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Effect of Hall Currents, on Hydro magnetic Convective Heat and Mass Transfer Flow of An Electrically Conducting Rotating , Dissipating Fluid in A Vertical Channel Bounded by Stretching and Stationary Walls In The Presence of Non-Uniform Heat Source

Suguna H.G.*[1] and Bhuvana Vijaya R[2]

[1]Department of Mathematics, Government Degree College for Boys, Chintamani, Chikkaballapur (Dt), Karnataka, India
Email : sugunareddy.srinivas@gmail.com
[2]Professor of Mathematics, College of Engineering, J.N.T.U.A., Anantapuramu, A.P., India
Email : bhuvanarachamall@gmail.com

ABSTRACT :

In this paper, we investigate the effect of Chemical reaction on convective and mass transfer flow of an electrically conducting, viscous, incompressible rotating fluid in a vertical channel bounded by a stretching sheet and a stationary walls. The non-linear governing equations have been solved by using Runge-Kutta shooting technique. The velocity, temperature and concentration have been analysed for different variations of m, A1, B1, R, Ec and Sr. The rate of mass transfer are evaluated numerically for different variations.

KEYWORDS : Rotating fluid, Hall effect, Soret effect, Dissipation, Non-uniform Heat Source.

***Corresponding author:**

Suguna H.G.

Assistant Professor,

Department of Mathematics,

Government Degree College for Boys,

Chintamani, Chikkaballapur (Dt),

Karnataka, India

Email : sugunareddy.srinivas@gmail.com

1. INTRODUCTION:

Laminar flows through channels have applications in the fields of gas diffusion,ablation cooling, filtration, micro fluidic devices, surface sublimation, grain regression (as in the case of combustion in rocket motors) and the modelling of air circulation in the respiratory system. Laminar air –flow systems have been used by the aerospace industry to control particular contaminstion.Futhermore,the laminar flow cabinet have been used in the maintainance of negative pressure and in the Adjustment of the fans to exhaust more air.Therefore,the Navier-Stokes equations which are the governing equations for these problems.,have attracted the interest of the researchers. Sutton and Barto[21] described an exact solution of Navier-Stokes equations for motion of an incompressible viscous fluid in a channel with different pressure gradients.Their solutions are helpful in verifying and validating computational models of complex on unsteady motions,to guide the design of fuel injectors and controlled experiments.Simulationof flow through microchannels with design roughness was presented numerically by Rawool et al[18] A numerical investigations is made by Robinson[17] for the problem of steady laminar incompressible flow in a porous channel with uniform suction at both walls. Taylor et al[24] studied three dimensional flow buy uniform suction through parallel porous walls. The investigations of Taylor[24] were further extended to a more general three dimensional stagnation point which can capture the phenomena in a single class of state by Hewitt et al8. Two dimensional viscous incompressible fluid flow between two porous walls with uniform suction was analysed by Cox[5]. Berman[3] proposed the two dimensional laminar steady flow through a porous channel which was driven by suction or injection .Similarity one/two dimensional laminar flow in a porous channel with wall suction or injection was examined analytically by Laurent et al [11].The problem of fluid flow in a channel with porous walls was solved by Karode[9]. Zheng et al[29] investigated asymptotic solutions for steady laminar flow of an incompressible viscous fluid along a channel with accelerating rigid porous walls.The exact solution for two dimensional steady laminar flow through a porous channel was generalized by Terril[25], Sheathe and Terril[23,25], Brady[4], Watson et al[27] and Cox[5] under varied conditions. Deng and Marinez[6] worked on two dimensional flow of a viscous fluid in a channel partially filled with porous medium with wall suction. Wang[26] worked on viscous flow due to stretching sheet with slip and suction and proved a closed form unique solution for two dimensiuonal flows.For axisymmetric stretching both existence and uniqueness were shown. Muhammad Ashraf et al[14] investigated micro polar fluid flow in a channel with Shrinking walls. Haipour and Dehkordi[7] studied the transient behavioue of fluid flow and heat transfer in vwertical channel partially filled with a porous medium including the effects of inertial term and viscous dissipation. Kashif Ali et al[10] have discussed numerical study of micropolar fluid flow and heat transfer in a channel eith shrinking and stationary wall. Madhavilatha et al [13] have discussed the combined influence of Hall currents, chemical reaction, thermo-diffusion, dissipation on hydro magnetic convective heat and mass transfer flow of an electrically conducting fluid in a vertical channel bounded by stretching and stationary walls in the presence of heat sources. Recently, Sukanya et al[21] have investigated convective heat and mass transfer flow of a rotating fluid in a vertical channel bounded by stretching and stationary walls with thermo-diffusion effect, chemical reaction, thermal radiation in the presence of non-uniform heat source.

