January - February 2020
ISSN: 0193 - 4120 Page No. 14430 - 14439

Active and passive controls on chemically reacting free Convection of MHD Blasius and Sakiadis dissipated flow with variable conductivity and radiation

O. Ramakrishna[1], K. Jayalakshmi[2]
[1]Research scholar, Department of Mathematics,Jawaharlal Nehru Technological University Anantapur, Andhra Pradesh, India.
[2]Department of Mathematics, JNTU Anantapur, A. P, India

Article Info
Volume 82
Page Number: 14430 - 14439
Publication Issue:
January-February 2020

Article History
***Article Received**: 18 May 2019*
***Revised**: 14 July 2019*
***Accepted**: 22 December 2019*
***Publication**: 28 February 2020*

Abstract:
attempt focuses on relative study on the Blasius flow case and Sakiadis flow case. Further, thermophoresis, Brownian motion, magneto hydrodynamics, viscous dissipation and heat radiation are also accounted. The transformation of flow The current governing equations to ODEs (ordinary differential equations) with the aid of appropriate transformations is also investigated. Runge-Kutta method is acquired for the reliable and presentable results. The influence of various involved flow variables such as temperature, Nusselt number, velocity and skin friction are discussed graphically. The foremost physical implication of the result is that the passive and active flow conditions are controls the whole thermal, velocity and diffusion boundary layer. From this we can conclude that based on the situation we can use active or passive flow condition cases.
Keywords: *Active and passive Controls, Viscous dissipation, Chemical reaction, Magnetohydrodynamic, variable conductivity, Thermal radiation.*

I. Introduction

In the present era, researchers have made a major breakthrough in Nanoscience and nanotechnology. Advancement in nanotechnologies finds numerous engineering applications in microelectronics, metallurgy, solar energy applications, car engines, computer chips, food processing etc. Even though numerous techniques are applied to upgrade the rate of heat transport, their performance is continually constrained due to limited conductivity of the heat transfer fluids that fetch limitations in compactness and performance augmentation in heat exchangers. Dissipating higher heat loads has become a great challenge.Choi [1] proposed the theory of suspending nano particles in fluid base and observed improvement in thermal performance. Further researchers [2-6] has established that heat absorption propensity of nanofluids is more efficient than the traditional fluids. Buongiorno [7] based on thermophoresis and Brownian motion developed convection models in nanofluid. He affirmed that, abnormality in the heat transport takes owing to the random movement of particles in a liquid. Raju et al. [8] analyzed transport phenomenon of radiated saturated porous slenders with three revolutions considering Buongiorno's model. Wakif et al. [9] discussed the stability of thermo-hydrodynamic aqueous nanofluids loaded with metal nanoparticles by applying Buongiorno’s mathematical model. Rashid et al. [10] investigated non-Newtonian fluid considering slip and multiple convective boundary conditions taking into account of Thermophoresis and Brownian motion.

Aziz [11] investigated the radiation effect on heat transfer and fluid flow on stretching surface. Animasaun et al. [12] considered uneven diffusion cases in both the homogeneous and heterogeneous reactions of viscoelastic fluid in the attendance of nonlinear thermal radiation and induced magnetic-field. Babu et al. [13] studied on Ferro fluids

January - February 2020
ISSN: 0193 - 4120 Page No. 14430 - 14439

stagnation point flow by considering nonlinear thermal radiation and magnetic field effect. A study related to magnetic effects in the electrically conducting fluids is known by Magneto hydrodynamics (MHD). Over the years, researchers have addressed that in processes such as solar wind, earth magnetic field, fusion, star formation, X-ray radiation, polymer film, tumor therapy, plasmas etc. MHD has immense involvement. In view of these physical applications, Turkyilmazoglu [14] solved analytically the nonlinearly deforming permeable surface induced mixed convection MHD fluid flow. Hussain et al. [15] studied collective effects of MHD as well as radiation on elastic-viscous fluid flowing along pervious plate. Mamatha et al. [16] took up theoretically investigated Magneto hydrodynamics flow in Carreau fluid comprising dust and Graphene Nanoparticles.

Researchers are mesmerized about the performance and fluid flow characteristics over the sheet and plate. Blasius [17] in 1908 discussed theoretically the induced boundary layer flow along a stationary surface moving at constant velocity. There after Howarth [18] obtained numerical solution of Blasius equation. A Similar kind of flow problem occurring on a moving plane surface was addressed by Sakiadis [19] in 1961. Devi and Suriyakumar [20] investigated the magnetic field effect on the classical Sakiadis and Blasius nanofluid flow cases. Priyadharshini et al.

Considering the above-mentioned engineering and industrial applications of nanofluid, MHD, Radiation in the field of heating and cooling systems, the present investigation is carried out to explore the impacts of radiations, viscous dissipation, Thermophoresis and Brownian motion on MHD Blasius and Sakiadis flow. Numerical technique will be enforced to acquire reliable and presentable results.

Mathematical Formulation

Considering the natural steady flow convection of Blasius and Sakiadis MHD fluids at varying thermal conductivity over porous layers. The thermal and concentration boundary layers are controlled by combined impacts of viscous dissipation, Brownian motion, thermal radiation and thermophoresis with active and passive control of nanomaterial's conditions. The Cartesian system is present at the leading edge with the +ve *x*- axis increasing along surface direction and y-axis considered opposite to direction of flow with $U_w(x) = ax$ representing the stretching velocity. The effect of magnetic field that is induced is deserted assuming low value of Reynolds number. The conductivity parameter varies linearly with change in temperature. By taking these assumptions, according to the Bossinessq boundary layer approximation the equations for heat, mass transfer and convective flow of the Blasius flow case and Sakiadis flow case are:

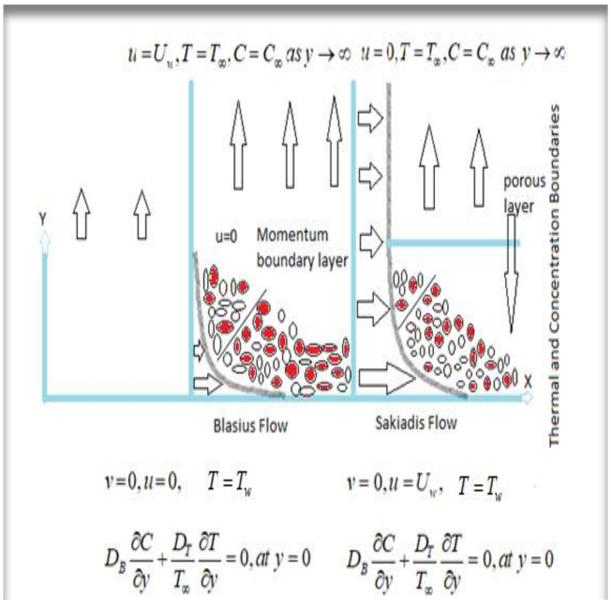


Fig.1 The flow configuration model

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

$$u\frac{\partial u}{\partial x} + v\frac{\partial v}{\partial y} = v\frac{\partial^2 v}{\partial y^2} + \rho g\big(\beta_c(c - c_\infty) + \qquad \frac{}{\partial y} \quad \partial x$$

$\beta TT{-}T\infty{-}\sigma B02\rho u{-}\vartheta K0u$ (2)

January - February 2020
ISSN: 0193 - 4120 Page No. 14430 - 14439

$$\rho C_p \left(u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}\right) = \frac{\partial}{\partial y}\left(K(T)\frac{\partial T}{\partial y}\right)+\mu\left(\frac{\partial u}{\partial y}\right)^2 + \tau\left(D_B\frac{\partial T}{\partial y}\frac{\partial C}{\partial y}+\frac{D_T}{T_\infty}\left(\frac{\partial T}{\partial y}\right)^2\right)+Q(T - T_\infty) + \frac{16\sigma^* T_\infty^3}{3k^*}\frac{\partial^2 T}{\partial y^2} \quad (3)$$

$$u\frac{\partial C}{\partial x}+v\frac{\partial C}{\partial y} = D_B\frac{\partial^2 C}{\partial y^2}+\frac{D_T}{T_\infty}\frac{\partial^2 T}{\partial y^2}-k_0(C-C_\infty)^n \quad (4)$$

the boundary conditions include

Passive control of nanomaterial's:

i) Blasius problem $v=0, u=0, T=T_w, D_B\frac{\partial C}{\partial y}+D_B\frac{\partial C}{\partial y}+\frac{D_T}{T_\infty}\frac{\partial T}{\partial y}=0, at\ y=0 u=U_w, T=T_w, C=C_\infty\ as\ y\to\infty\ as\ y\to\infty$ (5)

ii) Sakiadis problem $v=0, u=U_w, T=T_w, D_B\frac{\partial C}{\partial y}+\frac{D_T}{T_\infty}\frac{\partial T}{\partial y}=0, at\ y=0 u=0, T=T_\infty, C=C_\infty\ as\ y\to\infty$ (6)

The active control of nanomaterial

iii) Blasius problem $v=0, u=0, T=T_w, C=C_w\ at\ y=0$
$u=U_w, T=T_\infty, C=C_\infty\ as\ y\to\infty\ as\ y\to\infty$ (7)

iv) Sakiadis problem $v=0, u=U_w, T=T_w, C=C_w\ at\ y=0$
$u=0, T=T_\infty, C=C_\infty\ as\ y\to\infty$ (8)

It is assumed that the thermal conductivity is vary proportionally with temperature as:

$$K(T)=K_\infty\left(1+\frac{\varepsilon}{\Delta T}(T-T_\infty)\right) \quad (9)$$

Here $\Delta T=(T_w-T_\infty)$,

With an intention to transforms equations (2)-(4) to coupled ordinary differential equations, these forms of $U_w(x)$ and $T_w(x)$ were choosen.

The functions f and θ defines ζ as

$$\zeta = y\sqrt{\frac{a}{v_f}}, \Psi=(v_f a)^{\frac{1}{2}} x f(\zeta), \theta(\zeta)=\frac{(T-T_\infty)}{(T_w-T_\infty)}, \emptyset(\zeta)=\frac{(C-C_\infty)}{(C_w-C_\infty)} \quad (10)$$

Stream function $\Psi(x,y)$ is given by $(u,v)=(\frac{\partial\Psi}{\partial Y}-\frac{\partial\Psi}{\partial X})$

By substituting Eq. (10) into Equations (2)-(4) and making use of Eqs. (7), (8) and (9) we obtain

$$f''' + ff'' - f'^2 + \lambda_T\theta + \lambda_c\emptyset - (M+K)f' = 0 \quad (11)$$

$$\frac{1}{Pr}(\theta'' + \varepsilon\theta'^2 + \varepsilon\theta\theta'') + Ecf''^2 + Q_H\theta + \frac{4}{3}\frac{R}{Pr}\theta'' + f\theta' + Nt\theta'^2 + Nb\theta'\emptyset' = 0 \quad (12)$$

$$\frac{1}{Le}\emptyset'' + f\emptyset' + \frac{Nt}{Nb}\theta'' - Kr\emptyset^n = 0 \quad (13)$$

The boundary conditions of Passive control flow

i) Blasius flow case

$$f(0)=0, f'(0)=0, Nb\emptyset'(0)+Nt\theta'(0)=0, \theta(0)=1, f'(\infty)=1, \theta(\infty)=0, \emptyset(\infty)=0 \quad (14)$$

ii) Sakiadis flow case

$$f(0)=0, f'(0)=1, Nb\emptyset'(0)+Nt\theta'(0) = 0, \theta(0)=1, f'(\infty)=0, \theta(\infty) = 0, \emptyset(\infty)=0 \quad (15)$$

