A Study on Time based Fluctating Cass on Fluid Flow

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Abstract
As per the days gone the heat production of any machine will increase. So cooling will play an important role in any production. This paper deals with how the casson fluid cool down the temperature so that the life of the product will increase. Here we study of the flow of cassonfluid past a vertical porous plate. We haveconsidered different geometrical parameters to test the heat and mass transfer properties. Regular perturbation technique is used to findthe solution. Heat and mass transfer impact is analyzed with respect to different parameters characteristics.

Keywords:heat production, parameter, characteristics.

1. Introduction:

Day by day the needs of customer is increasing rapidly in the field of electronics appliances. It is very difficult meet the requirements of the customer always. In the field of Electrical, Electronic and mechanical, Production engineering the items production making as well as maintenance is a huge task. While using electronic and mechanical instruments definitely heat generates. If we cannot control this heat then the life of the instrument decreases or sometimes it will not work. Non Newtonian fluids especially casson fluid is very much useful in this regards. Blood, mud, ketchupsare examples for non-Newtonian fluid.On this many researchers are working for the last two decades. Many researchers are continuously working in this direction. Using magnetic field and chemical reaction Emmanuel &others [1] are analysed the effect of casson flow. By considering impulsively started moving flat plate, Mustafa &others [2] studied casson fluid characteristics. Kirubhushankumar& others [3,4] studied the liquid stream effectin electrically conducting plates. Many researchers like Arthur others [5], Pramanik& others [6] considered streaching surface while considering the casson fluid flow. Puspalatha&others [7] are studied magneto hydro dynamic casson fluid propertie boundary condition.Chandraredddy&others [8,9]givenpropertis of Rivilin Erickson fluid with respect to different parameters. Some of the related papers are published on casson fluid by Ramohanreddy& others[10], Siddareddy& others[11], Zhang & others[12,13,14] and vidyanadha babu & others[15,16,17].

2. Formulation of the problem:

Consider the x*-axis is in the direction of flow and y*-axis is normal to flow direction. After neglecting induced magnetic field, soret and dufour effects, assume the permeability of the porous plate and suction velocity can be consider as follows.

$$K^*(t^*) = K_p^*(1+\varepsilon e^{n^*t^*}), v^*(t^*) = -v_0(1+\varepsilon e^{n^*t^*}) \qquad (1)$$

Where $v_0 > 0$ and $\varepsilon \le 1$ positive constants.

With the above considerations th

$$\frac{\partial u^*}{\partial t^*} = (1+\frac{1}{\beta})\nu\frac{\partial^2 u^*}{\partial y^{*2}} + g\beta(T^* - T_\infty^*) + g\beta^*(C^* - C_\infty^*) - \sigma B_0^2\frac{u^*}{\rho} - (1+\frac{1}{\beta})\nu\frac{u^*}{k^*} \qquad (2)$$

$$\frac{\partial T^*}{\partial t^*}\rho c_p = K\frac{\partial^2 T^*}{\partial y^{*2}} - \frac{\partial q^*}{\partial y^*} - Q^*(T^* - T_\infty^*) + Q_l^*(C^* - C_\infty^*) \qquad (3)$$

$$\frac{\partial C^*}{\partial t^*} = D\frac{\partial^2 C^*}{\partial y^{*2}} - K_r(C^* - C_\infty^*) \; (4)$$

At starting U=1, T=T_w+€ [Tw-T∞]*exp(nt), C=C_w+€[Cw-C∞)*exp(nt) & when y->∞U=T=C=0(5)after. Considering dimensionless variables

$$y = \frac{v_0 t^*}{\nu},\ t = \frac{v_0^2 t^*}{4\nu},\ w = \frac{4\vartheta w^*}{v_0^2},\ u = \frac{u^*}{v_0},\ T = \frac{T^* - T_\infty^*}{T_W - T_\infty},\ C = \frac{C^* - C_\infty^*}{C_W - C_\infty},$$

$$S = \frac{\vartheta S^*}{v_0^2},\ K_p = \frac{v_0^2 K_p^2}{\nu^2},\ M^2 = \sigma\frac{B_0^2\nu}{v_0^2\rho},\ P_r = \frac{\nu}{K},\ S_c = \frac{\nu}{D},\ R_c = \frac{v_0^2 K_0}{\nu^2\rho},$$

$$G_c = \frac{\nu g\beta^*(C_W - C_\infty)}{v_0^3},\ G_r = \frac{\nu g\beta(T_W - T_\infty)}{v_0^3},\ F = \frac{4I_1\nu}{v_0^2\rho C_p}, s = \frac{Q\nu}{v_0^2\rho C_p},$$

$$R = \frac{Q_l\nu(C^*_W - C_\infty)}{v_0^2\rho(T^*_W - T_\infty)},\ K_c = \frac{k_r\nu}{v_0^2}, H = F + S \qquad (6)$$

