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Study of flow characteristics of conducting fluid embedded in porous media.

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Abstract : In this composition, we have explored systematically the impact of radiation and suction/injection in insecure MHD oscillatory stream past a vertical within constant wall temperature and concentration. The fluid is subjected to a transverse attractive field and the velocity slip at the lower plate is taken into thought. The non-dimensional governing conditions are solved in the closed shape by utilizing Perturbation procedure. Correct arrangements are gotten for velocity, concentration and temperature. With the assistance of these expressions Skin-friction, Sherwood number and Nusselt number are decided. Different physical parameter impacts on the over stream amounts are examined numerically with the assistance of charts. Moreover, the numerical values of skin-friction factor, rate of heat and mass transfers are tabulated As the suction parameter increments, the velocity, temperature and concentration are increments between the boundaries. Whereas as the injection parameter diminishes, the velocity, temperature and concentration diminishes between the boundaries. As the radiation parameter increments, the temperature profile diminishes between the boundaries.

Key words: Oscillatory flow, MHD, Radiation, Magnetic field, Fluid slip,Porous media.

1. Introduction

The slip impact on the MHD oscillatory stream of fluid in a porous channel with heat and mass exchange and chemical response has applications within the areas of designing, geophysics, farming, etc. These applications are geothermal stores, heat separator, oil recuperation, cooling of atomic reactor. Numerous chemical designing forms like polymer expulsion forms include cooling framework. In this cooling framework, superior electromagnetic properties are regularly utilized as cooling fluid as their stream can be directed by outside attractive areas in arranging to improve the quality of the ultimate item. The oscillatory flow could be a periodic flow that oscillates around a zero value. Oscillatory flow is continuously that always around zero value. Oscillatory flow is continually critical since it has many viable applications, for cause, within the streamlined features of the helicopter or in shuddering airfoil additionally in an assortment of bio-engineering issues. Magdy et al. [1] examined thermo-electric MHD with memory-dependent subordinate heat exchange. Ahmed [2] examined buoyancy actuated MHD transitory mass exchange stream with thermal radiation. Umamaheswar et al. [3] Studied unsteady MHD free convective visco-elastic fluid flow bounded by an unbounded slanted permeable plate within the nearness of a heat source, gooey scattering and ohmic heatings. Das et al. [4] Considered Magnetohydrodynamic blended convective slip flow over a slanted porous plate with viscous dissipation and Joule heating. Jing Li et al. [5] talked about MHD viscoelastic stream and heat exchange over a vertical stretching sheet with cattaneo-christov heat flux impact. Shuwei Huang [6] examined regularizing impact of radiation in one-dimensional compressible MHD conditions.

There are a few examinations on the impacts heat and mass exchange on fluid flow in several physical circumstances. Since of its significance in mechanical applications such as control transformer-electronics, semi-conductor-electronics, retention reactors, parallel dissemination systems, solar vitality frameworks and polymer handling within the plastics businesses. In specific, blended convection boundary layer stream over an extending sheet is broadly utilized in chemical and auto-mobile businesses. Jinhu Zhao et al. [7] examined convection heat and mass exchange of fragmentary MHD maxwell fluid in a porous medium with soret and dufour impacts. Dipankar Chatterjee et al. [8] investigated MHD stream and heat transfer behind a square barrel in a channel underneath strong essential appealing field.Turkyilmazoglu [9] considered heat and mass trade of MHD minute organizes slip stream. Misra et al. [10] inspected MHD oscillatory channel stream, heat and mass trade in a physiological fluid in closeness of chemical reaDipankar Chatterjee et al. [12] explored MHD stream and heat exchange behind a square barrel in a conduit beneath the solid pivotal attractive field. Abdul Gaffar et al. [13] considered numerical ponder of stream and heat exchange of non-Newtonian digression hyperbolic fluid from a circle with biot number impacts. Xiao-Hong Luo et al. [14] investigated effects of thermal radiation on MHD stream and heat exchange in a cubic depth. Vajravelu et al. [15] convective stream, heat and mass exchange of Ostwald-de Waele fluid over a vertical extending sheet.

Here are a few examinations on the impacts of chemical reaction to the fluid flow totally different physical circumstances. Analysis of heat and mass transfer with a chemical reaction is critical for chemical businesses due to its colossal applications in a few branches of science and designing, such as in drying, dissipation, supply building, fabricating of ceramics, nourishment preparing. The arrange of chemical response depends on numerous variables, for instance foreign mass, active fluid and stretching of sheet and so on. Tasawar Hayata et al. [16] examined MHD convective stream due to a curved surface with thermal radiation and chemical reaction. Rout et al. [17] examined chemical response impacts on MHD free convection stream in a micropolar fluid. Tasawar Hayat et al. [18] examined MHD convective stream due to a curved surface with thermal radiation and chemical response. Manjula et al. [19] examined impact of thermal radiation and chemical response on MHD stream, heat and mass exchange over an extending surface. Xiao-Hong Luo et al. [20] investigated effects of thermal radiation on MHD stream and heat exchange in a cubic cavity. Reddy et al. [21] examined thermal radiation and chemical response impacts on MHD blended convection boundary layer slip stream in a porous medium with heat source and ohmic heating. Pandya et al. [22] studied combined impacts of soret- dufour, radiation and chemical response to an insecure MHD stream of dusty fluid over slanted porous plate inserted in porous media.