Active control flow conditions

i) Blasius flow case

$f(0)=0, f'(0)=0, \emptyset(0)=1, \theta(0)=1, f'(\infty)=1, \theta(\infty)=0, \emptyset(\infty)=0$ (16)

ii) Sakiadis flow case

$f(0)=0, f'(0)=1, \emptyset(0)=1, \theta(0)=1, f'(\infty)=0, \emptyset(\infty)=0$ (17)

here a prime denotes differentiation with respect to ζ

$$c_f=\frac{\tau_w}{\rho U_w^2/2}, Nu_x=\frac{xq_w}{k_\infty(T_w-T_\infty)}, Sh_x=\frac{xj_w}{D_B(C_w-C_\infty)} \quad (18)$$

Where the

τ_w - Skin friction

q_w, j_w - Heat and mass transfer

$$\tau_w=\mu(\frac{\partial u}{\partial y})_{y=0}, q_w=-(\frac{\partial}{\partial y}(K(T)))_{y=0},$$

$$j_w=-D_B(\frac{\partial C}{\partial y})_{y=0} \quad (16)$$

Substituting Esq. (10) into (15) and (16), we obtain

$$Re_x^{1/2}Cf=f''(0), Re_x^{-1/2}Nu=-\left(1+\frac{4}{3}R+\varepsilon\theta'(0)^2+\right.$$

$$\epsilon\theta'0, Rex-1/2Sh=-\emptyset'(0) \quad (17)$$

Reynolds number $Re_x=U_w x/V_f$

II. Results and Discussion

The solutions for velocity and temperature parameter were obtained graphically for varying magnetic field values, conductivity, thermal radiation and buoyancy, Eckert number, Brownian motion and reaction rates encountered in the research problem. The influence of physical parameters of flow on Nusselt and Sherwood numbers and skin-friction coefficient are illustrating for Blasius and Sakiadis flow cases. The non-dimensional parameter chosen for the study $Ec=0.2, K=0.5, \lambda_T=3, \lambda_c=1, Le=0.3,, Nt=0.2, Nb=0.3, R$ that remains similar throughout the study. The graphs in magenta and green demonstrates passive flow condition, Red and Blue indicates active flow conditions as well as solid lines represent Sakiadis flow case and dashed line indicates Blasius flow cases .

From **Table 2** one can notice the variation in Skin$(\frac{1}{2}C_{fx}Re_x^{\frac{1}{2}})$, Nusselt$(\frac{1}{2}Nu_x Re_x^{-\frac{1}{2}})$ and Sherwood number $(\frac{1}{2}Sh_x Re_x^{-\frac{1}{2}})$ for various physical parameter values for passive flow Condition and active flow Condition for Sakiadis flow. It is observed that $(\frac{1}{2}C_{fx}Re_x^{\frac{1}{2}})$, is increasing function for improvement in R, Nb and Ec and decreasing function for improvement in Nt, Q_H, M and K. Nusselt number $(\frac{1}{2}Nu_x Re_x^{-\frac{1}{2}})$ increases with rising values of R and Q_H. $(\frac{1}{2}Nu_x Re_x^{-\frac{1}{2}})$ decreases with improvement in M, Ec and K. It is also noticed that $(\frac{1}{2}Nu_x Re_x^{-\frac{1}{2}})$show mixed performance for the improving values of Nt and Nb. Sherwood number $(\frac{1}{2}Sh_x Re_x^{-\frac{1}{2}})$improves with rising values of R, Nb, M, Ec and K.$(\frac{1}{2}Sh_x Re_x^{-\frac{1}{2}})$ decrease for the rising values of Nt and Q_H.

Table 3 portray the variation in Skin$(\frac{1}{2}C_{fx}Re_x^{\frac{1}{2}})$, , Nusselt$(\frac{1}{2}Nu_x Re_x^{-\frac{1}{2}})$ and Sherwood number $(\frac{1}{2}Sh_x Re_x^{-\frac{1}{2}})$ for different values of physical

January - February 2020
ISSN: 0193 - 4120 Page No. 14430 - 14439

parameters for passive flow Condition and active flow Condition for Blasius flow. In Blasius flow condition $(\frac{1}{2}C_{fx}Re_x^{\frac{1}{2}})$, increases for the improving values of R, Nt, Nb and Ec. $(\frac{1}{2}C_{fx}Re_x^{\frac{1}{2}})$, declines for improvement in Q_H, M and K. $(\frac{1}{2}Nu_x Re_x^{-\frac{1}{2}})$ elevates with improvement in R, Nt, Q_H and depreciates for rising values of Nb, M, Ec and K. $(\frac{1}{2}Sh_x Re_x^{-\frac{1}{2}})$ performance is increasing function for improvement in R and Nb. $(\frac{1}{2}Sh_x Re_x^{-\frac{1}{2}})$ depreciates for the rising values of Nt, Q_H, M, Ec and K. At the end, it is very clear that Sakiadis flow shows lesser Sherwood number, skin friction and Nusselt number and compared to Blasius flow.

Figs. 2 to 4 displays the influence of thermal radiation on concentration velocity and temperature active and passive flows as well as Blasius flow case and Sakiadis flow cases. Thermal radiation improves temperature s well as velocity fields where as concentration shows mixed performance. As we expected rising in thermal radiation creates heat in the flow that encourages temperature, velocity field. Interestingly, the concentration field shows mixed behavior in passive flow condition due to the particles moving randomly. The impact of thermophoresis these fields are shown in Figs. 5 to 7. From this it is clear that *Nt* shows decrement in temperature and mixed behavior in velocity and concentration fields (Passive flow condition). From Figs. 8 to 10 clear that the velocity reduces and concentration fields shows mixed performance in passive flow condition case, whereas the temperature field is increased as the particles move randomly. The effect of heat source on these profiles have been shown in Figs. 11 to 13 by these figures we conclude that the temperature and velocity profiles are reduced and concentration profiles are grown in both the active and passive flow conditions. In study, we considered the heat absorption parameter is responsible in decrease of temperature field. Figs. 14-16 indicates the impact of M on temperature, velocity and concentration profiles, by these graph we analyzed that magnetic field increases temperature and reduced the velocity of both Blasius and Sakiadis boundary layer, compare to velocity profile of active flow case the velocity profile of passive flow condition are low. Figs. 17-21 indicate temperature profiles and effects of dimensionless variables.

