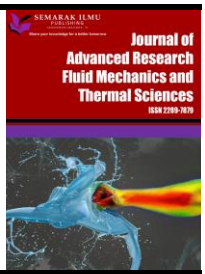
Journal of Advanced Research in Fluid Mechanics and Thermal Sciences

Journal homepage:
https://semarakilmu.com.my/journals/index.php/fluid_mechanics_thermal_sciences/index
ISSN: 2289-7879



Role of Soret, Dufour Influence on Unsteady MHD Oscillatory Casson Fluid Flow an Inclined Vertical Porous Plate in the Existence of Chemical Reaction

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ARTICLE INFO

Article history:
Received 17 July 2023
Received in revised form 5 October 2023
Accepted 14 October 2023
Available online 26 October 2023

Keywords:
Thermal radiation; porous medium; Casson fluid; chemical reaction; Soret effect; Dufour effect

ABSTRACT

A numerical investigation of the Soret-Dufour impacts on the motion of an unstable, viscous, and incompressible MHD flow through a semi-infinite, permeable, inclined plate that is immersed in a variable-temperature, mass-diffusing porous medium. This is done with the consideration that a chemical reaction and heat sink will have an effect on the motion of the flow. With the help of the finite difference method, the non dimensional governing equations of the flow field may be determined for a number of different possible combinations of the governing flow components. The results are consistent with other work of a similar kind that has been published in other places. The results are in line with a subset of other research that has been published in the past. In the context of inclination angle, Casson fluid, and aligned magnetic field characteristics, the findings of the present research indicate that a consistent slowing influence is maintained on velocity. This was determined by analyzing the results of the previous study. When all of these factors, including the inclination angle, magnetic field, Casson fluid, and alignment parameter, are raised, the velocity decreases.

1. Introduction

Magneto hydrodynamics (MHD) has key impact in science and engineering. MHD is an important topic of research that takes into account the effects of magnetic fields on physiological fluid flow that is electrically driven. MHD is very vital to the fields of astronomy, agriculture, and petroleum industries, in addition to geophysics. The subject of study known as magneto hydrodynamics is concerned with the motion of electrically accompanying fluids in the existence of a magnetic field. The purpose of this research is to explore the interaction of magnetic fields with electrically conducting fluids. The influence of and thermophoresis and Brownian motion in a non-Newtonian nanofluid was discussed by Gupta *et al.,* [1]. Veeresh *et al.,* [2] studied the flow of MHD

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https://doi.org/10.37934/arfmts.110.2.157175

mixed convection across a moving porous plate with a slope. Kim [3] analyzed changing suction via a semi-infinite vertically moving porous plate using Unsteady MHD convective heat transmission. In their research, Ahmed and Hazarika [4] looked at the mass transfer and convection processes occurring in an MHD fluid as it flows through a porous vertical plate.

A fluid is a substance that flows without stopping and can withstand shear stress. Fluid flow induced by an infinite vertical permeable plate is a recurrent area of study because of its use in so many different kinds of technology and industry. Newtonian and non-Newtonian fluids are the two main types of fluids. The viscosity of non-Newtonian fluids changes in response to external forces. As a result of its far-reaching consequences in mechanical and chemical engineering, the explore of non-Newtonian fluids has recently concerned the consideration of an extensive range of scholars. The non-Newtonian fluid with the highest demand is the Casson fluid. The rheological characteristics of substances like blood, ketchup, shampoo products, flow of plasma, and mercury amalgamated materials can be analyzed using the Casson fluid, which was first studied by Casson in 1959 to predict the behavior of flow of pigmentation oil in publishing oil.

Mukhopadhyay [5] studied the Casson fluid flow and heat transfer over a nonlinearly stretching surface A flat plate moving in a parallel free stream was used to investigate the flow and heat transfer properties of an unsteady boundary layer by Mustafa *et al.,* [6]. Using the technique of homotopy analysis, they were able to provide analytic solutions to the problems at hand. Kodi e*t al.,* [7] looked into the consequences of heat diffusion and chemical reaction on the flow of MHD Casson fluid via a vertical porosity plate. Casson fluid flow and heat transmission were investigated by Pramanik [8] in the context of thermal radiation across an exponentially porous stretched surface. Ramesh *et al.,* [9] examined the Casson fluid flow near the stagnation point over a stretching sheet with variable thickness and radiation. Mehmood *et al.,* [10] investigated radiating Casson fluid non-aligned stagnation point flow across a stretched surface. The influence of an induced magnetic field and homogeneous-heterogeneous reactions on the stagnation flow of a Casson fluid was investigated by Raju *et al.,* [11]. Mahabaleshwar *et al.,* [12] examined the Mass transfer characteristics of MHD Casson fluid flow past stretching/shrinking sheet. Using a stretched sheet, El-Aziz and Afify [13] investigated the effects of slip velocity and generated magnetic field on the MHD stagnation-point heat transfer and flow of Casson fluid. Bilal Ashraf *et al.,* [14] examined the mixed convection flow of Casson fluid over a stretching sheet with convective boundary conditions and Hall effect.

Despite all this research, the impact of Dufour and Soret on natural convective heat and mass transport in the form of heat absorption and thermal radiation beyond an infinite vertical plate implanted in a permeable medium has been largely ignored. The Unsteady MHD free convective mass transfer flow across an infinite vertical porous plate with changing suction and the Soret effect was investigated by Reddy *et al.,* [15]. The impact of Soret and Dufour on unsteady MHD flow were investigated by Vempati and Laxmi-Narayana-Gari [16] who looked at the flow through an infinite vertical porous plate with radiation. The investigation conducted by Raju *et al.,* [17] pertained to the examination of the Soret impact resulting from mixed convective on an unsteady MHD flow that passed a semi-infinite moving vertical plate. Unsteady MHD fluid flows across an infinite vertical plate embedded in a porous medium with the Soret impact was studied by Taid *et al.,* [18]. Numerical study of chemical reaction, Soret, and Dufour influences on MHD free convective gyrating flow over a vertical porous channel was analyzed by Ahammad and Krishna [19]. The impact of chemical reaction on MHD movement with mass and heat transmission via a vertical porous plate with viscous dissipation was studied by Kar*et al.,* [20]. Raghunath *et al.,* [21] investigated unsteady MHD fluid stream across an inclined vertical absorbent plate with some factor impact and Soret phenomena. The behaviour of the Soret and Dufour quantities on the flow of a micropolar fluid across a nonlinear starching cylinder were investigated by Khan *et al.,* [22].

In general, a significant number of endothermic and exothermic reactions occur simultaneously with chemical processes. These qualities are easily observable in a great number of different manufacturing procedures. In the context of a chemical reaction impact, there are a number of different transport mechanisms that may be illustrated by the combined impact of buoyancy forces. These procedures are caused by both heat diffusion and mass diffusion. Swain *et al.,* [23] investigated the influence of a chemical reaction on MHD convective flow while heat and mass were transferred through a semi-infinite vertical porous plate. The study conducted by Reddy [24] investigated the magneto hydrodynamic (MHD) flow occurring over a vertical porous plate in motion, while taking into account the effects of viscous dissipation and double diffusive convection. Additionally, the study considered the presence of chemical reaction. MHD heat and mass transfer were taken into account in a study of fluid flow across an infinite vertical plate with radiation and heat absorption by Goud and Reddy [25]. Chemical reaction on MHD natural convection flow in porous medium was studied by Reddy *et al.,* [26]. The research was conducted on a sheet under exponential stretching, taking into account heat source/sink and viscous dissipation. The influence of Soret and Dufour on the permeability flow analysis of Carreau fluid was investigated by Salahuddin *et al.,* [27], who looked at the area around a thermally radiated cylinder. Goud *et al.,* [28] used the finite element method to investigate the influence that radiation, Soret, and Dufour numbers have on the rate of heat and mass transfer of a magneto-Casson fluid across a vertical permeable plate when there is viscous dissipation present. Some of the authors researched some related works [29-35].