2. FORMULATION OF THE PROBLEM:

We consider the steady two dimensional hydromagnetic laminar convective heat and mass transfer flow of a viscous electrically conducting rotating fluid in a vertical channel bounded by a stretching sheet on the left a stationary plate on the right.we choose a rectangular coordinate systemO(x,y.z) with the walls at y= $\pm$ L .The flow is subjected to a strong magnetic field with a constant intensity Bo along the positive y-direction. Assuming magnetic Reynolds number Rm to be small we neglect the induced magnetic field in comparison to the applied magnetic field.It is used to compare the transport of magnetic lines of the force in a conducting fluid with the leakage of such lines from the fluid.

Taking the viscous dissipation and joule heating effects into consideration,the governing equations of the flow ,heat and mass transfer for the problem are

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}=0 \quad (1)$$

$$\rho(u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y})=-\frac{\partial p}{\partial x}+\mu(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2})-\frac{\sigma\mu_e^2 H_o^2}{1+m^2}(u+mw)-\rho g+2\Omega w \quad (2)$$

$$\rho(u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y})=-\frac{\partial p}{\partial y}+\mu(\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}) \quad (3)$$

$$\rho(u\frac{\partial w}{\partial x}+v\frac{\partial w}{\partial y})=\mu(\frac{\partial^2 w}{\partial x^2}+\frac{\partial^2 w}{\partial y^2})+\frac{\sigma\mu_e^2 H_o^2}{1+m^2}(mu-w)-2\Omega u \quad (4)$$

$$\rho C_P(u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y})=k_f(\frac{\partial^2 T}{\partial x^2}+\frac{\partial^2 T}{\partial y^2})+q'''+2\mu((\frac{\partial u}{\partial y})^2+(\frac{\partial w}{\partial y})^2)+ +\frac{\sigma\mu_e^2 H_o^2}{1+m^2}(u^2+w^2) \quad (5)$$

$$(u\frac{\partial C}{\partial x}+v\frac{\partial C}{\partial y})=D_b(\frac{\partial^2 C}{\partial x^2}+\frac{\partial^2 C}{\partial y^2})-k_c'(C-C_o)+\frac{D_T K_T}{T_m}(\frac{\partial^2 T}{\partial x^2}+\frac{\partial^2 T}{\partial y^2}) \quad (6)$$

$$\rho-\rho_o=-\beta(T-T_o)-\beta^*(C-C_o) \quad (7)$$

Where(u,v.0) are the velocity components along x,y directions respectively,T,C are the dimensional temperature and concentration respectively, ρ is the density,p is the pressure,σ is the electrical conductivity, μ_e is the magnetic permeability of the medium, μ is the dynamic viscosity,g is the gravity, is the strength of the heat source,Db is the molecular diffusivity,D_T is the mass diffusivity,K_T is the thermal diffusion ratio, β is the coefficient of thermal expansion, β^* is the coefficient of volume expansion,Tm is the mean fluid temperature, $m)=\omega_e\tau_e$ is the Hall parameter, $\omega_e = e\dfrac{B_o}{m_e}$ is the electron frequency

The coefficient q''' is the rate of internal heat generation (>0) or absorption (<0). The internal heat generation /absorption q''' is modelled as

$$q''' = \left(\frac{ku_s}{x\nu}\right)\left[A1\left(T_1 - T_1\right) f'(\eta) + B1\left(T - T_2\right)\right] \tag{8}$$

Where A1 and B1 are coefficients of space dependent and temperature dependent internal heat generation or absorption respectively. It is noted that the case A1>0 and B1>0, corresponds to internal heat generation and that A1<0 and B1<0, the case corresponds to internal heat absorption case.