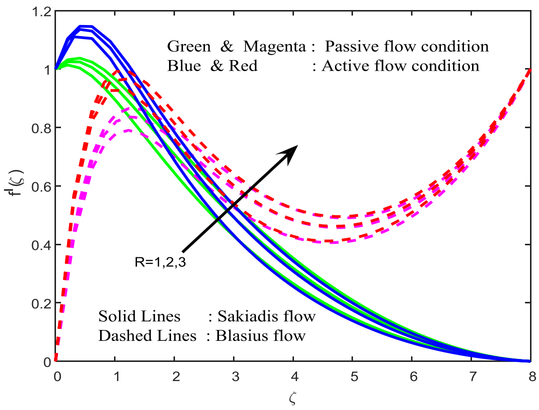
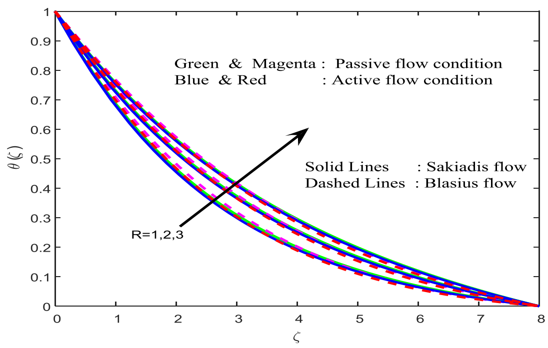


Fig.2: Velocity variation with R values



TEST Engineering & Management
January - February 2020
ISSN: 0193 - 4120 Page No. 14430 - 14439