The focus of the current research is on a number of parameters related to the MHD convective heat and mass transfer flow of an unsteady viscous electrically conducting fluid that is moving through a semi-infinite inclined vertical porous plate in the presence of Soret and Dufour effects. Numerical solutions are found for the governing equations of motion by employing a procedure known as the finite difference method. In this investigation, we have attempted to expand the work that Choudhury and Ahmed [36] have previously accomplished by taking into account inclined vertical porous plates, the Casson factor and aligned magnetic fields. This research has the potential to be beneficial in a variety of commercial uses, such as the synthesis of polymers, the fabrication of ceramics or food processing, glassware, and other similar uses.

2. Mathematical Formulation

The motion of a semi-infinite inclined plate that is submerged in a homogenous porous medium and is exposed to the unsteady 2D MHD movement of a viscous, incompressible, electrically conducting fluid is investigated in this study. Analysing the influence of a uniform transverse magnetic field B_0 is done here in the context of heat absorption and a chemical reaction that takes place in a homogeneous environment. It may be supposed that there is no applied voltage, it causes absolutely no electrical field to exist. Because both the Reynolds number and transversely applied magnetic field are very low, it is reasonable to anticipate that the induced magnetic field and the effects of the Hall effect will be on the low end of the spectrum except for the impact that changes in density have on the buoyant force part, it is assumed that all other characteristics of the fluid stay unchanged. The y −axis is aligned in a direction that is erect to the flow, while the x −axis is directed upward with the flow. In the beginning, it is assumed that the velocity of the free stream is increasing at an exponential rate due to minute disturbances, and it is also assumed that the plate is moving along the path of the fluid flow at a velocity that is constant, denoted by u*. In addition to this, it is presumed that both the suction velocity and the temperature or concentration at the wall is escalating at an exponential rate throughout the course of time. In Figure 1, you can see the exact configuration that was used. Given the parameters described above, each of the four conservation laws mass (continuity), momentum, energy, and concentration can be rephrased in the following way to illustrate their meaning. Choudhury and Ahmed [36] include specific information on the boundary conditions of the flow domain as well as the governing equations.

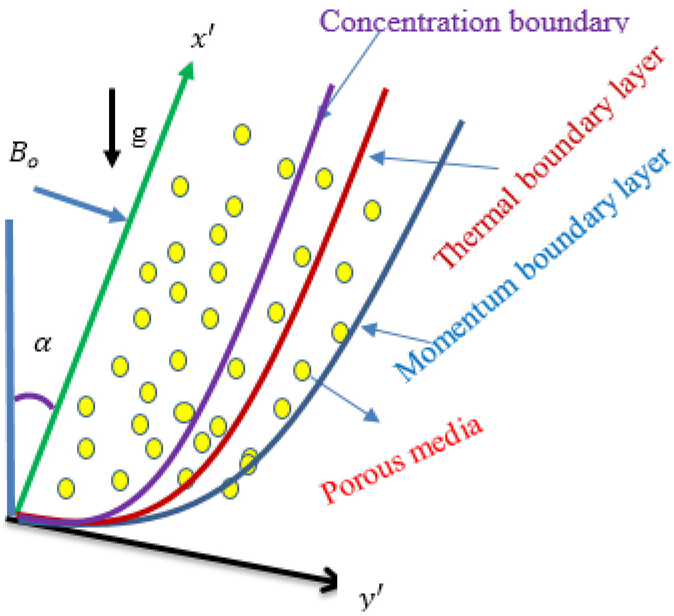

Fig. 1. Flow geometry

Continuity Equation:

$$\frac{\partial v'}{\partial y'} = 0 \rightarrow v' = -v_0 (v_0 > 0) \tag{1}$$

Momentum Equation:

$$\frac{\partial u'}{\partial t'} + V'\frac{\partial u'}{\partial y'} = -\frac{1}{\rho}\frac{\partial p'}{\partial x'} + \vartheta\left(1+\frac{1}{\lambda}\right)\frac{\partial^2 u'}{\partial y'^2} + g\beta_T cos\alpha + g\beta_c cos\alpha - \left(\frac{\sigma B_0^2}{\rho}\sin^2\gamma - \frac{\vartheta}{k'}\right)u' \tag{2}$$

Energy Equation:

$$\frac{\partial T'}{\partial t'} + V'\frac{\partial T'}{\partial y'} = \frac{K}{\rho C_p}\frac{\partial^2 T'}{\partial y'^2} - Q'(T' - T'_\infty) + D_2\frac{\partial^2 C'}{\partial y'^2} \tag{3}$$

Species Continuity equation:

$$\frac{\partial C'}{\partial t'} + V'\frac{\partial C'}{\partial y'} = D\frac{\partial^2 C'}{\partial y'^2} - K'(C' - C'_\infty) + D_1\frac{\partial^2 T'}{\partial y'^2} \tag{4}$$

If the above deductions hold, then the appropriate boundary conditions for the variations in the flow area are provided by.

$$\left.\begin{array}{ll} u' = u'_p,\ T' - T'_w = \varepsilon(T'_w - T'_\infty)e^{n't'},\ C' - C'_w = \varepsilon(C'_w - C'_\infty)e^{n't'} & at\ y' = 0 \\ u' = u'_\infty = U_0(1 + \varepsilon e'),\ T' \to T'_\infty,\ C' \to C'_\infty & as\ y' \to \infty \end{array}\right\} \tag{5}$$

We may determine that v' is a constant or a function of time by utilizing the continuity equation to find it. So, let's assume

$$v' = -V_0\left(1 + A\varepsilon e^{n't'}\right)\text{Here } A > 0, \tag{6}$$

Where A is any non-zero positive constant not equal to zero, ε & $A\varepsilon$ very small quantity, & V_o is the scale for measuring suction velocity.

The solution may be found outside the boundary layer by using Eq. (1).

$$-\frac{1}{\rho}\frac{\partial p'}{\partial x'} = \frac{\partial u_\infty}{\partial t'} + \left(\frac{\sigma B_0^2}{\rho}\sin^2\gamma + \frac{\vartheta}{k'}\right)u'_\infty \tag{7}$$

The following nondimensional variables and factors are introduced to the mathematical representation of the physical issue in order to achieve this normalization.

In order to achieve normalization, the mathematical representation of the physical issue incorporates the various nondimensional variables and factors. These quantities are carefully chosen and incorporated into the model and the following parameters involved.

$$u = \frac{u'}{U_0}, y = \frac{U_o y'}{\vartheta}, Gr = \frac{\vartheta g B_T(T'_w - T'_\infty)}{U_0^3}, Gm = \frac{\vartheta g B'_T(T'_w - T'_\infty)}{U_0^3}, \Pr = \frac{\mu C_p}{K_T}, M = \frac{\sigma B_0^2}{\rho U_o^2}, Du = \frac{D_2(C'_w - C'_\infty)}{\vartheta(T'_w - T'_\infty)}$$

$$K = \frac{U_0^2 K'}{\vartheta^2}, t = \frac{t' U_0^2}{4\vartheta}, Kc = \frac{\vartheta K'_c}{U_0^2}, Q = \frac{Q_1 v}{U_0^2}, Sc = \frac{\vartheta}{D}, \theta = \frac{T' - T'_w}{T'_w - T'_\infty}, \phi = \frac{C' - C'_w}{C'_w - C'_\infty}, Sr = \frac{D_1(T'_w - T'_\infty)}{\vartheta(C'_w - C'_\infty)}$$

Eq. (9) and Eq. (10) may also be written in other forms that do not depend on dimensional representations.

$$\frac{\partial u}{\partial t} - (1 + A\varepsilon e^{nt})\frac{\partial u}{\partial y} = \frac{dU_\infty}{\partial t} + \left(1 + \frac{1}{\lambda}\right)\frac{\partial^2 u}{\partial y^2} + Gr\ \theta cos\alpha + Gm\ \phi cos\alpha + \left(M\sin^2\gamma + \frac{1}{K}\right)(U_\infty - u) \tag{8}$$

$$\frac{\partial\theta}{\partial t} - (1 + A\varepsilon e^{nt})\frac{\partial\theta}{\partial y} = \frac{1}{Pr}\frac{\partial^2\theta}{\partial y^2} - Q\theta + Du\frac{\partial^2\phi}{\partial y^2} \tag{9}$$

$$\frac{\partial\phi}{\partial t} - (1 + A\varepsilon e^{nt})\frac{\partial\phi}{\partial y} = \frac{1}{Sc}\frac{\partial^2\phi}{\partial y^2} - K\phi + Sr\frac{\partial^2\theta}{\partial y^2} \tag{10}$$

For the relevant boundary circumstances, we have

$$\left.\begin{array}{ll} u = u_p, \theta = 1 + \varepsilon e^{nt}, \phi = 1 + \varepsilon e^{nt} & at\ y = 0 \\ u \to u'_\infty = 1 + \varepsilon e^{nt}, \theta \to 0, \phi \to 0 & as\ y \to \infty \end{array}\right\} \tag{11}$$

3. Problem Solving Method

Nonlinearity renders a direct numerical solution to the set of partial differential Eq. (8) to Eq. (10) constraints with Eq. (11). Because of this issue, we use the finite difference approach in this scenario. The finite difference method (FDM) is a common numerical methodology for solving a broad variety of differential and partial differential problems. It is very useful for tackling real-world engineering difficulties in a variety of fields.

