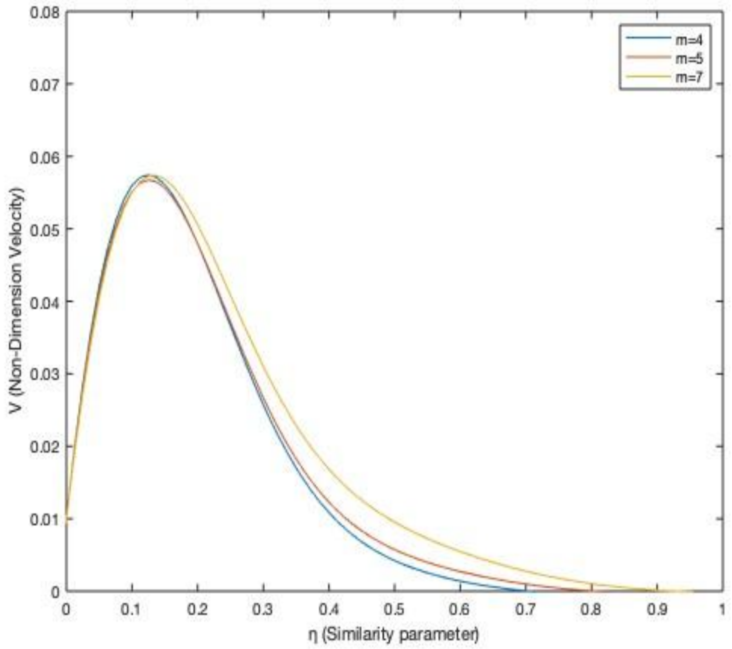

Fig.12. Thesecondary velocity profile for distinct entries of m

4. Conclusion

An analytic survey of biographies for temperature, concentration, primary velocities U and secondary velocities V on convective stream gone a parabolic accelerated perpendicular panel in the appearance of electromagnetic area and Hall impact has been carved out. In case of cooling of the plate $(Gr > 0, Gc > 0)$ as convection currents are carted from the plate is noted. It is observed that

i. Concentration (C) rise down for increasing relevance of Schmidt number (Sc).
ii. Temperature biographies rises for increasing relevance of time (T) and also rise down for
iii. increasingrelevance of thermal radiation parameter (R)
iv. Primary velocity (U)
  - Rises for raising relevance of hall parameter m, Thermal Grashof number Gr and Mass Grashof number Gc.
  - Rise down for raising relevance of Thermal radiation parameter R, Magnetic parameter M.
v. Transverse velocity (V)
  - Rises for raising relevance of Thermal Grashof number Gr and Mass Grashof number M, thermal radiation parameter R and Magnetic parameter M.
  - Rise down for raising relevance of hall parameter m.

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Nomenclature

a	-	Constant
B_0	-	Applied magnetic field
C_p	-	Specific heat at constant pressure
D	-	Mass diffusion coefficient
Gc	-	Mass Grashof number
Gr	-	Thermal Grashof number
g	-	Acceleration due to gravity
k	-	Thermal conductivity
M	-	Hartmann number (Magnetic
	-	parameter)
m	-	Hall parameter
Pr	-	Prandtl number
Sc	-	Schmidt number
C^*	-	Species concentration in the fluid
C_W^*	-	Concentration of the plate
$C_¥^*$	-	Concentration of the fluid far away from the plate
$T_¥^*$	-	Temperature of the fluid far away from the plate
θ	-	Dimensionless temperature
t^*	-	Time
t	-	Dimensionless time
u_0*	-	Velocity of the plate
$(u' v' w')$	-	Components of velocity field F
$(x' y' z')$	-	Cartesian Co-ordinates
Z	-	Dimensionless coordinate axis normal to the plate
ρ	-	Density of the fluid
v	-	Kinetic viscosity
β	-	Volumetric coefficient of thermal expansion
β^*	-	Volumetric coefficient of expansion
$erfc$	-	Complementary error function
C	-	Dimensionless concentration
T^*	-	Temperature of the fluid near the plate
T_W^*	-	Temperature of the plate