Fig.3: Temperature variation with R values

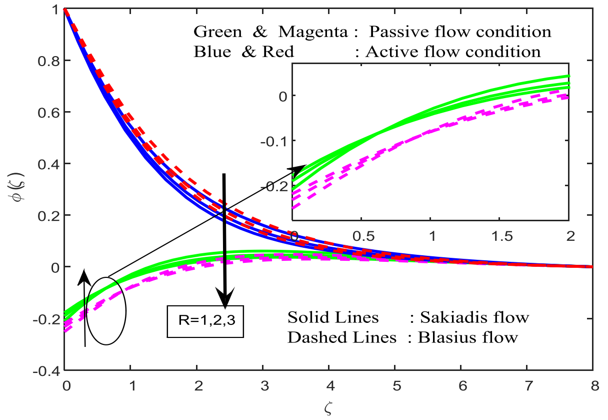


Fig.4 Concentration profiles variation with R

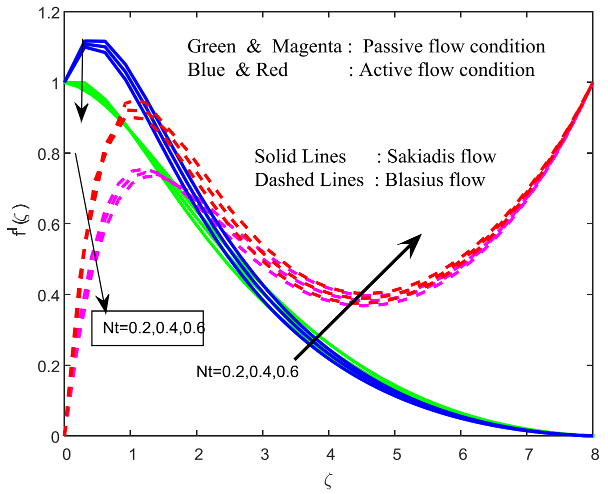


Fig.5 Velocity variation at different Nt

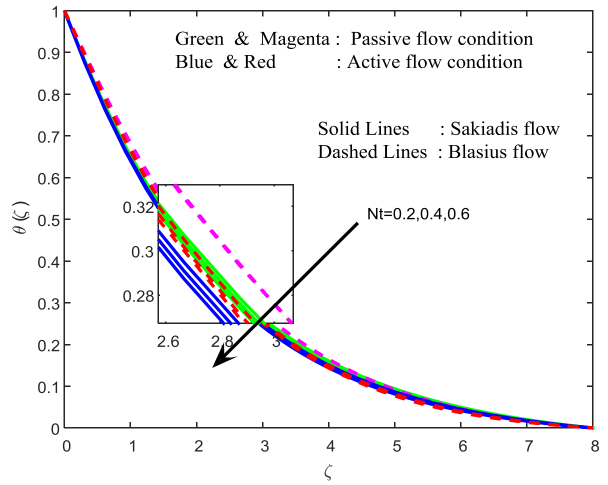


Fig.6 Temperature variation at different Nt

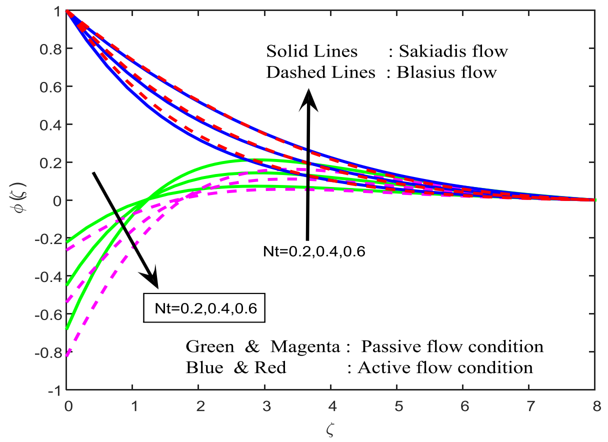


Fig.7 Concentration variations at different Nt values

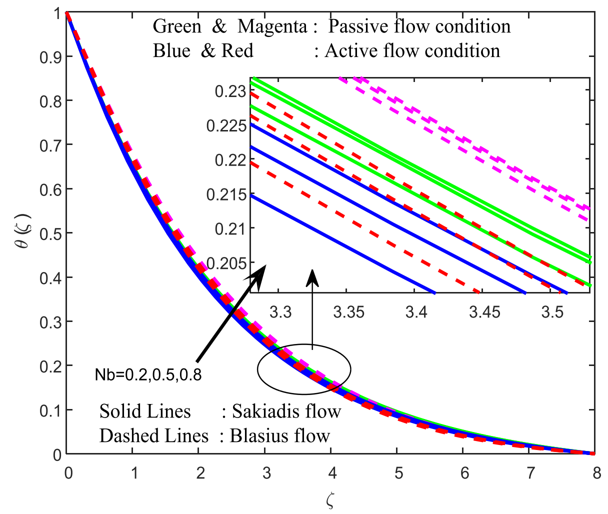


Fig.8 Temperature variation at different Nb

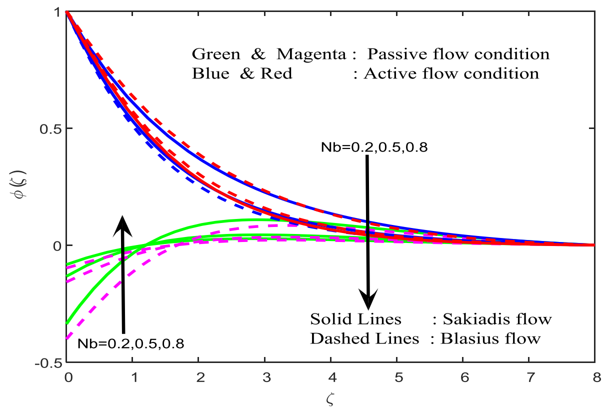


Fig.9 Concentration variation at different Nb

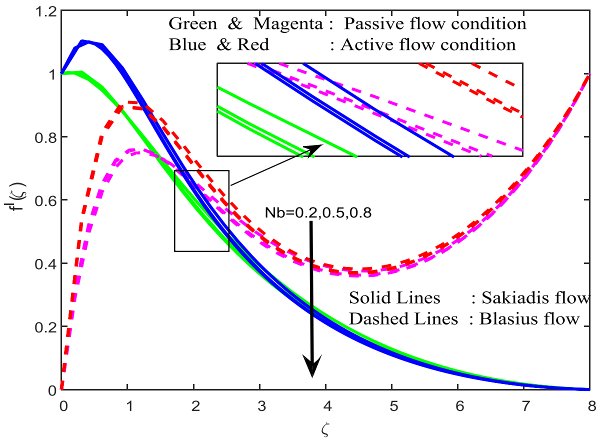


Fig.10 Velocity variation at different *Nb*

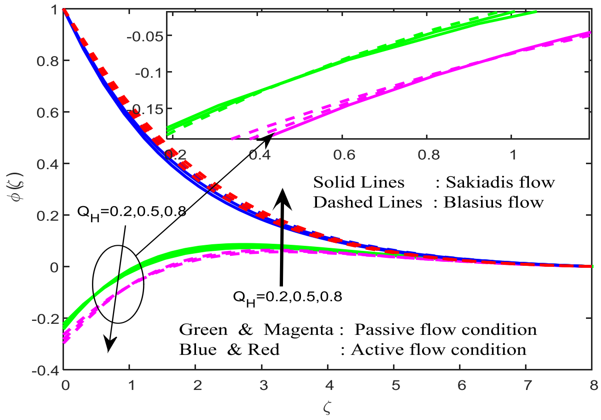


Fig.13 Concentration variation with Q_H

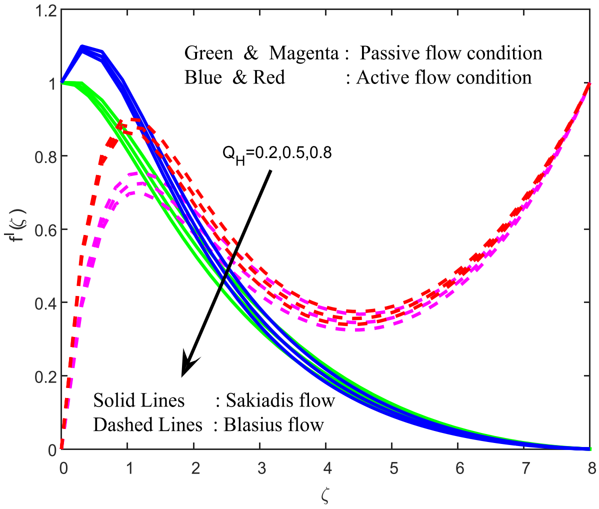


Fig.11 Velocity variation at different Q_H