The following four procedures need to be carried out:
Specifically,
(i) We first discretize the domain
(ii) Solve the problem at discrete time steps,
(iii) Utilize finite differences rather than derivatives,
(iv) Finally develop a recursive method.

Formulas for finite differences are substituted, $\frac{\partial \xi}{\partial t} = \frac{\xi_i^{j+1} - \xi_i^j}{\Delta t}$, $\frac{\partial \xi}{\partial t} = \frac{\xi_i^{j+1} - \xi_i^j}{\Delta y}$, $\frac{\partial^2 \xi}{\partial y^2} = \frac{\xi_{i-1}^{j+1} - 2\xi_i^j + \xi_{i+1}^{j+1} + \xi_{i-1}^j - 2\xi_i^j + \xi_{i+1}^j}{\Delta y^2}$ in Eq. (8) to Eq. (11)with boundary constraints.

The space step size, which is represented here by $\Delta y = y_i - y_{i-1}$, remains the same during the whole of the study.

4. Results and Discussion

The flow profiles are the primary areas of emphasis in the numerical computations used to develop a mechanistic understanding of the situation. The results and interpretation are presented in the following discussion. In all of our calculations, we use, $R = 1, Ql = 0.1, h = 0.1, k = 0.001, Gr = 2.0, Gm = 1.0, Sc = 0.65, Sr = 0.5, A = 1, Up = 0.5, \gamma = 0.5, n = 0.1, t = 0.5, Pr = 0.71, M = 1, K = 0.5, Q = 1, \varepsilon = 0.002, Kr = 0.5, Du = 0.3$.

Figure 2 depicts the velocity distributions for a range of Gr values. As Gr is increased, it is seen that velocity goes up as well. As the Grashof number increases, the buoyancy forces increase, causing the flow to speed up owing to free convection impacts.

Figure 3 shows the varied fields of velocity for each of the following values of Gm: It has been noticed that when the value of Gm grows, the velocity increases as well: The flow is sped up as a result of the augmentation in the buoyant forces that corresponds to the rising values of the Mass Grashof number, which can also be described as the effects of free convection.

Figure 4 shows how changing the magnetic parameter M influences the velocities. When M is made larger, the boundary layer thins out and the velocity amplitude diminishes. Since M grows, so does the drag force, slowing the flow. This is to be anticipated from a purely physical standpoint, since the presence of a transverse magnetic field leads in a resistive type force (called Lorentz force) comparable to the drag force.