There are a few examinations on the impacts of porous medium of the fluid stream in several physical circumstances. The application of incompressible viscous flow through a porous medium with including heat and mass exchange beneath the impact of transversely connected uniform magnetic field is of extraordinary significance in numerous ranges of science and designing. Falade et al. [23] talked about the MHD oscillatory stream through a porous channel immersed with a porous medium. Samuel et al. [24] considered MHD oscillatory slip stream and heat exchange in a channel filled with porous media. Kozlov et al. [25] considered numerical think about of the ionization handle and radiation transport within the channel of the plasma quickening agent. Jyotsna Rani et al. [26] explored radiation and mass exchange impacts on MHD stream through porous medium past an exponentially quickened slanted plate with variable temperature. Singh et al. [27] examined the current impact on visco-elastic MHD oscillatory convective stream through a porous medium in a vertical channel with thermal radiation. Srinivasacharya et al. [28] examined impacts of thermophoresis and variable properties of mixed convection along a vertical wavy surface in a fluid immersed porous medium.

There are a few examinations on the impacts of attractive field on fluid flow completely different physical circumstances. The characteristics of the magnetic field which controls the stream design of the fluid has pulled in various analysts to consider the magnetohydrodynamic (MHD) flow, heat and mass transfer perspectives totally different geometries. Heath et al. [29] considered analysis of thixotropic nanomaterial in a doubly stratified medium, considering attractive field effects. Salawu et al. [30] examined the radiative heat exchange of variable viscosity and thermal conductivity impacts on the slanted attractive field with scattered in a non-Darcy medium. Kulkarni et al. [31] examined shaky MHD stream of elastico-viscous incompressible fluid through a porous medium between two parallel plates beneath the impact of an attractive field. Salawu et al. [32] radiative heat transfer of variable consistency and thermal conductivity impacts on the slanted attractive field with dissemination in a non-Darcy medium.

2. Mathematical analysis

Consider the unsteady laminar flow of an incompressible viscous electrically conducting fluid through a channel with slip at the cold plate. An outside attractive field is set over the ordinary to the channel. It is accepted that the fluid incorporates a small electrical conducting and the electromagnetic drive delivered is additionally exceptionally little. The stream is subject to suction at the cold wall and injection at the heated wall. We select a Cartesian facilitate a framework (x', y’). Where x' lies along the center of the channel, and y' are the separate measured within the ordinary area such that y'=a is the channel's half width as appeared in Fig.1.

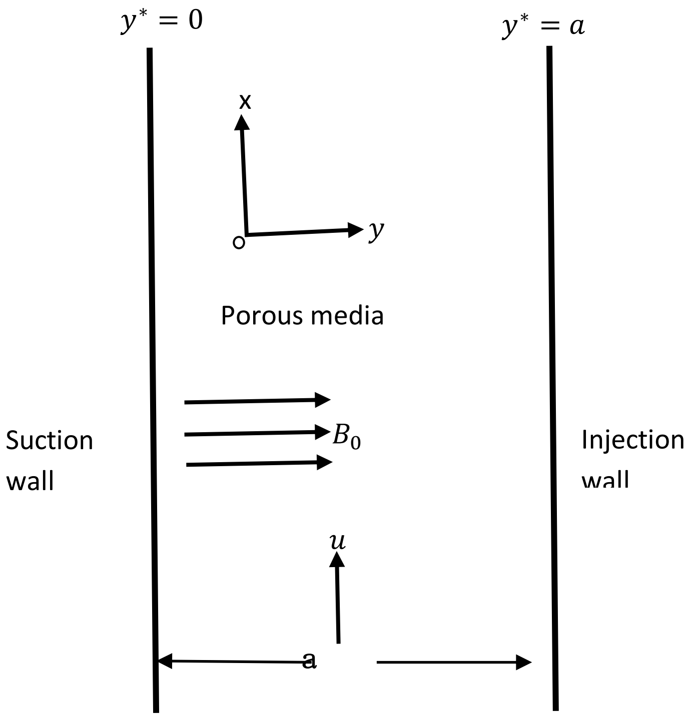

Fig. 1 Physical model of the problem

Under the normal Bousinesq estimation the conditions governing the stream are as takes after:

$$\frac{\partial u^{*}}{\partial t^{*}}-v_{0}\frac{\partial u^{*}}{\partial y^{*}}=-\frac{1}{\rho}\frac{dp^{*}}{dx^{*}}+\nu\frac{\partial^{2}u^{*}}{\partial y^{*2}}-\frac{\nu}{K}u^{*}-\frac{\sigma eB^{2}0}{\rho}u^{*}+g\beta(T^{*}-T_{0})+g\beta(C^{*}-C_{0}) \quad (1)$$

$$\frac{\partial T^{*}}{\partial t^{*}}-v_{0}\frac{\partial T^{*}}{\partial y^{*}}=\frac{k_{f}}{\rho C_{P}}\frac{\partial^{2}T^{*}}{\partial y^{*2}}+\frac{4\alpha^{2}}{\rho C_{P}}(T^{*}-T_{0})-\frac{1}{\rho C_{P}}\frac{\partial q_{r}}{\partial y^{*}} \quad (2)$$

$$\frac{\partial c^{*}}{\partial t^{*}}-v_{0}\frac{\partial c^{*}}{\partial y^{*}}=D\frac{\partial^{2}c^{*}}{\partial y^{*2}}-Kr(C^{*}-C_{0}) \quad (3)$$