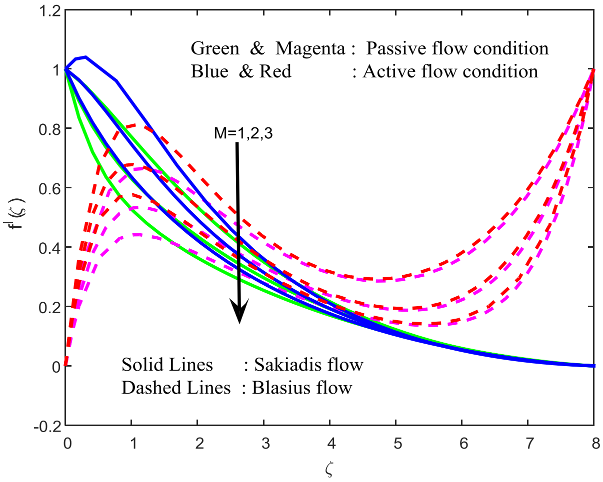


Fig.14 Velocity variation with *M*

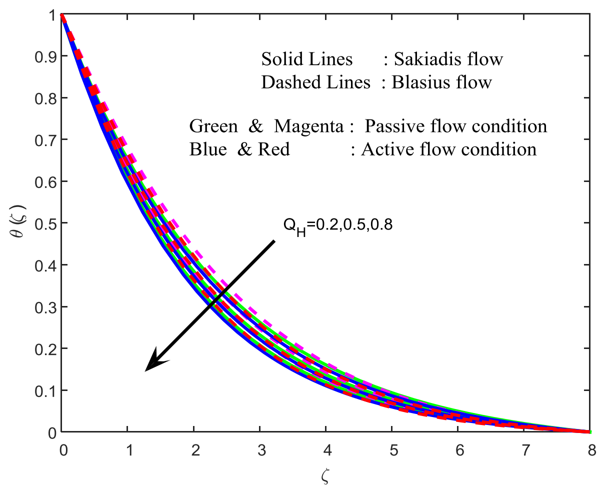


Fig.12 Temperature variation at different Q_H

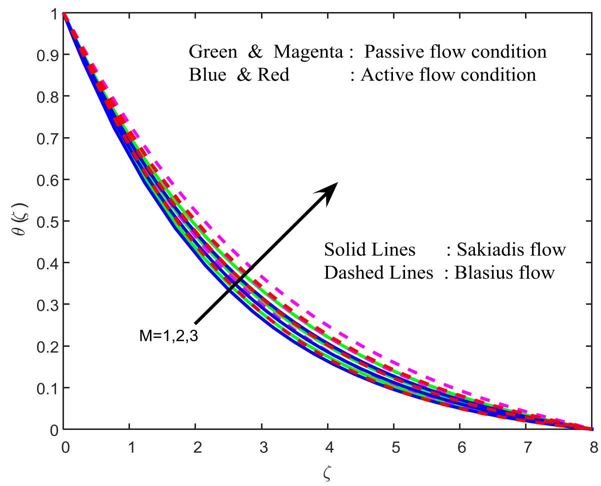


Fig.15 Temperature variation with *M*

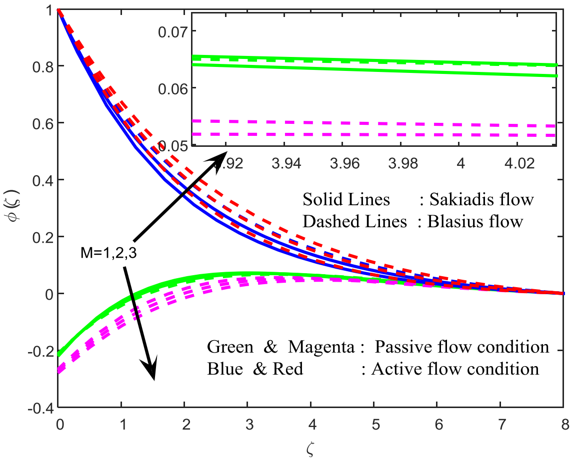


Fig.16 Concentration variation with M

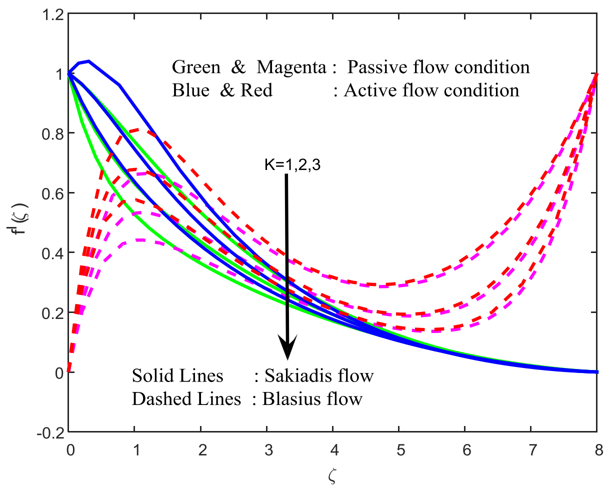


Fig.19 Velocity variation with K

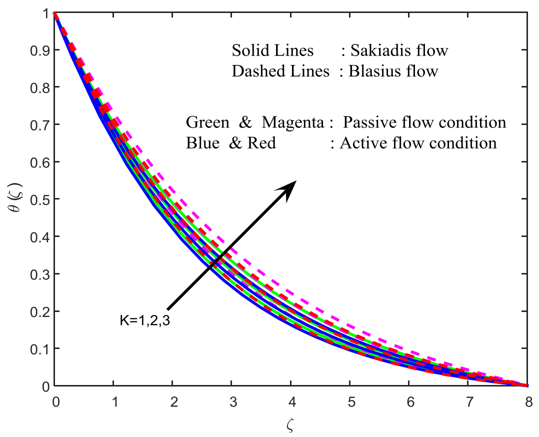


Fig.20 Temperature variation with K

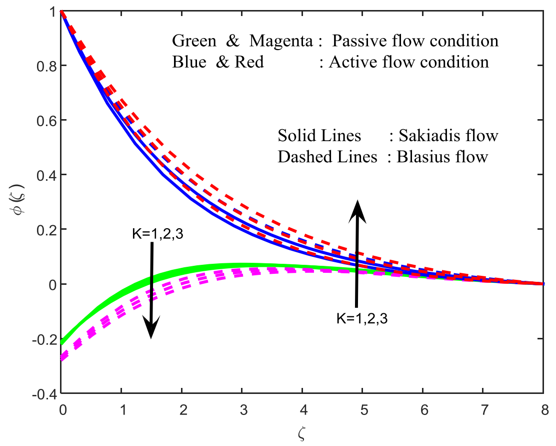


Fig.21 Concentration variation with K

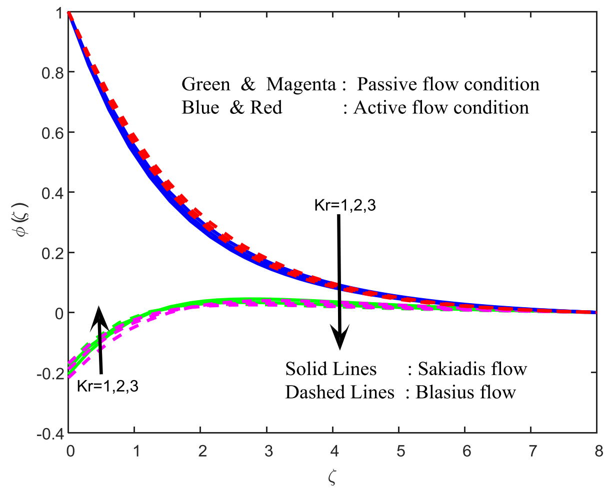


Fig.22 Concentration variation with Kr

Table 1: Comparison of some of the values of wall temperature gradient $-\theta'(0)$ obtained by Grubka and Bobba [24], Ali [25] and Ishak et al. [26] when $Ec = K = Nt = Nb = Kr = R = 0$.