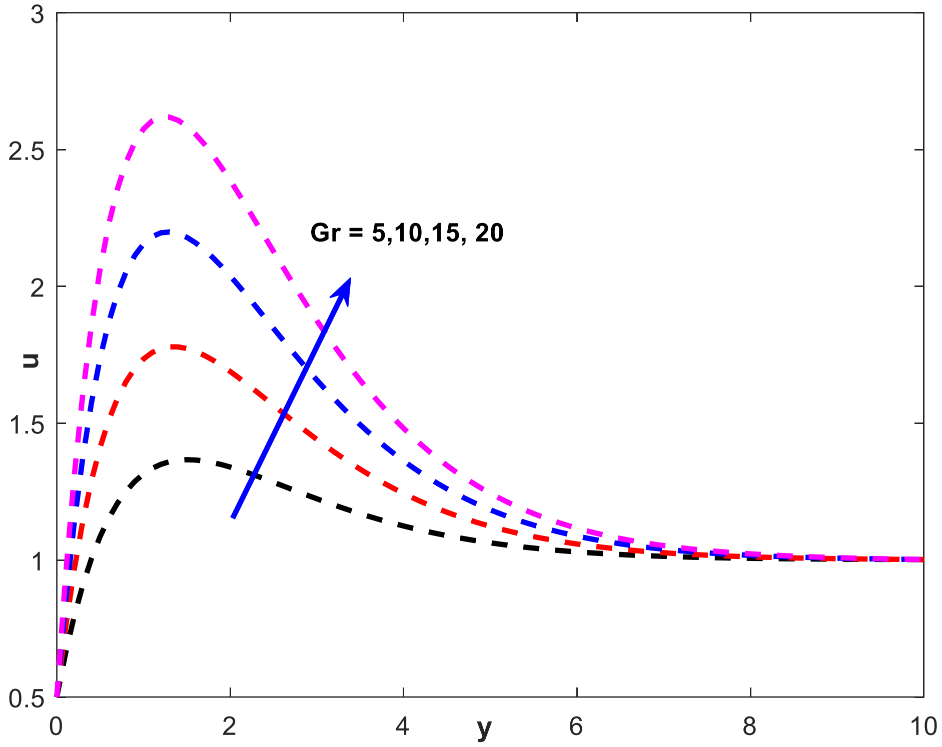

Fig. 2. Gr v/s Velocity

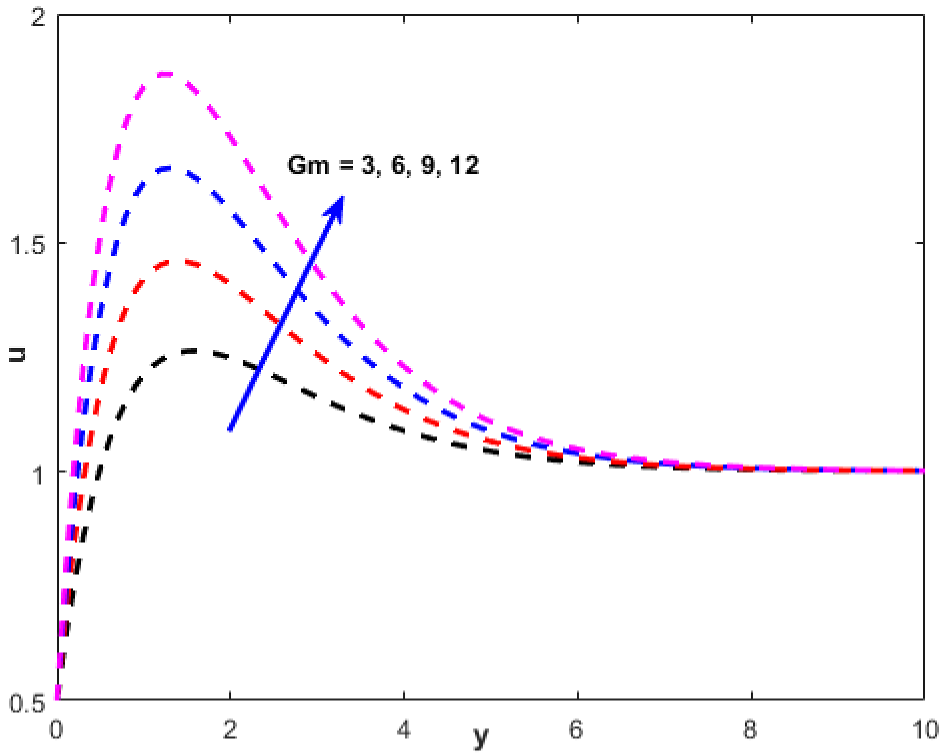

Fig. 3. Gm v/s Velocity

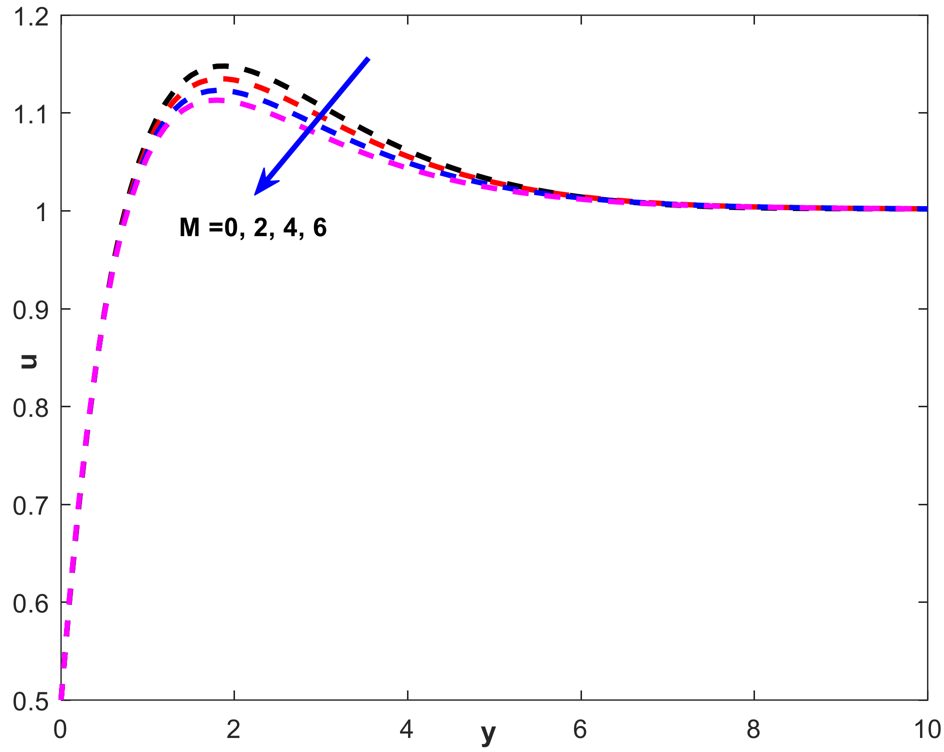

Fig. 4. M v/s Velocity

For different values of the permeability parameter K, while holding all other parameters constant, the velocity profiles are shown in Figure 5. As K grows, the resistance of the fluid's pores decreases, leading to a rise in momentum generation within the flow regime and, eventually, a boost in the velocity field, as seen for high values of K.

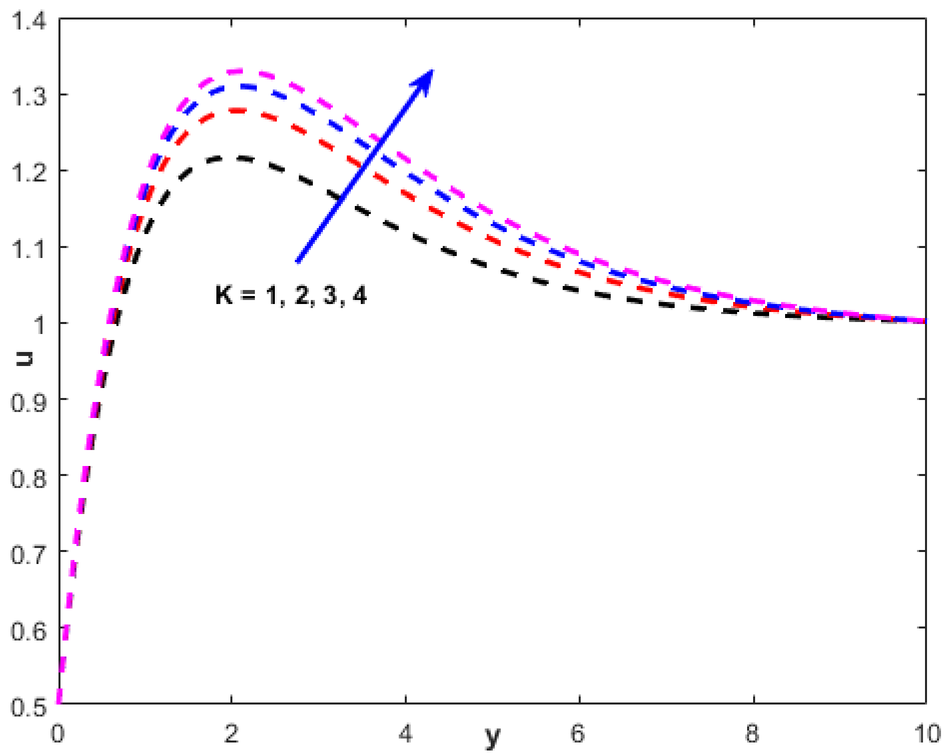

Fig. 5. K v/s Velocity

The velocity outlines shown in Figure 6 demonstrate that the rise in the Casson fluid factor results in a discernible slowing down of the rate of motion. In addition to this, it can be seen from this figure that the boundary layer momentum width diminishes as the value of the Casson fluid factor an upsurge.

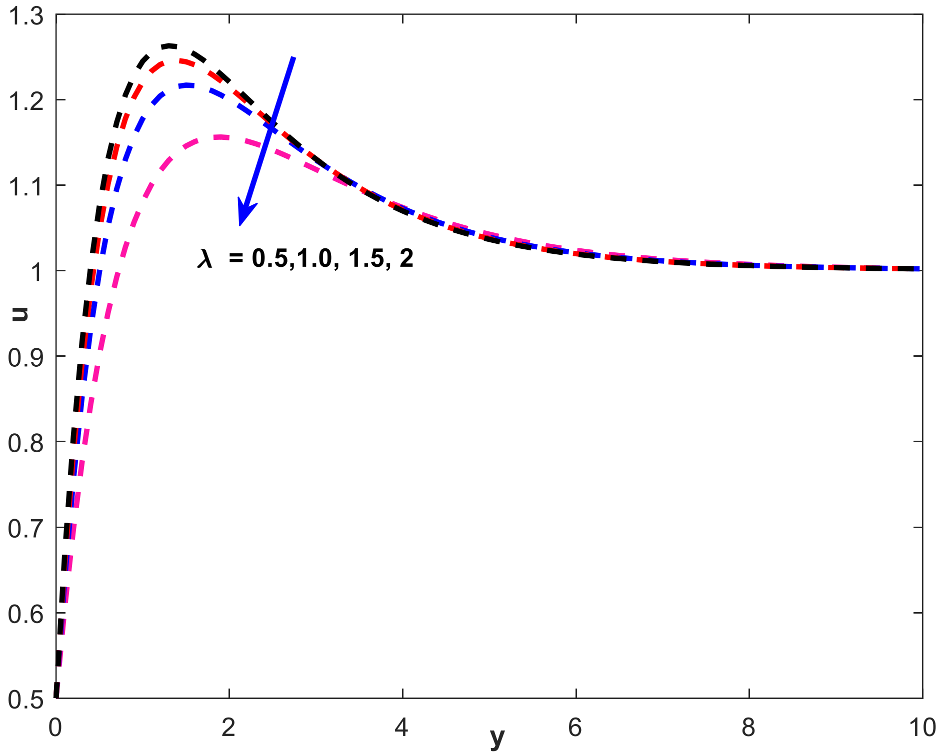

Fig. 6. λ v/s Velocity

The velocity field's relationship with the angle of inclination of the plate (α) and aligned magnetic field (γ) is illustrated in Figure 7 and Figure 8. The findings indicate that when both parameters enhance, there is a proportional decline in the velocity field.

The observed trend in Figure 9 reveals a decline in temperature as the Prandtl number (Pr) increases. This phenomenon can be attributed to the decrease in thermal conductivity of the fluid with an increase in Pr, subsequently leading to a reduction in the width of the thermal boundary layer. When an upsurge in Pr induces a decrease in temperature, this shows that the thermal conductivity of the fluid is substantially lower than its viscosity. It is important to note that raising the Pr values results in a significant decrease in temperature. Therefore, variable thermal conductivity is a very helpful instrument for figuring out the rate of heat transport. The Pr is used to control the depth of the thermal boundary layer during the process of heat transfer. This is done in order to maintain a constant temperature.