The boundary conditions for the velocity,temperature and concentration are

$$\begin{aligned} &u(x,-L) = us = bx, u(x,+L) = 0, v(x,\pm L) = 0, \\ &T(x,-L) = T_1, T(x,+L) = T_2 \\ &C(x,-L) = C_1, C(x,+L) = C_2 \end{aligned} \tag{9}$$

Where b>0 is the stretching rate of the channel wall,T1,T2(with (T1>T2)are the fixed temperature of the left and right walls respectively,C1,C2(with C1>C2) or the fixed concentrations of the channel walls respectively.We introduce the following Similarity variables as:

$$\begin{aligned} &\eta = \frac{y}{L}; u = bxf'(\eta); v = -bLf(\eta), w = bxg_0(\eta) \\ &\theta(\eta) = \frac{T - T_2}{T_1 - T_2}, \phi(\eta) = \frac{C - C_2}{C_1 - C_2} \end{aligned} \tag{10}$$

The above velocity field is compatible with continuity equation (1) and therefore, represents the possible fluid motion.

Eliminating the pressure between the equations (2) and (3) and using (7)&(9) the momentum equation reduces to

$$\begin{aligned} &f^{iv} + \mathrm{Re}_x(f'''f - ff''') - \frac{M^2}{1+m^2}(f'' + mg_0') \\ &\qquad + Gr(\theta' + N\phi') + Rg_0' = 0 \end{aligned} \tag{11}$$

$$g_0 \; + \mathrm{Re}_x(f_0 g' - f' g_0) + \frac{M^2}{1+m^2}(mf' - g_0) - Rf' = 0 \tag{12}$$

where as the equations (6)&(7) in view of equation(9).are

$$\theta'' + \Pr \operatorname{Re} x(f\theta') + (A1f' + B1\theta) + \Pr Ec((f'')^2 + (g_o^{'})^2) + \\ + \frac{M^2 Ec}{1+m^2}((f')^2 + g_0{}^2) = 0 \quad (13)$$

$$\phi'' + Sc \operatorname{Re} x(f\phi') - \gamma\phi + ScSo\theta'' = 0 \quad (14)$$

Where $Gr = \frac{\beta g(T_1 - T_2)L}{bx}$, is the Grashof number, $N = \frac{\beta^*(C_1 - C_2)}{\beta(T_1 - T_2)}$, is the buoyancy ratio, $M^2 = \frac{\sigma\mu_e^2 H_o^2 L^2}{\nu x}$, magnetic parameter, $R = \frac{2\Omega}{xL}$, Rotation parameter,

$\Pr = \frac{\mu C_p}{k_f}$ is Prandtl number, $\operatorname{Re} x = \frac{bL^2}{\mu}$, is the local Reynolds number,

$Sc = \frac{\nu}{D_m}$, is the Schmidt number, $So = \frac{D_T K_T (T_1 - T_2)}{T_m (C_1 - C_2)}$, is the Soret parameter

$\gamma = \frac{k_c L^2}{D_m}$ is the chemical reaction parameter, $Ec = \frac{b^2 x^2}{C_p \Delta T}$ is the Eckert number

Boundary conditions(8),in view of equation(10) in dimensional form reduces to

$$f(\pm 1) = 0,\ f'(-1) = 1,\ f'(+1) = 0, g_0(-1)=0, g_0(+1)=0$$

$$\theta(-1) = 1, \theta(+1) = 0, \phi(-1) = 1, \phi(+1) = 0, \quad (15)$$

3.MTHOD OF SOLUTION:

A usual approach is to write the nonlinear ODE in form of a first order initial value problem as follows:

$$f = f_1, f' = f_2 f'' = f_3, f''' = f_4, g = f_5, g' = f_6 \\ \theta = f_7, \theta' = f_8, \phi = f_9, \phi' = f_{10} \quad (16)$$

$$f^{iv} = f_4^{'} = -\operatorname{Re} x(f_4 f_1 - f_2 f_3) - \frac{M^2}{1+m^2}(mf_6 + f_3) + \\ + Gr(f_6 + Nf_8) - Rf_6 \quad (17)$$

$$g^{ii} = f_6^{'} = -\operatorname{Re} x(f_6 f_1 - f_2 f_5) - \frac{M^2}{1+m^2}(mf_2 - g) + Rf_2 \quad (18)$$