Table 1 Variation in values of Skin $\left(\frac{1}{2} C_{fx} \mathrm{Re}_x^{1/2}\right)$, Nusselt $\left(\frac{1}{2} Nu_x \mathrm{Re}_x^{-1/2}\right)$ and Sherwood number $\left(\frac{1}{2} Sh_x \mathrm{Re}_x^{-1/2}\right)$ for different values of physical parameters for Passive Flow Condition for Sakiadis flow and Blasius flow.

TEST Engineering & Management

January - February 2020
ISSN: 0193 - 4120 Page No. 14430 - 14439

Pr	Grubka and Bobba [24]	Ali [25]	Ishak et al. [26]	Present results
0.01	0.0197		0.0197	0.019723
0.72	0.8086	0.8058	0.8086	0.808836
1.0	1.0000	0.9961	1.00000	1.000000
3.0	1.9237	1.9144	1.9237	1.923687
10.0	3.7207	3.7006	3.7207	3.720788
10.0	12.2940		12.2941	12.30039

Table 2 Variation in values of Skin $\left(\frac{1}{2} C_{fx} \mathrm{Re}_x^{1/2}\right)$, Nusselt $\left(\frac{1}{2} Nu_x \mathrm{Re}_x^{-1/2}\right)$ and Sherwood number $\left(\frac{1}{2} Sh_x \mathrm{Re}_x^{-1/2}\right)$ for different values of physical parameters for Active Flow Condition for Sakiadis flow and Blasius flow.

R	Nt	Nb	Q_H	M	Ec	K	$\left(\frac{1}{2} C_{fx} \mathrm{Re}_x^{1/2}\right)$				$\left(\frac{1}{2} Sh_x \mathrm{Re}_x^{-1/2}\right)$	
							Sakiadis flow	Blasius flow	Sakiadis flow	Blasius flow	Sakiadis flow	Blasius flow
1							0.141279	0.622136	3.718170	3.787366	-0.243018	0.580744
2							0.196739	0.665895	4.644282	4.725415	-0.203697	0.619768
3							0.230841	0.692790	5.466452	5.554919	-0.180411	0.642153
	0.2						0.097329	0.587438	3.183045	3.242729	-0.275588	0.547452
	0.4						0.035013	0.616341	3.183328	3.250820	-0.551226	0.424053
	0.6						-0.029556	0.644663	3.181604	3.256698	-0.826391	0.303006
		0.2					0.065934	0.600228	3.186940	3.276517	-0.413888	0.482098
		0.5					0.121996	0.578687	3.179572	3.193108	-0.165173	0.599925
		0.8					0.135693	0.576093	3.177476	3.130792	-0.103165	0.629807
			0.2				0.097329	0.587438	3.183045	3.242729	-0.275588	0.547452
			0.5				0.064668	0.563388	3.494811	3.548103	-0.302581	0.521513
			0.8				0.035616	0.542001	3.783057	3.830671	-0.327537	0.497261
				1			-0.156069	0.322264	3.063819	3.141275	-0.265266	0.525571
				2			-0.589473	-0.136413	2.852097	2.954348	-0.246935	0.487062
				3			-0.951659	-0.523135	2.675001	2.791336	-0.231602	0.454723
					1		0.111904	0.599835	3.125901	3.132076	-0.270641	0.547249
					3		0.146246	0.614931	2.992976		-0.259132	0.546977
					5		0.177931	0.629604	2.870878	2.852766	-0.248561	0.546686
						1	-0.156069	0.322264	3.063819	3.141275	-0.265266	0.525571
						2	-0.589473	-0.136413	2.852097	2.954348	-0.246935	0.487062
						3	-0.951659	-0.523135	2.675001	2.791336	-0.231602	0.454723

R	Nt	Nb	Q_H	M	Ec	K	$\left(\frac{1}{2} C_{fx} \mathrm{Re}_x^{1/2}\right)$		$\left(\frac{1}{2} Nu_x \mathrm{Re}_x^{-1/2}\right)$		$\left(\frac{1}{2} Sh_x \mathrm{Re}_x^{-1/2}\right)$	
							Sakiadis flow	Blasius flow	Sakiadis flow	Blasius flow	Sakiadis flow	Blasius flow
1							1.762482	2.333030	3.077939	3.126902	-0.201173	0.472776
2							1.814676	2.371877	3.992797	4.058569	-0.175123	0.502185
3							1.847794	2.396390	4.814043	4.890410	-0.158879	0.519603
	0.2						1.722525	2.303057	2.558602	2.594545	-0.221524	0.448541
	0.4						1.618727	2.329032	2.550029	2.594316	-0.441563	0.362125
	0.6						1.507575	2.354550	2.538296	2.592529	-0.659298	0.277480
		0.2					1.670926	2.314276	2.557489	2.621686	-0.332141	0.402061
		0.5					1.762554	2.295678	2.558930	2.552661	-0.132931	0.485875
		0.8					1.784607	2.293997	2.558917	2.498289	-0.083082	0.507261
			0.2				1.722525	2.303057	2.558602	2.594545	-0.221524	0.448541
			0.5				1.682898	2.277490	2.882325	2.909339	-0.249552	0.422458
			0.8				1.647094	2.254467	3.183070	3.202059	-0.275590	0.397856
				1			1.585844	2.148895	2.459964	2.514288	-0.212984	0.425349
				2			1.378952	1.907436	2.300729	2.379708	-0.199197	0.387147
				3			1.229846	1.727221	2.178577	2.271115	-0.188621	0.356831
					1		1.805656	2.337467	1.937123	1.621098	-0.167716	0.447802
					3		2.072073	2.383539	-0.272103	0.298385	0.023559	0.447026
					5		2.486845	2.433613	-4.304029	-1.161177	0.372643	0.446539
						1	1.585844	2.148895	2.459964	2.514288	-0.212984	0.425349
						2	1.378952	1.907436	2.300729	2.379708	-0.199197	0.387147
						3	1.229846	1.727221	2.178577	2.271115	-0.188621	0.356831