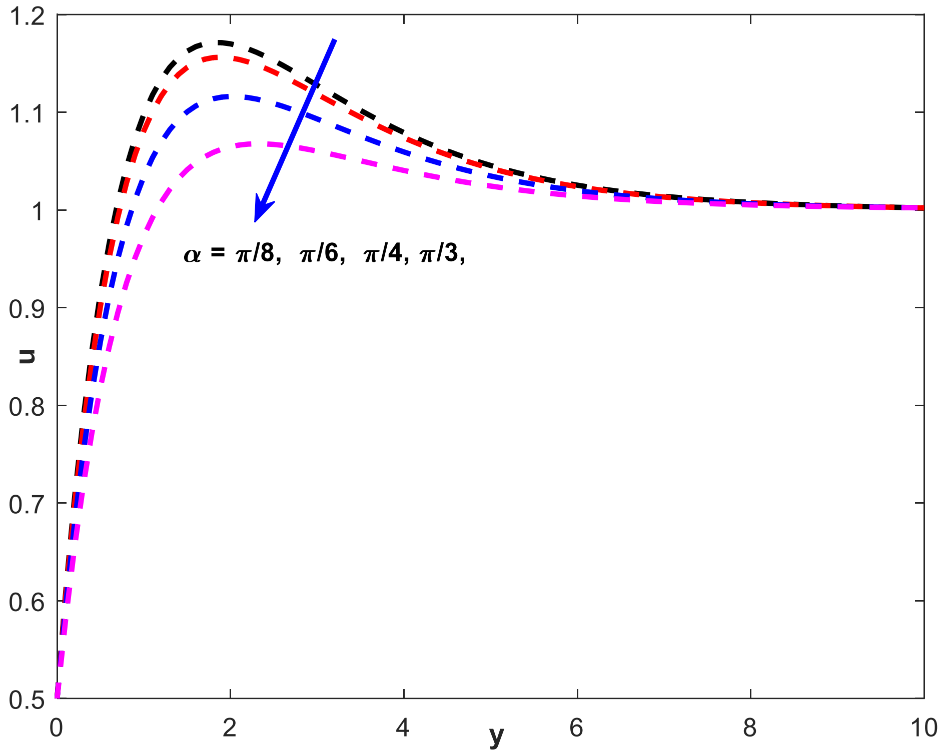

Fig. 7. α v/s Velocity

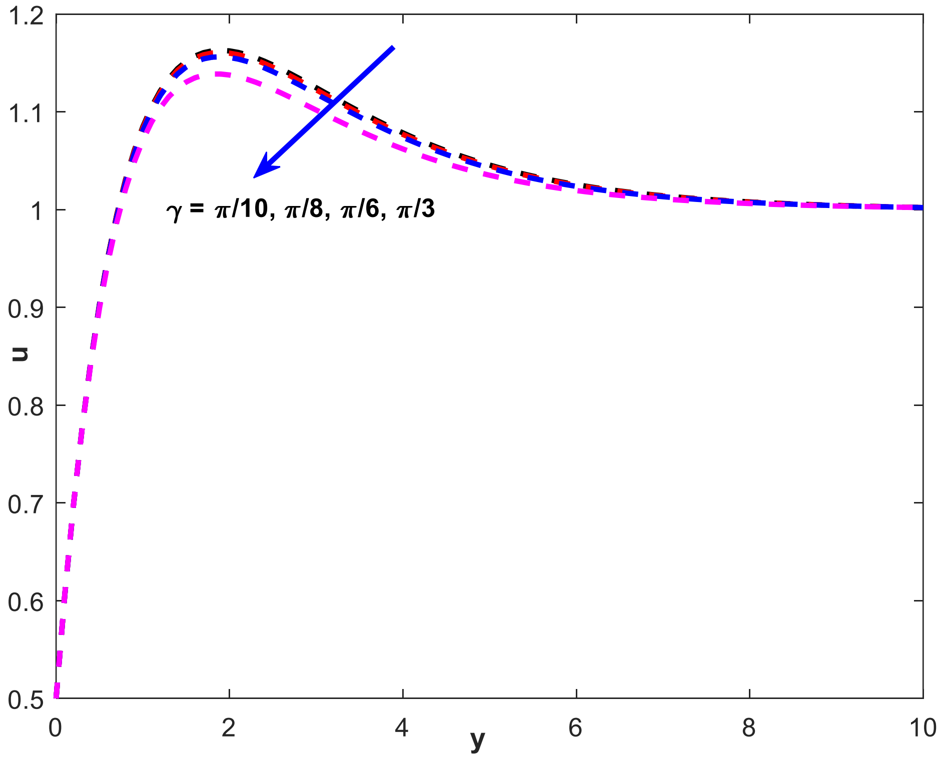

Fig. 8. γ v/s Velocity

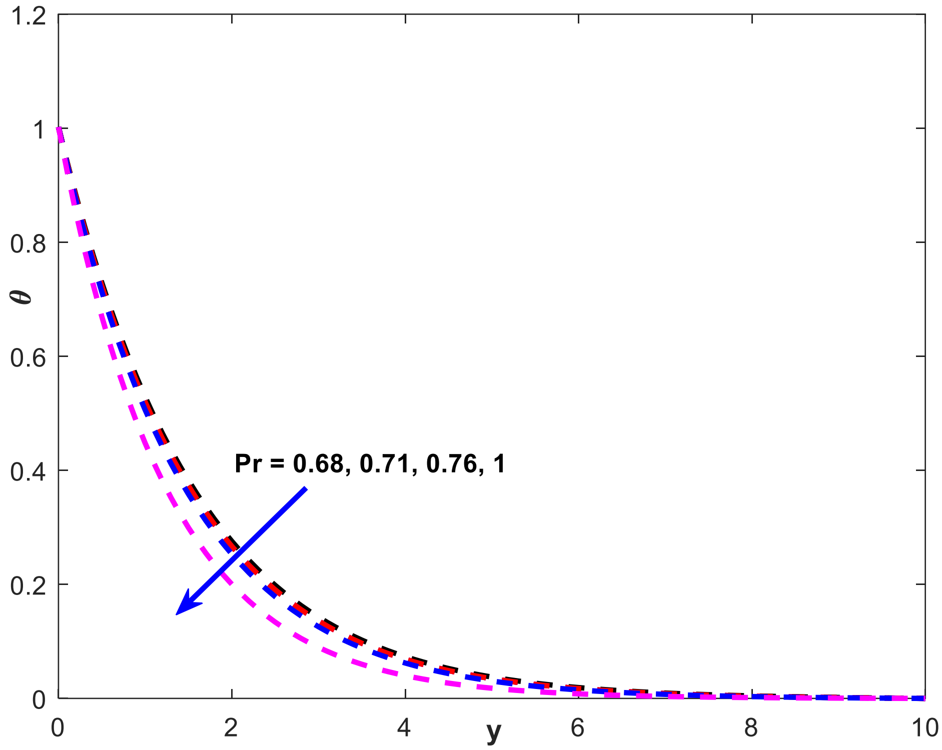

Fig. 9. Pr v/s Temperature

The impact of the heat absorption coefficient (Q) on the temperature curves is depicted in Figure 10. In physical terms, the existence of thermal sink (heat absorption) causes the fluid temperature to drop.