$$\theta'' = f_6^{'} = [-\Pr \operatorname{Re} x(f_1 f_6 + (A1 f_2 + B1 f_7) - \Pr Ec(f_3^2 + f_6^2) - \frac{M^2 Ec}{1+m^2}(f_2^2 + f_5^2) \quad (19)$$

$$\phi'' = f_8^{'} = [-Sc \operatorname{Re} x(f_1 f_{10}) + \gamma f_9 - ScSo(-\Pr \operatorname{Re}_x (f_1 f_8) - (A1 f_2 + B1 f_7) - \\ - \frac{M^2 Ec}{1+m^2}(f_2^2 + f_5^2) - \Pr Ec(f_3^2 + f_5^2)] / (1 + ScSr) \quad (20)$$

The corresponding boundary conditions are

$$f_1(\pm 1) = 0,\ f_2(-1) = 1,\ f_2(+1) = 0,\ f_5(-1) = 1,\ f_5(+1) = 0,$$

$$f_6(-1) = 1,\ f_6(+1) = 0,\ f_7(-1) = 1, \qquad (21)$$

$$f_7(+1) = 0,\ f_8(-1) = 1,\ f_8(+1) = 0,$$

Here $f_3(-1), f_4(-1), f_6(-1), f_8(-1), f_{10}(-1)$ are the unknown initial condition,Therefore,a shooting methodology is incorporated to solve the above system,which may be a combination of the Runge-Kutta method(to solve first order ODE) and a five dimensional zero finding algorithm(to find the missing coordinates).It is note that the missing initial conditions are coupled so that the solution satisfies the boundary conditions f(+1)=0, f'(+1)=0, g(+1)=0, θ(+1)=0, $\phi(+1) = 0$ of the original boundary value problem.

4. COMPARISION:

In the absence of Hall effects, time dependent heat sources (m=0,A1=0) the results are in good agreement with those of Madhavilatha et al [13].

Parameters		Madhavilatha et al [13]		Present results	
		Nu(+1)	Sh(+1)	Nu(+1)	Sh(+1)
M	**0.5**	0.022196	0.0606915	**0.0212488**	**0.591385**
	1.0	0.024684	0.0604617	**0.0200025**	**0.589545**
	2.0	0.029702	0.0684358	**0.0197469**	**0.589122**
R	**1.0**	0.089325	0.591217	**0.089322**	**0.591211**
	1.5	0.155246	0.545667	**0.155240**	**0.545661**
	2.0	0.219296	0.491788	**0.219288**	**0.491789**
Sr	**1.0**	0.043009	1.55876	**0.043006**	**1.55872**
	1.5	0.035481	2.51013	**0.035482**	**2.51010**
	2.0	0.029375	3.45357	**0.029372**	**3.45352**

5. DISCUSSION OF THE NUMERICAL RESULTS:

In this analysis we investigate the influence of Hall currents, rotation, thermo-diffusion, non-uniform heat sources on convective heat and mass transfer flow of a viscous, dissipative fluid in a vertical channel bounded by a stretching sheet and stationary plates. The non-linear governing equations have been solved by employing Fourth order Runge-Kutta –Shooting technique.

The primary velocity, secondary velocity, temperature and concentration have been analysed for different variations of m, R, A1,B1,Ec and Sr.

Figs.1a-1d demonstrate f' ,g,θ and C with Hall parameter(m).As mentioned above, the Lorentz force has retarding effect on the primary velocity. This retarding is reduced with increase in the Hall parameter and hence the primary velocity is enhances and consequently the boundary layer becomes thicker. The secondary velocity increases as the Hall parameter m increases .The effect of Hall parameter on temperature and concentration is observed to be opposite to that of magnetic field.

Figs.2a-2d,illustrates f',g,θ,ϕ with variation in space dependent Heat source parameter (A1>0).The presence of the heat sources generates energy in the momentum, thermal and solutal boundary layers and as a consequence the velocity components, temperature and the concentration increase in the boundary layers. In the case of heat absorption(A1<0) the velocity components, temperature and the concentration reduces with decreasing values of A1<0,owing to the absorption of energy in the boundary layer.