III. CONCLUSION

current attempt focuses on comparison of the Blasius and Sakiadis flow. Further thermal radiation, thermophoresis, Brownian motion, magneto hydrodynamics, viscous dissipation are also considered for the study. The flow equations are transformed to ordinary differential equations (ODE's) with the aid of appropriate transformations. Runge-Kutta method is acquired for the reliable and presentable results.

The observations include;

1. It is found that Sakiadis flow shows lesser Nusselt number, Sherwood number and skin friction compared to Blasius flow.
2. The heat transfer rates are higher for passive flow condition compared to active flow conditions whereas skin friction and Sherwood numbers are quite opposite to that behavior. From this it is clear that depending on the situation we select the active or passive flow conditions.

3. The velocity profiles are higher in active flow conditions in all the physical parameters compared to passive flow conditions.
4. The temperature distribution is higher in passive flow condition when compared to active flow condition. From above two results help us to conclude the based on the industrial need we can either active flow or passive flow situations.

IV. References

[1]. S.U. S Choi, J.A. Eastman, Enhancing thermal conductivity of Fluids with nanoparticles. ASME Pub.Fed.231(1995)99-106.

[2]. O. Mahian, A. Kianifar, S.A. kalogirou, I. Pop, S. Wongwises, A review of the applications of nanofluids in solar energy, Int. J. Heat Mass Transf.57(2013) 582-594.doi: 10.1016/j.ijheatmasstransfer.2012.10.037.

[3]. R. Saidur, S.N. Kazi, M.S. Hossain, M.M. Rahman, H.A. Mohammed, A review on the performance of nanoparticles suspended with refrigerants and lubricating oils in refrigeration systems, renew. Sustain. Energy Rev.15(2011) 310-323.doi: 10.1016/j.rser.2010.08.018.

[4]. C.S.K. Raju, M.M. Hoque, N.N. Anika, S.U. Mamatha, and Pooja Sharma. Natural convective heat transfer Analysis of MHD unsteady Carreau nanofluid over a cone packed with alloy nanoparticles. Power Technology 317(207)408-416.

[5]. Santhosh H.B and Raju.C.S. K, Unsteady Carreau Radiated Flow in a Deformation of Graphene nanoparticles with Heat Generation and Convective Conditions, Journal of nanofluids,7(6) (2018)1130-1137.

[6]. Raju.C.S. K, Sandeep, Sugunamma.V Unsteady Magneto-Nanofluid flow caused by a rotating cone with temperature dependent viscosity: A Surgical implant Application J. Mol.Liq 222(2016) 1183-1193.doi: 10.1016/j.molliq.2016.07.143

[7] Buongiomo, Hu.L. W, Nanofluid coolants for Advanced Nuclear power plants, proceedings of ICAPP, Vol.5. (2005)15-19.

[8]. Raju.C.S. K, Saleem.S, S.U. Mamatha, Iqtadar Hussain, Heat and Mass transport phenomena of radiated slender body of three revolutions with saturated porous: Buongiomo's model, International Journal of Thermal Sciences,132(2018)309-315.

[9]. Abderrahim Wakif, Zoubair Boulahia, SR Mishra, Mohammad Mehdi Rachid Sehaqui, Influence of a uniform transverse magnetic field on the thermo-hydrodynamic stability in water-based nanofluids with metallic nano particles using the generalized Buongiomo's, Mathematical Model, The European physical Journal plus 133(5) (2018)181.

[10]. Rashid Mehmood, Sadaf Mukhtar, Noreen Sher Akbar, Nanoparticle analysis of Non-Newtonian Fluid with slip and multiple convective boundary conditions, proceedings of the institution of mechanical Engineers, Part E: Journal of process Mechanical Engineering,232(3) (2018)369-379.

[11]. Abd El-Aziz Radiation effect on the flow and heat transfer over an unsteady stretching sheet, Int.Commun. Heat Mass Transf. 36(2009) 521-524.doi: 10.1016/j.icheatmasstransfer.2009.01.016.

[12].IL Animasaun, Raju CSK, Sandeep N, Unequal Diffusivities case of homogeneous-heterogeneous reactions within viscoelastic fluid flow in the presence of induced magnetic -field and nonlinear thermal radiation, Alexandria Engineering Journal,55(2) (2016)1595-1606.

[13]. Babu.M. J, Sandeep, Raju. CSK, Reddy.J.V. R, Sugunamma.V, Nonlinear Thermal Radiation and Induced Magnetic field Effects on Stagnation-point flow of Ferrofluids, Journal of Advanced Physics.5(2015) 1-7.doi:10.1116/jap.2015.1271.

[14]. Turkyilmazoglu.M, Analytical Solutions to mixed convection MHD fluid flow induced by a nonlinearly deforming permeable surface, communications in Nonlinear Science and Numerical Simulation,63(2018)373-379.

[15]. Hussain. Sarwar.L, Nadeem.S, Akbar.S, Jamal.S, Inquisition of combined effects of radiation and MHD on elastic-viscous fluid flow past a pervious plate, Journal of the Brazilian Society of Mechanical Sciences and Engineering,40(7) (2018)343.