With the boundary conditions $T=T_{1}$

$$u^{*}=\frac{\sqrt{K}}{\alpha_{S}}\frac{du^{*}}{dy^{*}},\ \mathrm{T}^{*}=T_{0},\ C^{*}=C_{0} \qquad on \quad y^{*}=0. \quad (4)$$

$$u^{*}=0,\ T^{*}=T_{1},\quad C^{*}=C_{1} \qquad on\ y^{*}=a. \quad (5)$$

The local radiant absorption in the case of an optically thin gray fluid is expressed as

$$\frac{\partial q_{r}}{\partial y^{*}}=-4\bar{a}\bar{\sigma}(T_{0}^{4}-T^{*4}) \quad (6)$$

Where $\bar{a}$ and $\bar{\sigma}$ are the Stefan-Boltzmann constant and the Mean absorption coefficient. We assume that the temperature differences within the flow are sufficiently small so that T^{*4} can be expressed as a linear function of T after using Taylor's series to expand T^{*4} about the free stream temperature T_{0} and neglecting higher- order terms. This results in the following approximation:

$$T^{*4}\cong 4T_{0}^{3}T^{*}-3T_{0}^{4} \quad (7)$$

$$\frac{\partial q_{r}}{\partial y^{*}}=16\bar{a}\bar{\sigma}T_{0}^{3}(\mathrm{T}^{*}-T_{0}) \quad (8)$$

Then the heat transfer equation becomes

$$\frac{\partial T^{*}}{\partial t^{*}}-v_{0}\frac{\partial T^{*}}{\partial y^{*}}=\frac{k_{f}}{\rho C_{P}}\frac{\partial^{2}T^{*}}{\partial y^{*2}}+\frac{4\alpha^{2}}{\rho C_{P}}(T^{*}-T_{0})-16\bar{a}\bar{\sigma}T_{0}^{3}(\mathrm{T}^{*}-T_{0}) \quad (9)$$

Where t^{*} is the time, u^{*} is the axial velocity, V_{0} is the constant horizontal velocity, ρ is the fluid density, p^{*} is the Fluid pressure, ν is the kinematic viscosity, K is the porous permeability, σ_{e} is the electrical conductivity, B_{0} is the Magnetic field intensity, g is the gravitational acceleration, β is the volumetric expansion, C_{p} is the specific heat at constant pressure, α is the term due to thermal radiation, k is the represents the thermal conductivity, T^{*} is the fluid temperature, T_{0} is the referenced fluid temperature, D is the mass diffusivity, C^{*} is the fluid concentration for away from the wall, C is the concentration and Kr is the rate of chemical reaction.

Introducing the dimensionless parameters and variables given in (10)

$$(X,Y)=\frac{(x^*,y^*)}{h},\quad u=\frac{hu^*}{\nu},\quad t=\frac{\nu t^*}{h^2},\quad p=\frac{h^2p^*}{\rho\nu^2},\ \theta=\frac{(T^*-T_0)}{(T_1-T_0)},\quad \phi=\frac{(C^*-C_0)}{(C_1-C_0)},\quad \delta=\frac{4\alpha^2h^2}{\rho C_P\nu},$$

$$Gr=\frac{g\beta(T_1-T_0)h^3}{\nu^2},\ \Pr=\frac{\rho C_P\nu}{k_f},\ \gamma=\frac{\sqrt{K}}{\alpha_s h},\ Ha^2=\frac{\sigma_e B_0^2h^2}{\rho\nu},\ \mathrm{Da}=\frac{K}{h^2},\ Sc=\frac{\gamma}{D},\ Kc=\frac{Krh^2}{\nu}$$

$$s=\frac{\nu_0 h}{\nu},\quad \Gamma=\frac{16\overline{a}\overline{\sigma}h^2T_0^3}{k_f},\quad Gc=\frac{g\beta(C_1-C_0)h^3}{\nu^2} \tag{10}$$

Using the transformation (9), the non-dimensional forms of (1), (2), (3) and (8) are

$$\frac{\partial u}{\partial t}-s\frac{\partial u}{\partial y}=\frac{dp}{dx}+\frac{\partial^2 x}{\partial y^2}-(Ha^2+\frac{1}{Da})u+Gr\theta+Gc\phi \tag{11}$$

$$\frac{\partial\theta}{\partial t}-s\frac{\partial\theta}{\partial y}=\frac{1}{\Pr}\frac{\partial^2\theta}{\partial y^2}+\delta\theta-\frac{\Gamma}{\Pr}\theta \tag{12}$$

$$\frac{\partial\phi}{\partial t}-s\frac{\partial\phi}{\partial y}=\frac{1}{Sc}\frac{\partial^2\phi}{\partial y^2}-Kc\,\phi \tag{13}$$

With the appropriate boundary conditions (14) and (15)

$$u=\gamma\frac{du}{dy},\quad \theta=0,\ \phi=0\ \ on\quad \gamma=0 \tag{14}$$

$$u=0,\quad \theta=0,\ \phi=0\ \ on\quad \gamma=0 \tag{15}$$

In Eqs. (11) - (15), Da is the Darcy parameter, s is the Suction/injection parameter, Ha^2 is the Hartmann's number, Gr is the Grashof number, Gc is the mass Grashof number, Pr is the prandtl number, Sc is the Schmidt number, Γ is the Radiation parameter, Kc is the Chemical reaction, δ is the heat Observation/generation parameter and γ is the Navier slip parameter.