Figs.3a-3d,illustrates f',g,θ,ϕ with variation in temperature dependent heat source parameter (B1>0).As in the case of space dependent heat source,the velocity components,temperature and the concentration enhance due to the release of energy for B1>0 while they drop for decreasing values of B1<0 owing to the absorption of energy.The presence of the temperature dependent heat sources generates energy in the momentum boundary layer, thermal boundary layer and the solutal boundary layer and as a consequence the velocity components, temperature increases and the concentration enhances in the boundary layers. In the case of heat absorption(B1<0) the velocity components ,temperature and the concentration fall with decreasing values of B1<0,owing to the absorption of energy in the boundary layer.

The effect of rotation parameter (R) on f',g,θ,ϕ is demonstrated in figs.4a-4d.We observe from the profiles that the both the velocity components enhances and the temperature,concentration decreases with increase in R in the entire flow region.Thus higher the coriolis force larger the thickness of the momentum boundary layer and smaller the thermal and solutal boundary layers.

The effect of dissipation(Ec) on f',g,,θ and C is shown in figs.5a-5d. It can be found that higher the dissipative energy larger the magnitude of the primary velocity , temperature and the concentration and smaller the secondary velocity in the flow region. This is due to the fact that heat energy is reserved due to frictional heating(figs.5a-5d).

Figs.6a-6d represent f',g, ,,θ and C with Soret parameter Sr. It can be noticed from the profiles that higher the thermo-diffusion effects larger the magnitude of primary velocity , temperature and concentration and smaller the secondary velocity in the flow region. This can be attributed to the fact that increasing values of So increases the thickness of the momentum, thermal and solutal boundary layers .