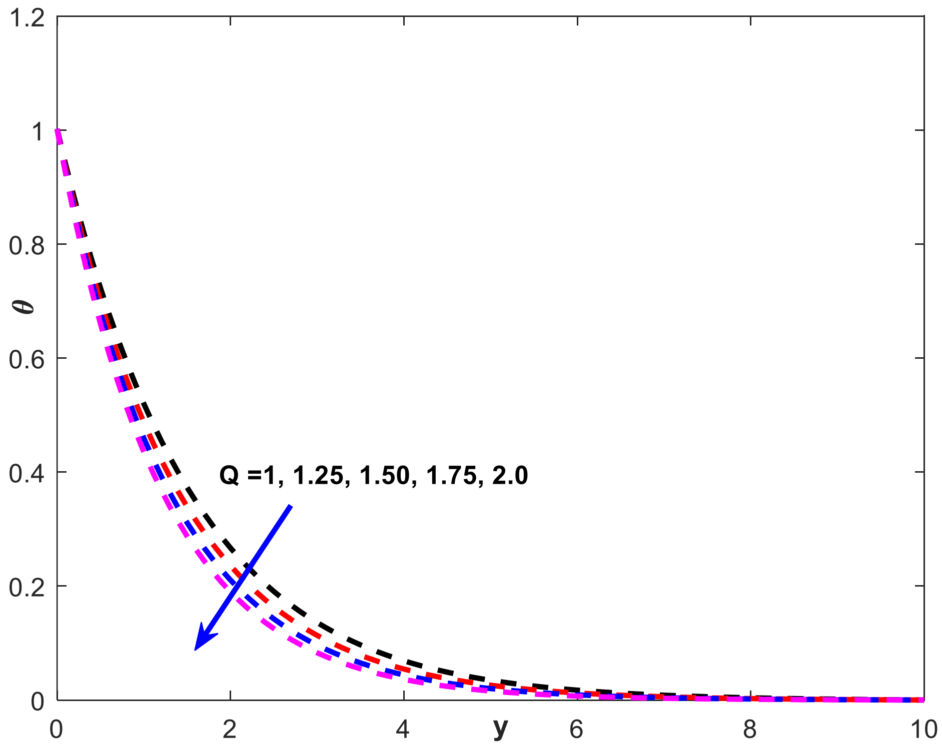

Fig. 10. Qv/s Temperature

The influence of the Soret parameter on concentration is illustrated in Figure 11. It is observed that as the Soret number increases, the concentration also increases. The Soret number (Sr) quantifies the impact of temperature gradients on mass diffusion phenomena. It is perceived that an elevation in Sr leads to an augmentation in concentration within the boundary layer.

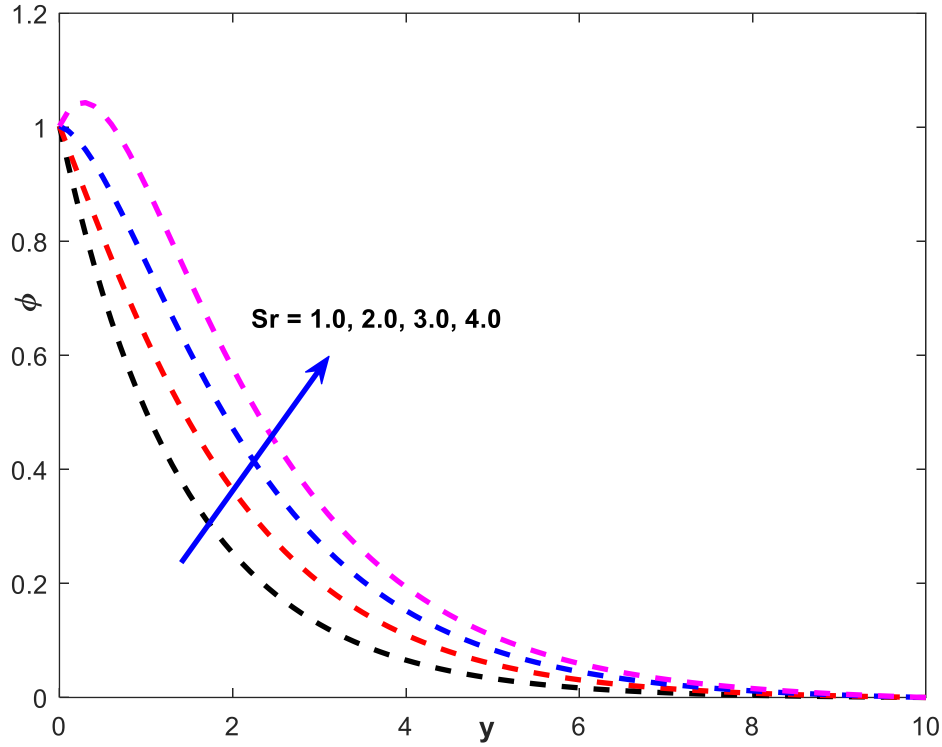

Fig. 11. Srv/s Temperature

Figure 12 is sketched to show the impacts of Schmidt number (Sc)on Concentration outlines. A decrease in the diffusion rate of species is correlated with larger Schmidt numbers Sc, which represent the ratio of momentum to mass diffusivity in a fluid. Therefore, when Sc rises, there is a dramatic reduction in the width of the concentration boundary layer.

Concentration profiles as a function of the chemical reaction parameter Kr are shown in Figure 13. Consistent with predictions, the existence of the chemical reaction has a profound impact on the concentration curves. It is important to note that a destructive chemical reaction, Kr, is the instance explored. As the Kr value of a chemical reaction rises, concentration falls. There is a clear difference in the width of the concentration-dependent boundary layer and the boundary layer defining momentum as a result of a rise in the Kr values.