3. Method of solution

As appeared in [1, 2, 3]. We accept oscillatory pressure gradient, such that arrangements of the dimensionless Eqs. (11) - (15) is within the taking after frame.

$$-\frac{dp}{dx}=\lambda e^{i\omega t},\ u(t,y)=u_0(y)e^{i\varpi t},\ \theta(t,y)=\theta_0(y)e^{i\varpi t},\ \phi(t,y)=\phi_0(y)e^{i\varpi t} \tag{16}$$

Where λ is any positive constant and ω is the frequency of oscillation. In view of (16), Eqs . (11)- (15) reduced to a boundary valued problem in the following form

$$u_0''+su_0'-(Ha^2+\frac{1}{Da}+i\omega)u_0=-\lambda-Gr\theta_0-Gc\phi_0$$

$$u_0(0)=\gamma u_0'(0),u(1)=0 \tag{17}$$

$$\theta_0'' + s\,\mathrm{Pr}\,\theta_0' + ((\delta - i\omega)Pr - \Gamma)\theta_0 = 0$$
$$\theta_0(0) = 0,\ \theta_0(1) = 1 \tag{18}$$

$$\phi_0'' + sSc\phi_0' - (Kc + i\omega)Sc = 0$$
$$\phi_0(0) = 0,\ \phi_0(1) = 1 \tag{19}$$

The exact solution of (18) becomes

$$\theta(y,t) = (A_0 e^{m_1 y} + B_0 e^{m_2 y})e^{i\omega t} \tag{20}$$

As a result, the rate of heat transfer/Nusselt Number is given by

$$Nu = \frac{\partial\theta}{\partial y} = (A_0 m_1 e^{m_1 y} + B_0 m_2 e^{m_2 y})e^{i\omega t} \tag{21}$$

The exact solution of (19) becomes

$$\phi(y,t) = (A_1 e^{m_3 y} + B_1 e^{m_4 y})e^{i\omega t} \tag{22}$$

As a result, the rate of mass transfer/ Sherwood Number is given by

$$Su = \frac{\partial\phi}{\partial y} = (A_1 m_3 e^{m_3 y} + B_1 m_4 e^{m_4 y})e^{i\omega t} \tag{23}$$

While exact solution of (17) is

$$u(y,t) = (A_2 e^{m_5 y} + B_2 e^{m_6 y} + Q_0 + Q_1 e^{m_1 y} + Q_2 e^{m_2 y} + Q_3 e^{m_3 y} + Q_4 e^{m_4 y})e^{i\omega t} \tag{24}$$

and the shear stress is given by the relation

$$Sf = \frac{\partial u}{\partial y} = (A_2 m_5 e^{m_5 y} + B_2 m_6 e^{m_6 y} + Q_0 + Q_1 m_1 e^{m_1 y} + Q_2 m_2 e^{m_2 y} + Q_3 m_3 e^{m_3 y} + Q_4 m_4 e^{m_4 y})e^{i\omega t} \tag{25}$$

Where

$$m_1 = \frac{-s\,\mathrm{Pr} + \sqrt{(s\,\mathrm{Pr})^2 - 4(\delta - i\omega)\,\mathrm{Pr} - \Gamma)}}{2} \qquad m_2 = \frac{-s\,\mathrm{Pr} - \sqrt{(s\,\mathrm{Pr})^2 - 4(\delta - i\omega)\,\mathrm{Pr} - \Gamma)}}{2}$$

$$m_3 = \frac{-sSc + \sqrt{(s\,Sc)^2 + 4Sc(Kc + i\omega)}}{2} \qquad m_4 = \frac{-sSc - \sqrt{(s\,Sc)^2 + 4Sc(\mathrm{Kc} + i\omega)}}{2}$$

$$m_5 = \frac{-s + \sqrt{s^2 + 4(Ha^2 + \frac{1}{Da} + i\omega)}}{2} \qquad m_6 = \frac{-s - \sqrt{s^2 + 4(Ha^2 + \frac{1}{Da} + i\omega)}}{2}$$

$$A_0 = -\frac{1}{e^{m_2} - e^{m_1}} \qquad B_0 = \frac{1}{e^{m_2} - e^{m_1}} \qquad A_1 = -\frac{1}{e^{m_4} - e^{m_3}} \qquad B_1 = \frac{1}{e^{m_4} - e^{m_3}}$$

$$A_2 = \frac{B_2(\gamma m_6 - 1) - n_0 + n_1}{(1 - \gamma m_5)} \qquad B_2 = -\frac{\left(n_2 + \dfrac{(n_1 - n_0)e^{m_5}}{(1 - \gamma m_5)}\right)}{\left(e^{m_6} + \dfrac{(\gamma m_6 - 1)e^{m_5}}{(1 - \gamma m_5)}\right)} \qquad Q_0 = \frac{\lambda}{(Ha^2 + \dfrac{1}{Da} + i\omega)}$$

$$Q_1 = -\frac{GrA_0}{m_1^2 + sm_1 - (Ha^2 + \dfrac{1}{Da} + i\omega)} \qquad Q_2 = -\frac{GrB_0}{m_2^2 + sm_2 - (Ha^2 + \dfrac{1}{Da} + i\omega)}$$

$$Q_3 = -\frac{GcA_1}{m_3^2 + sm_3 - (Ha^2 + \dfrac{1}{Da} + i\omega)} \qquad Q_4 = -\frac{GcB_1}{m_4^2 + sm_4 - (Ha^2 + \dfrac{1}{Da} + i\omega)}$$

$$n = Q_0 + Q_1 + Q_2 + Q_3 + Q_4 \qquad n_1 = Q_0 + Q_1 e^{m_1} + Q_2 e^{m_2} + Q_3 e^{m_3} + Q_4 e^{m_4}$$