Eq (2)-(5) can be written as

$$\frac{1}{4}\frac{\partial u}{\partial t} = (1+\frac{1}{\beta})\frac{\partial^2 u}{\partial y^2} + G_r T + G_c C - (M^2 + \frac{1}{K_p})u \qquad (7)$$

$$\frac{1}{4}\frac{\partial T}{\partial t} = \frac{1}{P_r}\frac{\partial^2 T}{\partial y^2} - HT + RC \qquad (8)$$

$$\frac{1}{4}\frac{\partial C}{\partial t} = \frac{1}{S_c}\frac{\partial^2 C}{\partial y^2} - K_c C \qquad (9)$$

Initially U=1,T=1+€*exp(nt), C=1+€*exp(nt), & U=0 , T=0 , C=0(10)

3. SOLUTION:

Following equations can be made to solve the above by perturbation method.

$$(1+\frac{1}{\beta})u_0^{11} - (M^2 + \frac{1}{K_p})u_0 = -G_r T_0 - G_c C_0 \qquad (12)$$

$$(1+\frac{1}{\beta})u_1^{11} - (M^2 + \frac{1}{K_p} + \frac{n}{4})u_1 = -G_c C_1 - G_r T_1 \qquad (13)$$

$$T_0^{11} - P_r H T_0 = -R P_r C_0 \tag{14}$$

$$T_1^{11} - (H + \frac{n}{4}) P_r T_1 = -R P_r C_1 \tag{15}$$

$$C_0^{11} - K_c S_c C_0 = 0 \tag{16}$$

$$C_1^{11} - (K_c + \frac{n}{4}) S_c C_1 = 0 \tag{17}$$

The BCC are initially U=1, T=1,C=1 as y increases U=0, T=0 & C=0 (18)

Keeping (18) in mind solving (12) to (17) we get

$$u(y,t) = (1 - b_3 - b_4) e^{-\sqrt{a_5} y} + b_3 e^{-\sqrt{a_3} y} + b_4 e^{-\sqrt{a_1} y} + \varepsilon e^{nt} \left\{ (-b_5 - b_6) e^{-\sqrt{a_8} y} + b_5 e^{-\sqrt{a_4} y} + b_6 e^{-\sqrt{a_2} y} \right\} \tag{19}$$

$$T(y,t) = (1 - b_1) e^{-\sqrt{a_3} y} + b_1 e^{-\sqrt{a_1} y} + \varepsilon e^{nt} \left\{ (1 - b_2) e^{-\sqrt{a_4} y} + b_2 e^{-\sqrt{a_2} y} \right\} \tag{20}$$

$$C(y,t) = e^{-\sqrt{a_1} y} + \varepsilon e^{nt} \left\{ e^{-\sqrt{a_2} y} \right\} \tag{21}$$

Heat and mass transfer characteristics are

$$\tau = \frac{\partial u_0}{\partial y} + \varepsilon e^{nt} \frac{\partial u_0}{\partial y}, \text{ at y = 0}$$

$$\tau = \left[-(1 - b_3 - b_4)\sqrt{a_5} - b_3 \sqrt{a_3} - b_4 \sqrt{a_1} \right] + \varepsilon e^{nt} \left[(b_5 - b_6)\sqrt{a_8} - b_5 \sqrt{a_4} - b_6 \sqrt{a_2} \right] \tag{22}$$

$$N_u = -\left[\frac{\partial T_0}{\partial y} + \varepsilon e^{nt} \frac{\partial T_1}{\partial y} \right] \text{at y=0;} \quad N_u = \left[(1 - b_3)\sqrt{a_3} + b_1 \sqrt{a_1} \right] + \varepsilon e^{nt} \left[(1 - b_2)\sqrt{a_4} + b_2 \sqrt{a_2} \right] \tag{23}$$

$$S_h = -\left[\frac{\partial C_0}{\partial y} + \varepsilon e^{nt} \frac{\partial C_1}{\partial y} \right] \text{At y = 0;} \quad S_h = \left[\sqrt{a_1} \right] + \varepsilon e^{nt} \left[\sqrt{a_2} \right] \tag{24}$$