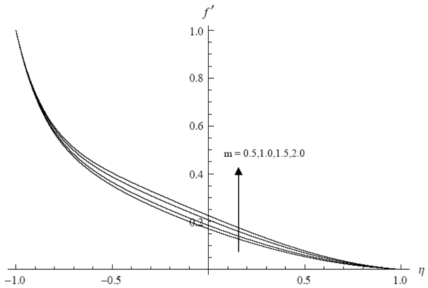

Fig.1a : Variation of f' with m
R=2,A_1=0.1, B_1=0.1,Ec=0.01,Sr=0.5

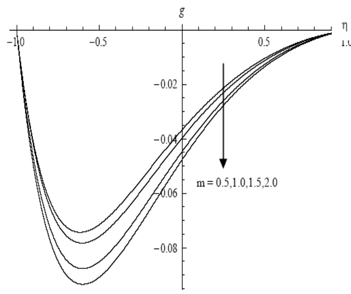

Fig.1b : Variation of g with m
R=2,A_1=0.1, B_1=0.1,Ec=0.01,Sr=0.5

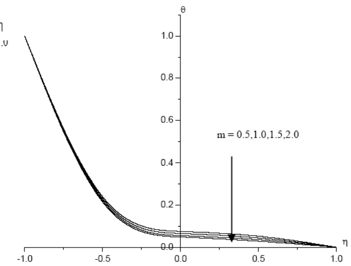

Fig.1c : Variation of θ with m
R=2,A_1=0.1, B_1=0.1,Ec=0.01,Sr=0.5

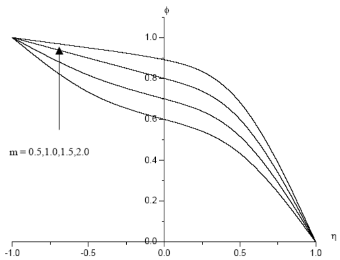

Fig.1d : Variation of ϕ with m
R=2,A_1=0.1, B_1=0.1,Ec=0.01,Sr=0.5

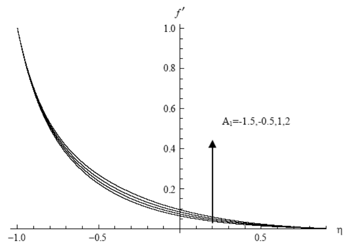

Fig.2a : Variation of f' with A_1
m=0.5,R=2, B_1=0.1,Ec=0.01,Sr=0.5

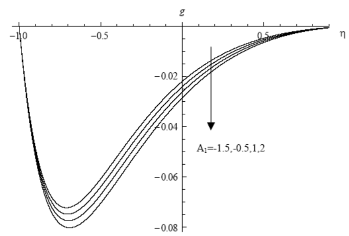

Fig.2b : Variation of g with A_1
m=0.5,R=2, B_1=0.1,Ec=0.01,Sr=0.5

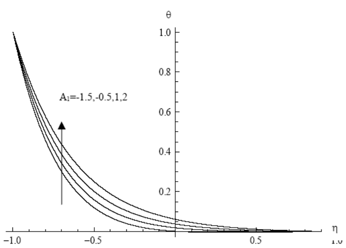

Fig.2c : Variation of θ with A_1
m=0.5,R=2, B_1=0.1,Ec=0.01,Sr=0.5

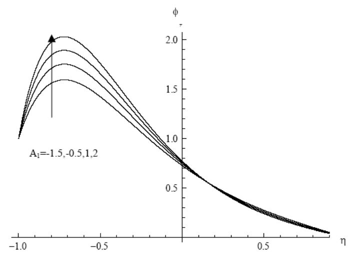

Fig.2d : Variation of ϕ with A_1
m=0.5,R=2, B_1=0.1,Ec=0.01,Sr=0.5

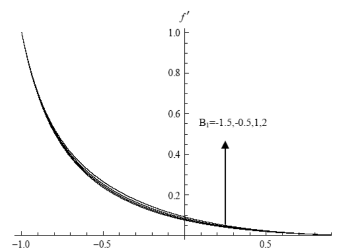

Fig.3a : Variation of f' with B_1
m=0.5,R=2,A_1=0.1, Ec=0.01,Sr=0.5

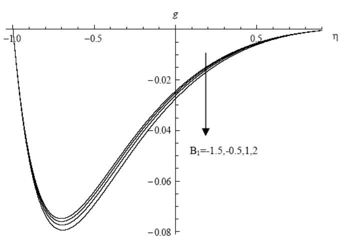

Fig.3b : Variation of g with B_1
m=0.5,R=2,A_1=0.1, Ec=0.01,Sr=0.5

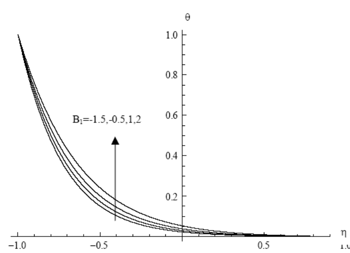

Fig.3c : Variation of θwith B_1
m=0.5,R=2,A_1=0.1, Ec=0.01,Sr=0.5

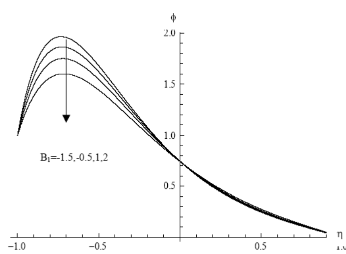

Fig.3d : Variation of ϕ with B_1
m=0.5,R=2,A_1=0.1, Ec=0.01,Sr=0.5

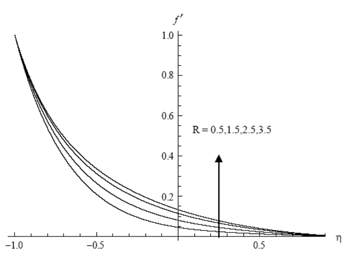

Fig.4a : Variation of f' with R
m=0.5, A_1=0.1, B_1=0.1,Ec=0.01,Sr=0.5

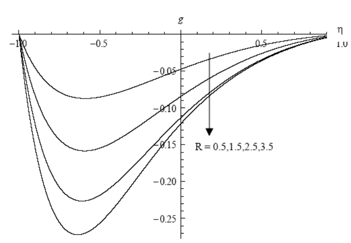

Fig.4b : Variation of g with R
m=0.5, A_1=0.1, B_1=0.1,Ec=0.01,Sr=0.5

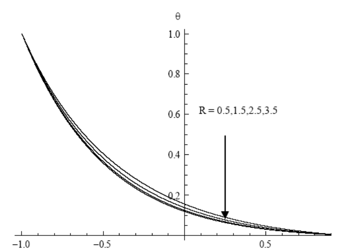

Fig.4c : Variation of θ with R
m=0.5, A_1=0.1, B_1=0.1,Ec=0.01,Sr=0.5

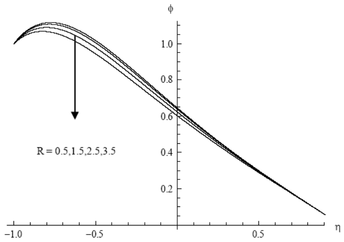