4. Results and discussion

In Fig. 2, it is watched that an increment within the heat observation/generation parameter increments the fluid velocity due to an inside heat generation that improves the fluid stream. Fig. 3, presents the plot of increment in channel porous penetrability on the velocity profile. As watched, as the penetrability of the medium increments, there's an increment within the fluid velocity since barriers placed within the stream way decrease as Da increments permitting at no cost stream thus increasing the speed. As watched in Fig. 4, as the Navier slip parameter increments at the cold wall, there's a comparable rise within the velocity at the cold wall. Be that as it may, Fig. 5, shows the buoyancy impact on the fluid flow during heating (Gc>0) as observed, and an increment within the mass Grashof number improves the fluid flow velocity whereas a diminish within the parameter diminishes the fluid velocity due to cooling. In Fig. 6, appears the buoyancy impact on the fluid flow during during (Gr>0) as watched, and an increment within the Grashof number improves the fluid stream velocity whereas a decrease within the parameter decreases the fluid velocity due to cooling. In Fig. 7, the impact of the impending impact of Lorentz power display within the attractive field of the fluid stream is presented. It is watched that greatest stream happens within the nonappearance of the attractive field, and encourage increment within the Hartmann's number is seen to diminish the fluid velocity. In Fig. 8, appears the impact of the weight, slope (pump) on the stream, and it is watched that pumping of fluid enhances the stream against the gravitational force. In Fig. 9, it is watched that an increment within the radiation parameter diminishes the fluid velocity due to internal heat generation that enhances the fluid stream. In Fig. 10, the result appears that as the suction parameter increases, there's an increment within the fluid velocity. Whereas as the injection parameter diminishes, there's a diminish within the fluid velocity due to cooling.

As appeared in Fig. 11, it is watched that an increment within the recurrence of prandtl number increments the fluid temperature within the channel usually due to the heat exchange from the heated wall to the fluid from the fluid assimilates its own radiations. Fig. 12, as the heat observation/generation parameter increments, and the fluid temperature is seen to be increasing. From Fig. 13, it is watched that an increment within the recurrence of radiation parameter decreases the fluid temperature inside the channel. This is often credited with a reduction within the heat exchange rate as the heating recurrence. In Fig. 14, the result shows that as the suction parameter increments, there's an increment within the fluid temperature. Whereas as the injection parameter diminishes, there's a decrease within the fluid temperature due to cooling.

In Fig. 15, it is watched that an increment within the Schmidt number diminishes the fluid concentration due to an inner heat generation that upgrades the fluid stream. In Fig. 16, it is observed that an increment within the chemical response diminishes the fluid concentration due to an inside heat generation that improves the fluid stream. In Fig. 17, the result shows that as the suction parameter increments, there's an increase within the fluid concentration. Whereas as the injection parameter decreases, there's a decrease within the fluid concentration due to cooling.

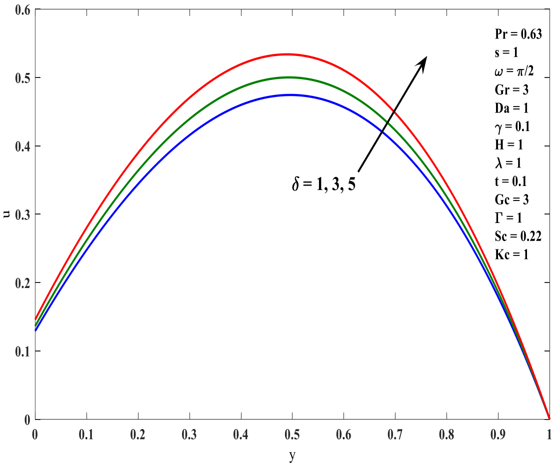

Fig. 2 Effect of Observation/generation in fluid velocity.

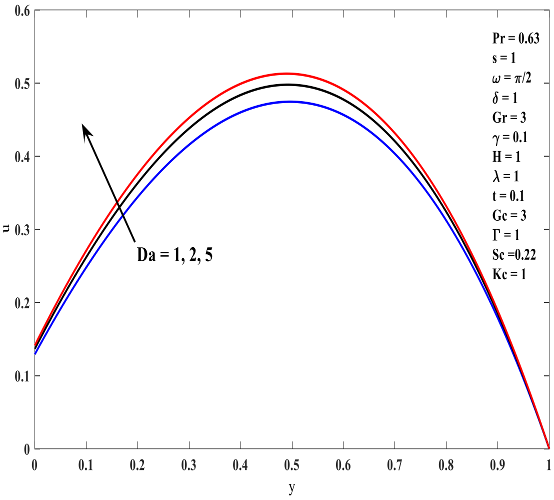

Fig.3 Effect of Darcy parameter on fluid velocity.