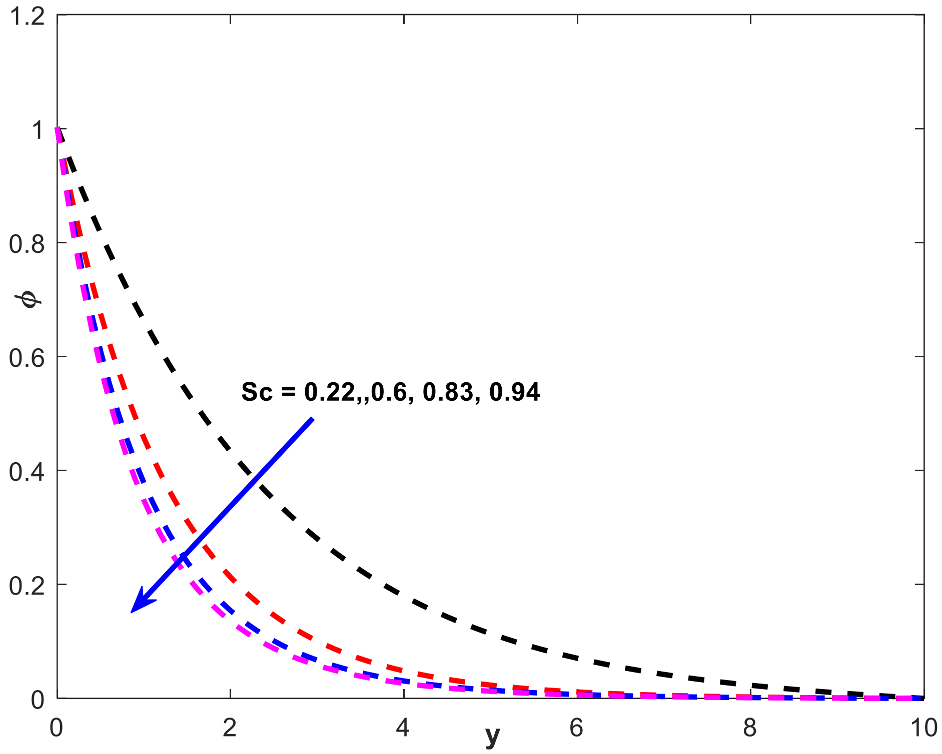

Fig. 12. SC v/s Concenration

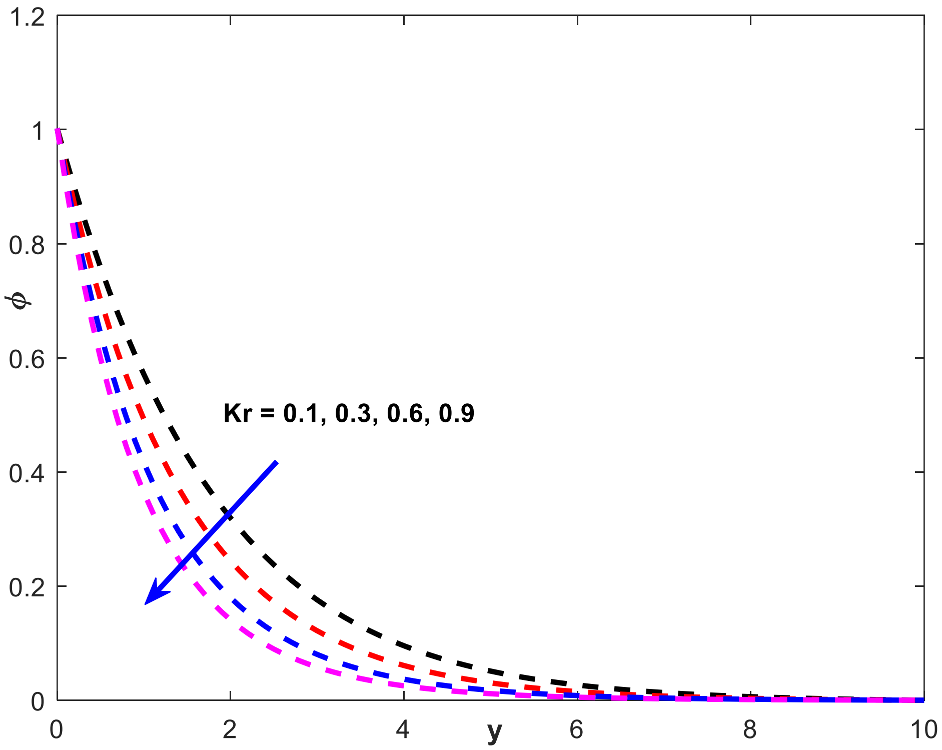

Fig. 13. Kr v/s Concentration

Figure 14 shows the fluctuation of velocity profiles versus y for various values of the heat absorption parameter Ql, while holding all other physical parameters constant. As it can be seen from the graph, the temperature lowers when Ql rises for the same cause as stated earlier.

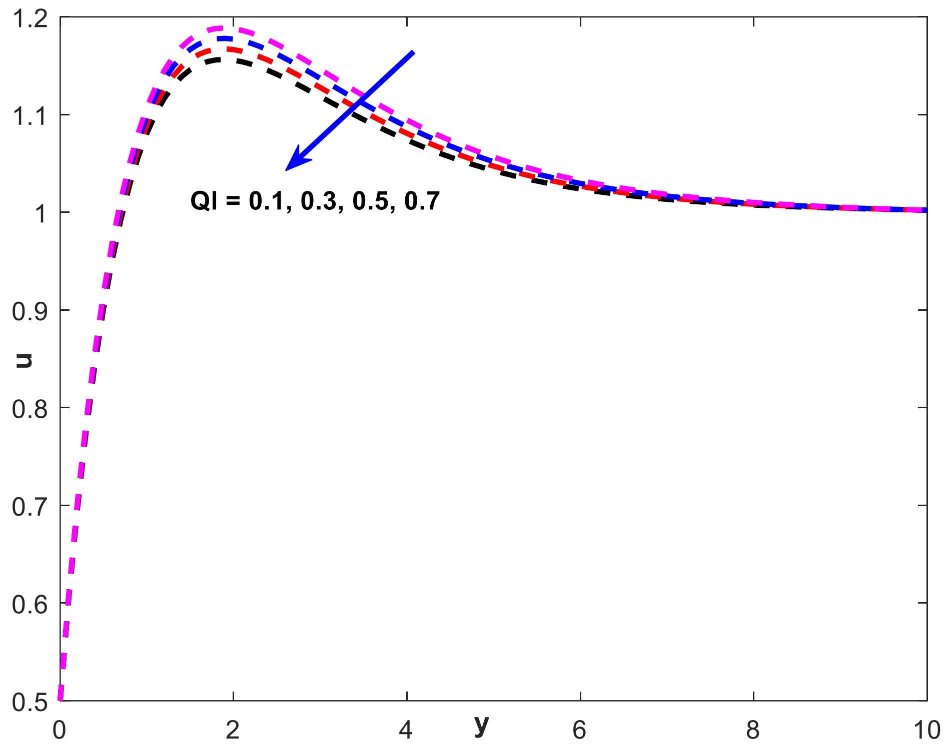

Fig. 14. Ql v/s Velocity

By holding all other physical variables constant, the temperature gradients for various values of the heat absorption factor Ql are shown in Figure 15 as a function of y. For the same cause that the temperature drops as Ql rises, this graph shows that lowers in value as Ql rises.

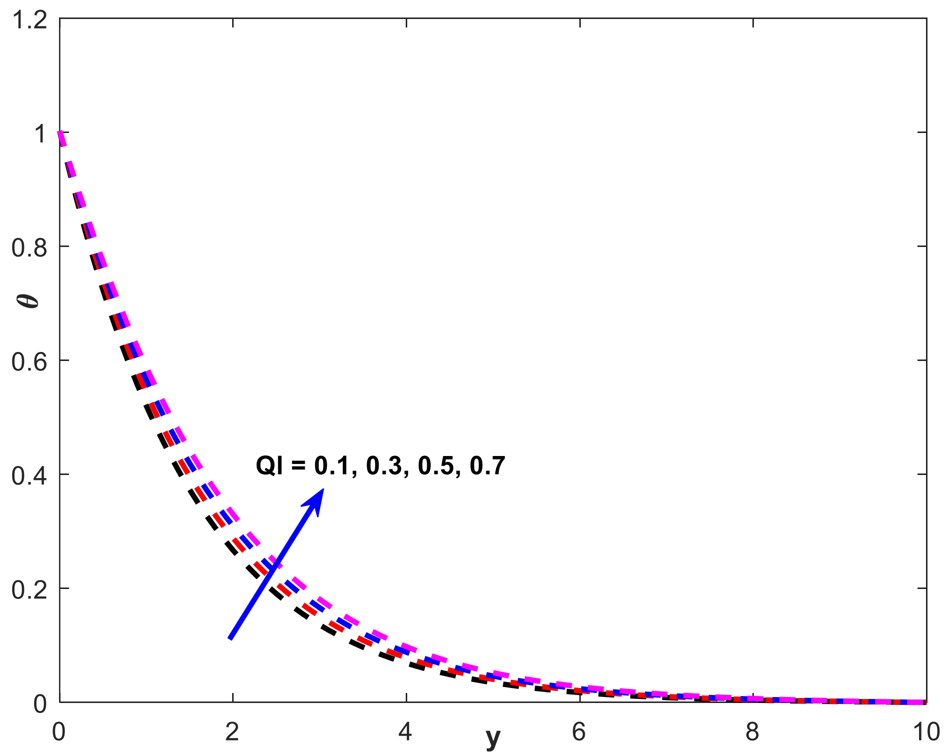

Fig. 15. Ql v/s Temperature

The velocity and temperature curves are shown in Figure 16 and Figure 17, respectively, over a range of Dufour numbers. The Dufour number(Du) is the fraction of the total thermal energy flux that may be attributed to gradients in concentration. Both the rate of change and temperature in the outermost layer are observed to increase when the Du raised. The temperature profiles, after all, decrease gradually from the plate to the value in the free stream. A zero-velocity profile occurs at the boundary layer's edge, but there is a significant velocity overshoot close to the plate.