Fig.4d : Variation of ϕ with R
m=0.5, A_1=0.1, B_1=0.1,Ec=0.01,Sr=0.5

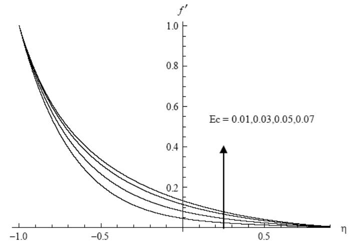

Fig.5a : Variation of f' with Ec
m=0.5, R=2,A_1=0.1,B_1=0.1, Sr=0.5

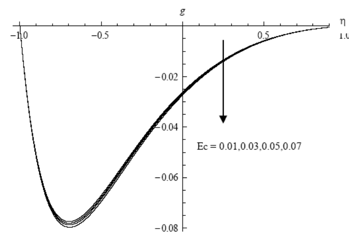

Fig.5b : Variation of g with Ec
m=0.5, R=2,A_1=0.1,B_1=0.1, Sr=0.5

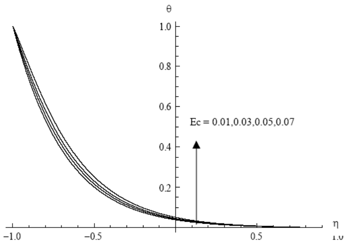

Fig.5c : Variation of θ with Ec
m=0.5, R=2,A_1=0.1,B_1=0.1, Sr=0.5

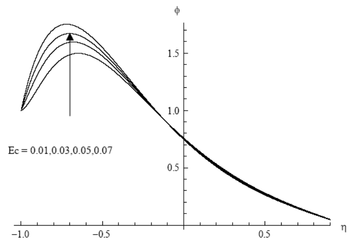

Fig.5d : Variation of ϕ with Ec
m=0.5, R=2,A_1=0.1,B_1=0.1, Sr=0.5

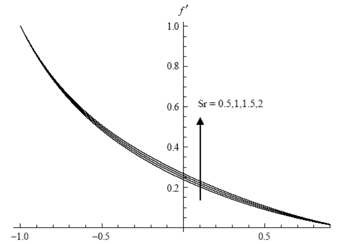

Fig.6a : Variation of f' with Sr
m=0.5,R=2,A_1=0.1, B_1=0.1,Ec=0.01

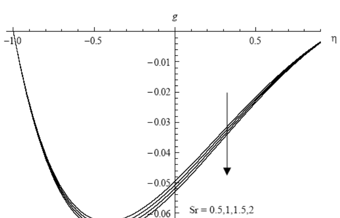

Fig.6b : Variation of g with Sr
m=0.5,R=2,A_1=0.1, B_1=0.1,Ec=0.01

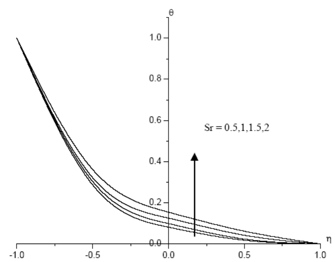

Fig.6c : Variation of θ with Sr
m=0.5,R=2,A_1=0.1, B_1=0.1,Ec=0.01

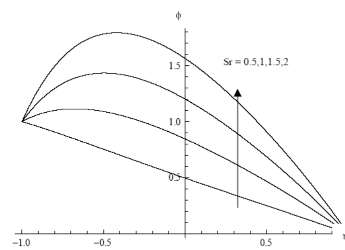

Fig.6d : Variation of ϕ with Sr
m=0.5,R=2,A_1=0.1, B_1=0.1,Ec=0.01

The rate of heat transfer(Nusselt number) at $\eta = \pm 1$ is exhibited in table.1 for different parametric variations An increase in Hall parameter (m) enhances Nu at η=-1 and reduces at η=+1. An increase in rotation parameter R reduces Nu at η=-1 and increases it at η=+1. The rate of heat transfer reduces at η=-1 and enhances at η=+1 in the space dependent heat generating source(A1>0) while in the heat absorbing source ,Nu enhances at η=-1 and reduces at η=+1.An increase in B1>0, reduces Nu at η=-1 and enhances at η=+1 while a reversed effect is noticed with increase in B1<0. Higher the dissipation effects smaller Nu at η=-1 and larger Nu at η=+1.The variation of Nu with Sr shows that higher the thermo-diffusion effects larger Nu at η=-1 and smaller Nu at η=+1.