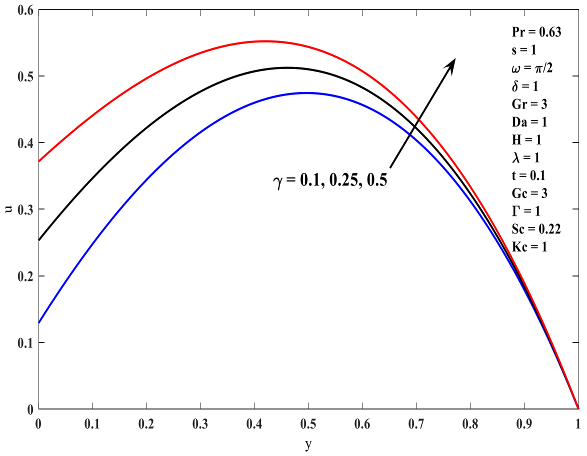

Fig. 4 Effect of Navier slip parameter on fluid velocity.

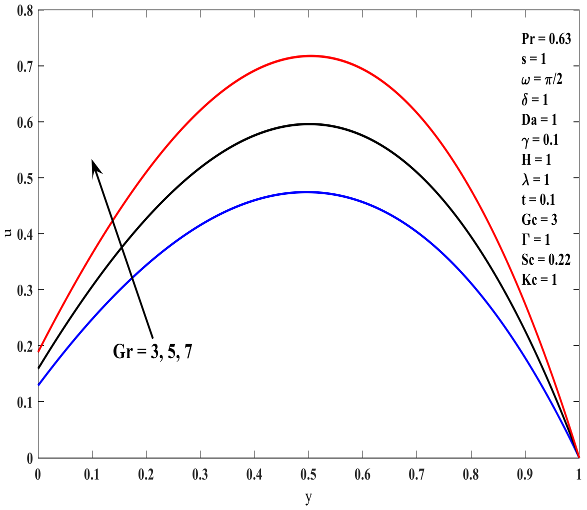

Fig.5 Effect of Grashof number of fluid velocity.

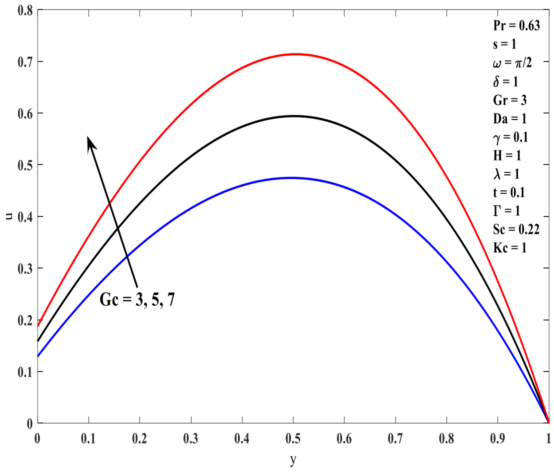

Fig .6 Effect of mass Grashof number of fluid velocity.

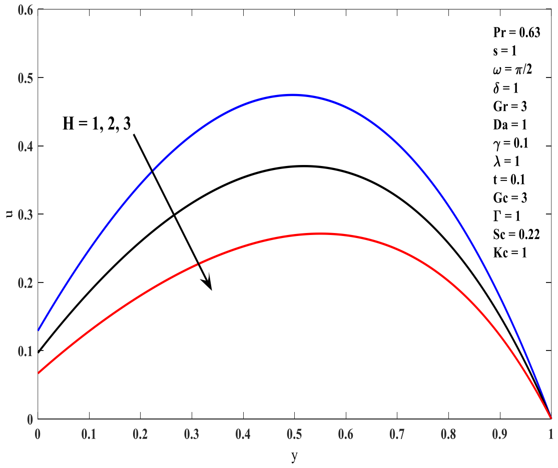

Fig. 7 Effect of Hartmann's number on fluid velocity.

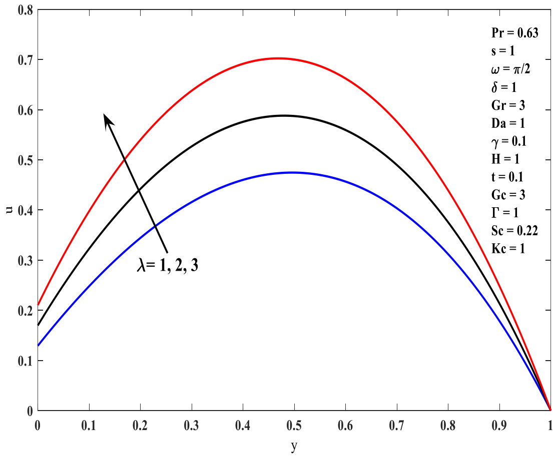

Fig. 8 Effect of pressure gradient on fluid velocity.

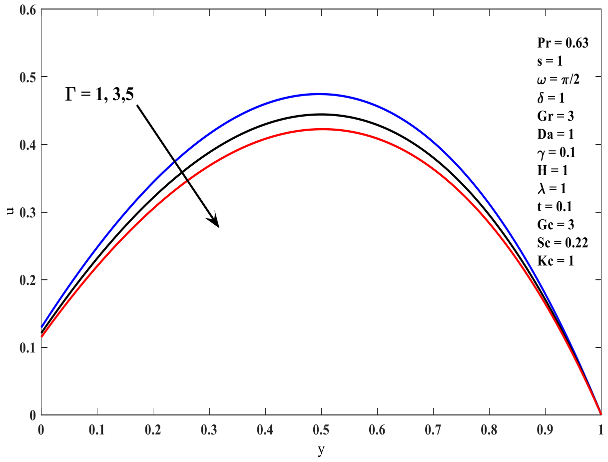

Fig. 9 Effect of radiation parameter on fluid velocity.