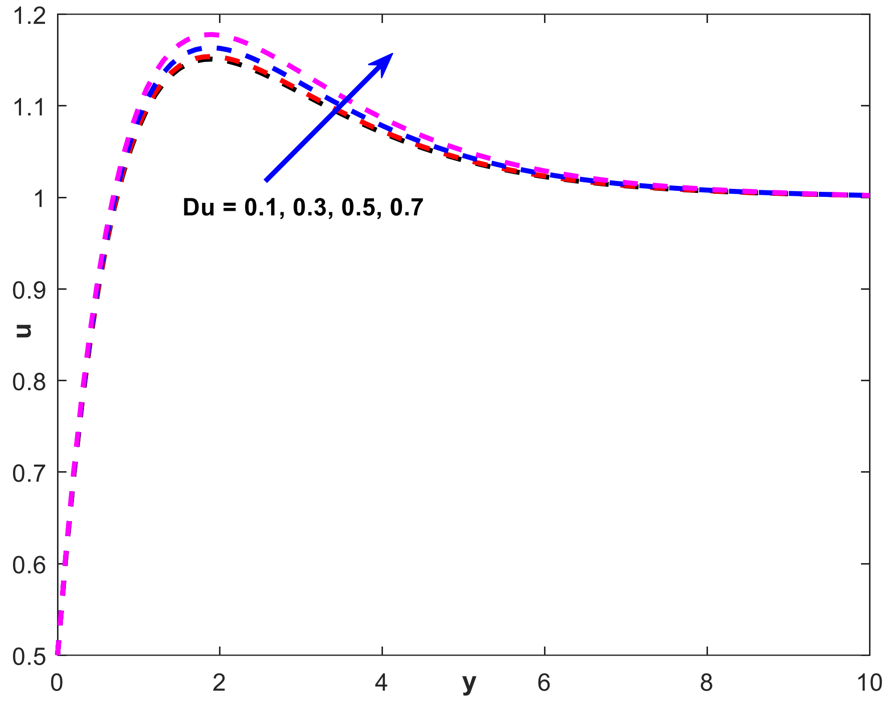

Fig. 16. Du v/s Velocity

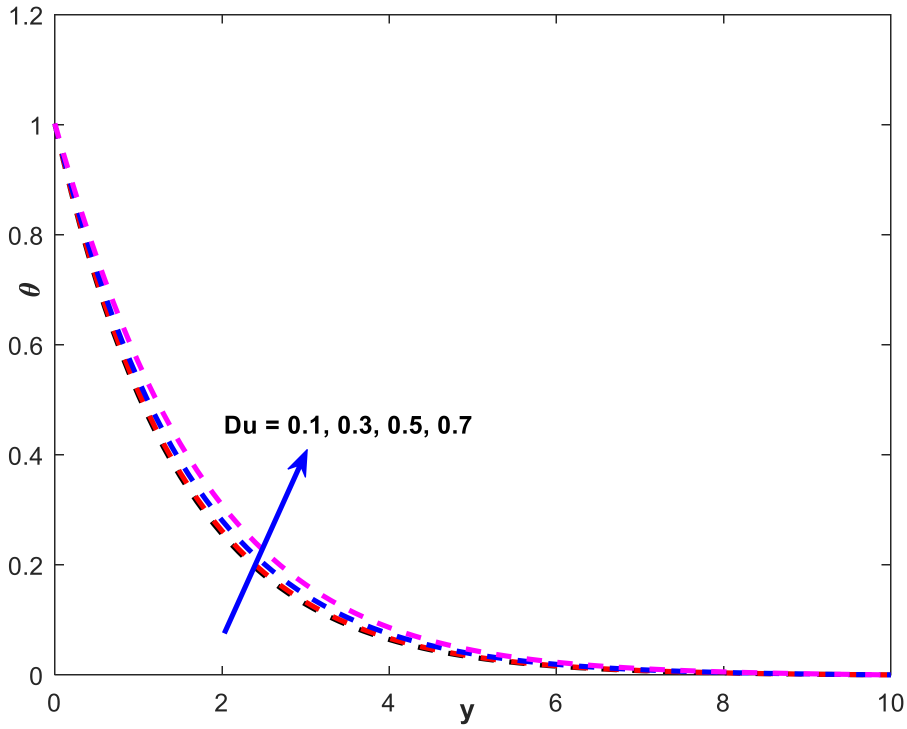

Fig. 17. Du v/s Temperature

Different values of M, K, Gm, and Gr are shown in Table 1 to illustrate the resulting changes in skin friction. The table shows that when M, Gr, and Gm rise, skin friction also increases, but K has the opposite effect. The last tables demonstrate how changing the flow parameters affect the skin friction coefficient, Nusselt number, and Sherwood number. Table 2 and Table 3 make the behaviour of these factors clear; thus they won't go into detail about them here.

Table 1
The stimulus of an assortment of different factors on the skin friction for $R = 1; Ql = 0.1; Sc = 0.65; Sr = 0.5; A = 1; Up = 0.5; \gamma = \frac{\pi}{6}; \alpha = \pi/6, \quad n = 0.1; t = 0.5;\ Pr = 0.71;\ Q = 1; e = 0.002; Kr = 0.5; Du = 0.3$

M	K	Gm	Gr	τ	
1	0.5	1	1	0.0566	↑
2				0.0930	
3				0.1283	
1	1			-0.0997	↓
	2			-0.1850	
	0.5	2		0.1300	↑
		3		0.2033	
		1	2	0.1485	↑
			3	0.2404	

Table 2
The stimulus of an assortment of different factors on the skin friction, Nusselt number and Sherwood number for $R = 1; Ql = 0.1; Gm = 1.0; Gr = 1.0; A = 1; Up = 0.5; \gamma = \frac{\pi}{6}; \alpha = \frac{\pi}{6}, n = 0.1; Pr = 0.71;\ t = 0.5; M = 1; Q = 1; K = 0.5; e = 0.002$

Sc	Kr	Q	Sr	Du	τ	Nu	Sh	
0.22	0.1	1	0.5	0.3	0.0855	1.0064	0.7296	↓↓↑
0.3					0.0775	0.9982	0.8647	
0.6					0.0596	0.9695	1.2801	
0.22	0.3				0.0850	1.0053	0.7484	↓↓↑
	0.5				0.0845	1.0042	0.7671	
	0.1	2			0.0832	1.1060	0.7209	↓↑↓
		3			0.0811	1.2005	0.7125	
		1	1		0.0889	1.0107	0.6613	↑↑↓
			1.5		0.0923	1.0151	0.5921	
				0.5	0.0867	0.9852	0.7315	↑↓↑
				1	0.0896	0.9313	0.7364	

Table 3
The stimulus of an assortment of different factors on the skin friction, Nusselt number and Sherwood number for $R = 1; Ql = 0.1; Gr = 1.0; Gm = 1.0; Sc = 0.65; Sr = 0.5; A = 1; Up = 0.5; \gamma = \frac{\pi}{6}; \alpha = \frac{\pi}{6}, n = 0.1; tM = 1; K = 0.5; e = 0.002; Kr = 0.5$

Q	Pr	t	Du	τ	Nu	Sh	
1	0.71	0.5	0.3	0.0566	0.9606	1.4019	↓↑↓
2				0.0545	1.0626	1.3805	
3				0.0524	1.1593	1.3598	
1	1			0.0485	1.1594	1.3543	↓↑↓
	3			0.0243	2.2135	1.0696	
	0.71	1		0.0567	0.9608	1.4021	↑↑↑
		1.5		0.0568	0.9609	1.4023	
		0.5	0.5	0.0586	0.9049	1.4159	↑↓↑
			1	0.0635	0.7583	1.4529	

5. Code Validation

Comparison values of skin friction with$R = 1; Gr = 2.0; Gm = 1.0; A = 1; Up = 0.5; \gamma = \pi/2; n = 0.1; t = 0.5; Pr = 0.71; M = 1; K = 0.5; e = 0.2; Kr = 0.5$. Enhanced skin friction numerical results for various fluids Sc, K, Q, and Sr has shown the validity of the method. Parameters are summed up as $Ql = 0, \alpha = 0, Du = 0$. Table 4 uses the numbers from Choudhury and Ahmed [36] to draw comparisons between the three studies. It demonstrates the precision expected. A verification code is thus allowed.

Table4
Comparison table with Sc, K, Q and Sr values

Sc	K	Q	Sr	Choudhuryand Ahmed [36]	Present Study
0.6	0.5	1	0.3	3.2099	3.2199
0.22				3.5059	3.5068
0.6	0.1			3.3792	3.3796
		0		3.4103	3.4108
		1	1.5	3.2641	3.2682

6. Conclusions

In this study, we use computational methods to exam in the consequences of chemical reaction with heat absorption, Soret and Dufour effects in the context of unsteady MHD oscillatory Casson fluid flow via an inclined porous vertical plate. The equations are solved by using a finite difference method. The following are drawn from the results of this study:

(i) When there is an increase M, γ, α, λ, Q_l, and Du the fluid velocity will slow down, but it will speed up when there is an increase in Gr, G, K.
(ii) The temperature of the fluid decreases asPr and Q both rise and the opposite impact in $Q_l$and Du.
(iii) The fluid's concentration level goes up as the Soret number goes up, but it goes down as the Sc and Kr goes up.

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