The rate of mass transfer(Sherwood number) at $\eta = \pm 1$ is exhibited in table.1 for different parametric variations. An increase in Hall parameter (m) increases Sh at η=-1 and reduces at η=+1. An increase in A1>0 and B1>0 reduces Sh at $\eta = -1$ and enhances it at η=+1 while an increase in A1<0,B1<0 enhances at η=-1 and reduces at η=+1.With respect to R we find that the rate of mass transfer reduces at η=-1 and enhances at η=+1 fixing the other parameters. The rate of heat transfer reduces $\eta = \pm 1$ in degenerating chemical reaction cases while in the case of generating chemical reaction case,it enhances at $\eta = \pm 1$.Higher the dissipation lesser Sh at $\eta = -1$ and enhances at η=+1.With reference to Sr we notice an enhancement in Sh at both the walls.

Table 1 : Nusselt number and Sherwood number at η = –1 and η = +1

Parameter		η = –1		η = +1	
		Nu(0)	Sh(0)	Nu(0)	Sh(0)
m	**0.5**	2.25537	-2.04024	0.0212488	0.591385
	1.0	2.27723	-2.09073	0.0200025	0.589545
	1.5	2.28226	-2.10247	0.0197469	0.589122
	2.0	2.28323	-2.1048	0.0197134	0.589044
R	**0.5**	2.25537	-2.04024	0.0212488	0.591385
	1.5	2.12533	-1.74921	0.0317932	0.601208
	2.5	1.93944	-1.34003	0.0518081	0.609584
	3.5	1.77722	-0.982551	0.0718148	0.611931
A_1	**0.1**	2.25537	-2.04024	0.0212488	0.591385
	0.3	1.98884	-1.39377	0.0309274	0.616075
	-0.1	2.49902	-2.63537	0.0127793	0.570261
	-0.3	2.74471	-3.23998	0.00474074	0.550313
B_1	**0.1**	2.25537	-2.04024	0.0212488	0.591385
	0.3	1.97461	-1.35372	0.0294453	0.616746
	-0.1	2.48745	-2.61959	0.0158856	0.573086
	-0.3	2.70472	-3.17138	0.0119443	0.557955
Ec	**0.01**	2.25537	-2.04024	0.0212488	0.591385
	0.03	1.89152	-1.04954	0.0237568	0.604423
	0.05	1.63454	-0.350776	0.0256127	0.613885
	0.07	1.21509	0.787972	0.0288108	0.629815
Sr	**0.5**	2.25537	-2.04024	0.0212488	0.591385
	1.5	2.31254	-9.97099	0.0173462	1.54018
	2.5	2.36368	-18.3506	0.0146315	2.46778
	3.5	2.40991	-27.1235	0.0126737	3.37702

6. CONCLUSIONS:

In this paper, we aim at investigating the effect of rotation, Soret effect, Hall effects, dissipation and chemical reaction in the presence of non-uniform heat sources on convective heat and mass transfer flow of an electrically conducting fluid in a vertical channel bounded by stretching and stationary walls. the highly non-linear fourth order momentum equation, second order equations of energy and diffusion have been solved by using Runge-Kutta Shooting method. The impact of different physical parameters, like, Hall parameter(m), rotation parameter (R), Soret parameter(Sr), Eckert parameter (Ec), Heat source parameters (A1,B1) on the flow characteristics have been studied graphically in detail. It is found that a rise in rotation parameter (R) enhances. The Nusselt and Sherwood number reduces at η=-1 and enhances at η=+1.An increase in Hall parameter(m). Nu and Sh enhances at η=-1 and reduces at η=+1 with increase in m. Nu enhances with Sr at η=-12 while at η=+1,a reversed effect is noticed with Sr. Higher the dissipation larger Nu and Sh reduces at η=-1 and enhances at η=+1. Sh reduces in the degenerating chemical reaction case at both the walls. Nu reduces at η=-1 while a reversed effect is noticed at η=+1 with increase in γ>0.

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