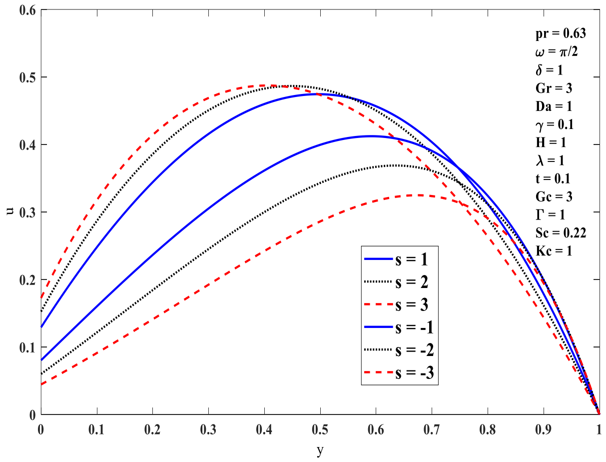

Fig. 10 Effect of suction/injection on fluid velocity.

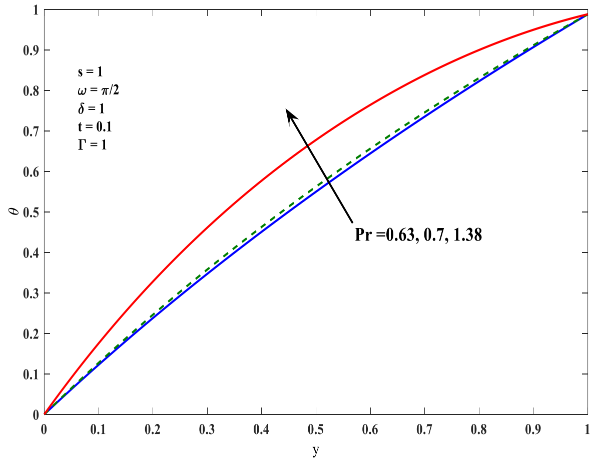

Fig .11 Effect of prandtl number on fluid temperature.

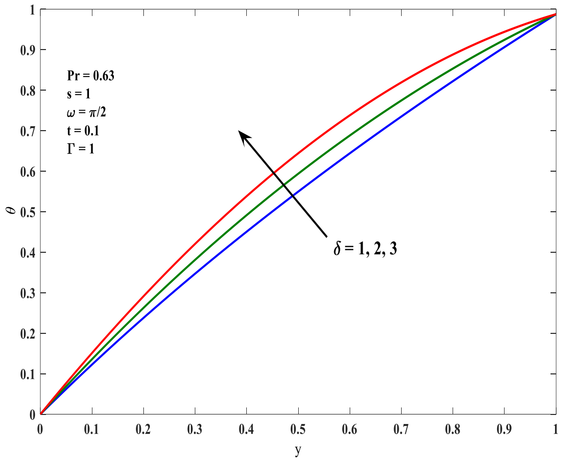

Fig. 12 Effect of bservation/generation on fluid temperature.

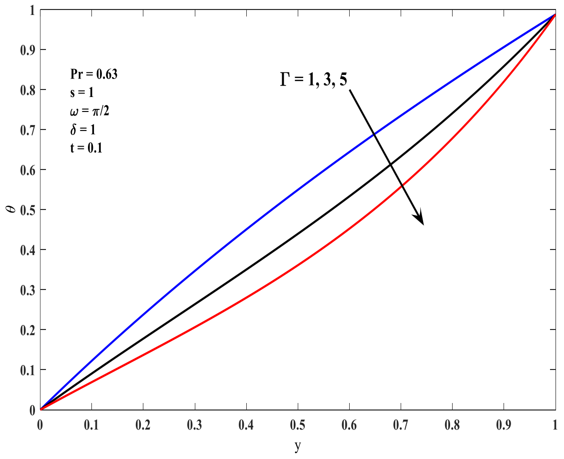

Fig. 13 Effect of radiation parameter on fluid temperature.

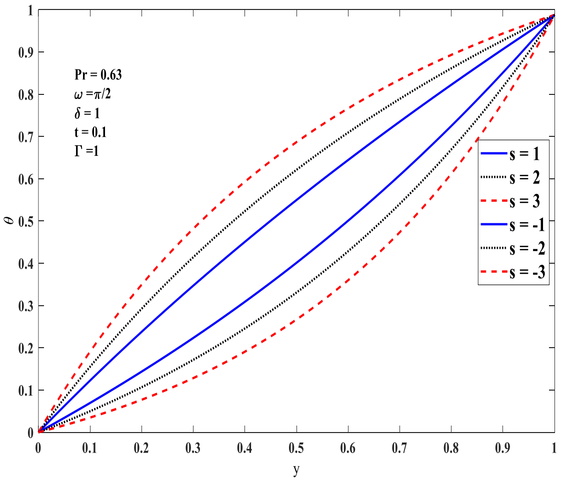

Fig. 14 Effect of suction/injection parameter on fluid temperature.

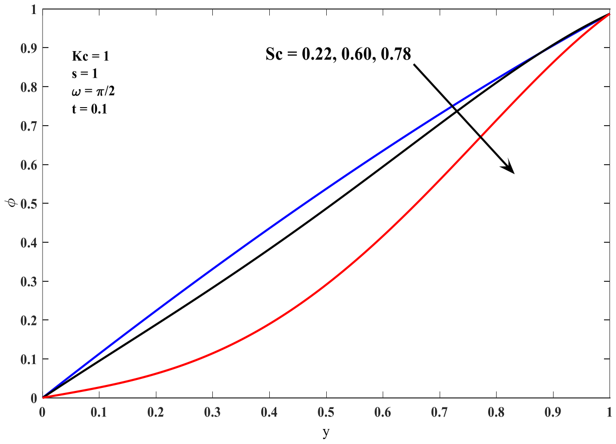

Fig. 15 Effect of Schmidt number on fluid concentration.

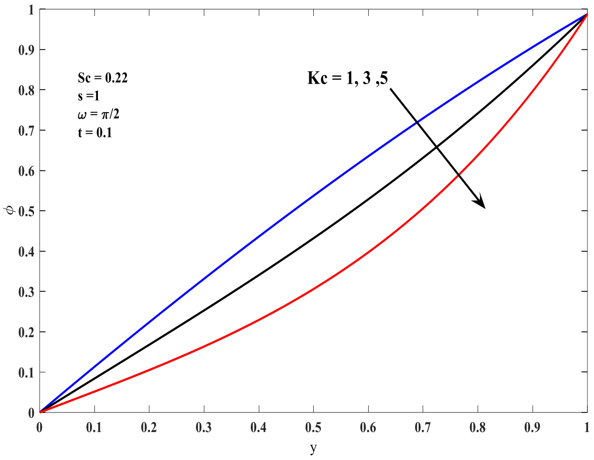

Fig.16 Effect of chemical reaction on fluid concentration.

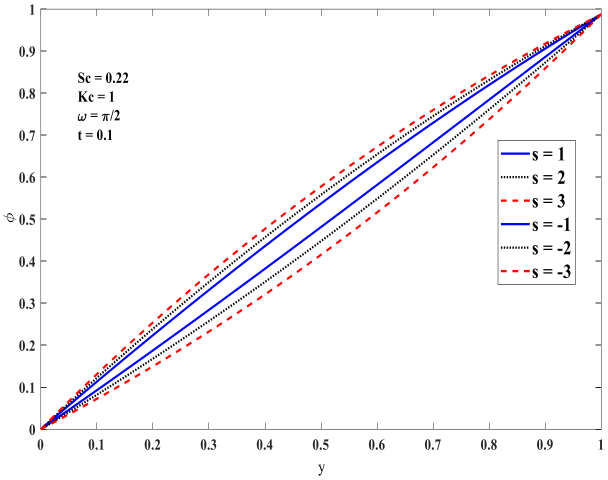

Fig.17 Effect of suction/injection parameter on fluid concentration.

Numerical values of skin-friction coefficient at the plate for various values of physical parameters.

Sc	s	ω	Kc	t	Su
0.22	1	$\pi/2$	1	0.1	1.1453
0.60					0.9704
0.78					0.2573
	2				1.2490

	3				1.3560
		$\pi/4$			1.0820
		$\pi/6$			1.0708
			3		0.8479
			5		0.5182
				0.2	1.1260
				0.3	1.0789

Numerical values of the rate of heat transfer/ Nusselt number at the plate for various values of physical parameters.

Pr	s	ω	λ	Γ	t	Nu
0.63	1	$\pi/2$	1	1	0.1	1.2624
0.7						1.3154
1.38						1.8759
	2					1.6497
	3					2.0925
		$\pi/4$				1.2671
		$\pi/6$				1.2680
			2			1.3998
			3			1.5589
				3		1.0799
				5		0.9316
					0.2	1.2474
					0.3	1.2016

Numerical values of the rate of shear stress number at the plate for various values of physical parameters. $\Pr = 0.63,\ s = 1,\ \omega = \frac{\pi}{2}$

Pr	s	ω	δ	Gr	Da	H	λ	t	γ	Γ	Sc	Kc	Gc	Sf
0.63	1	$\pi/2$	1	3	1	1	1	0.1	0.1	1	0.22	1	3	1.6352
0.7														1.6443
1.38														1.7285
	2													1.8690
	3													2.0690
		$\pi/4$												1.7379
		$\pi/6$												1.7667
			3											1.7068
			5											1.8016
				5										1.9344
				7										2.2336
					2									1.7310
					5									1.7785
						2								1.1565
						3								0.7666
							2							2.3835
							3							3.1319
								0.2						1.6624
								0.3						1.6487
									0.25					1.3562
									0.5					1.0868
										3				1.5520
										5				1.4927
											0.60			1.5520
											0.78			1.3842
												3		1.5483
												5		1.4524
													5	1.9271
													7	2.2191

Conclusion

In this paper, the Radiation impact on an unsteady MHD oscillatory flow of a chemically responding fluid past a vertical channel saturated with porous medium considered within the optically thin thermal radiation limit.

-As the heat observation/generation, Darcy parameter, slip parameter, Grashoff number, mass Grashoff number and pressure gradient increments, the velocity profile increments between the boundaries .

-As the Hartmann's number and radiation parameter and increments, the velocity profile diminishes between the boundaries.

-As the suction parameter increments, the velocity, temperature and concentration are increments between the boundaries. Whereas as the injection parameter diminishes, the velocity, temperature and concentration diminishes between the boundaries.

-As the heat observation/generation and Prandtl number increments, the temperature profile increments between the boundaries.

-As the radiation parameter increments, the temperature profile diminishes between the boundaries.

- As the chemical reaction, Schmidt number and time increments, the concentration profile decrease between the boundaries.

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