4. Graphs:

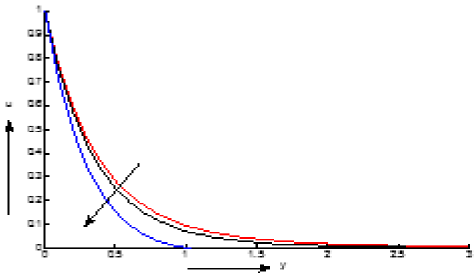


FIG:1

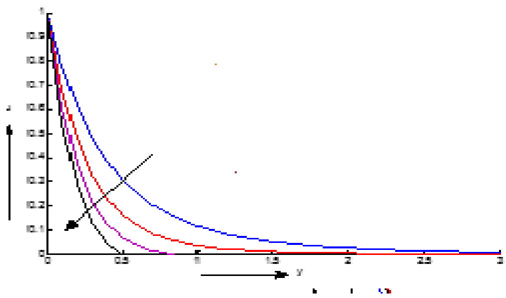


FIG:2

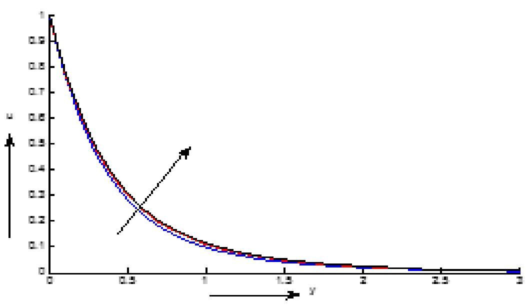


FIG:3

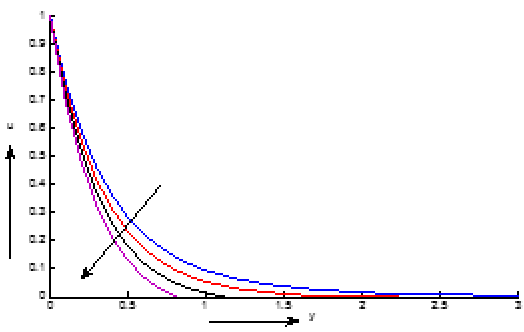
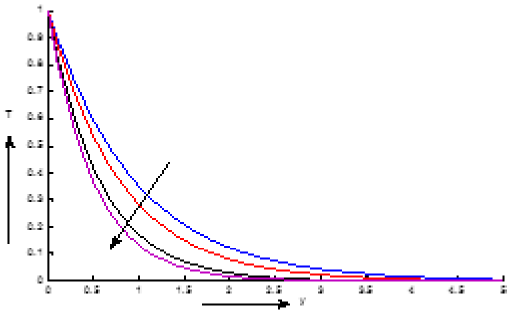


FIG:4



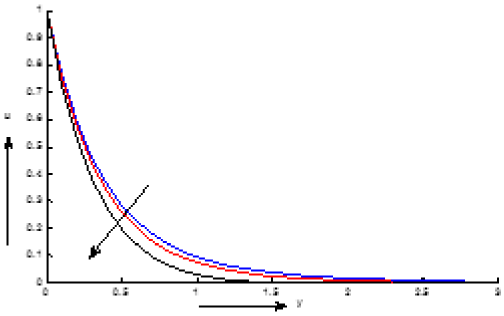
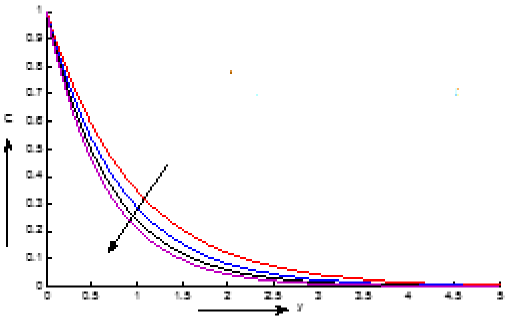
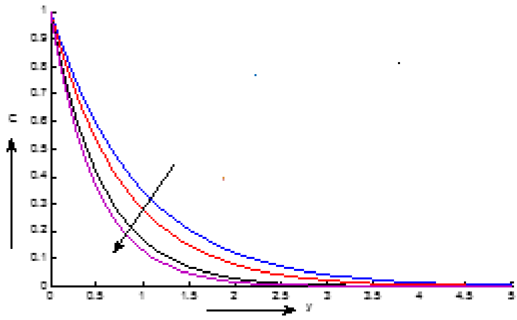


FIG:5

FIG:6





FIG;7

FIG:8

Gra no.	Mod gra no.	Mag par no.	Kp	τ
10	9	0.7	1.7	10.5467
10	10	0.7	1.7	10.3456
10	6	2.5	1.7	12.5637
10	6	3.0	1.7	12.3452
10	6	3.5	1.7	11.4567
10	6	4.0	1.7	11.1034
10	6	0.7	0.4	8.6789
10	6	0.7	0.5	9.8976
10	6	0.7	0.6	9.9067
10	6	0.7	0.7	9.9156

Table 1 and Table 2shows the skin-friction and Sherwood numbers

Conclusion: The fluid velocity is inversely proportional to Casson parameter and heavier species. The Concentration values are also inversely proportional to Schmidt's number. Skin friction values are proportion to the values of R whereas Nusselt's values are inversely proportional.

Appendix

$$a_1 = S_c K_c`, a_2 = (K_c + \frac{n}{4})S_c \; ; \; a_3 = P_r H \; ; \; a_4 = (H + \frac{n}{4})P_r ; \; a_5 = (M^2 + \frac{1}{K_P})/(1 + \frac{1}{\beta}) \; ; \; a_6 =$$

$$-\mathrm{Gr}/(1 + \frac{1}{\beta}); a_7 = -\mathrm{Gc}/(1 + \frac{1}{\beta}); a_8 = (M^2 + \frac{1}{K_P} + \frac{n}{4})/(1 + \frac{1}{\beta}) ; \; b_1 = \frac{-RP_r}{a_1 - a_3} ; \; b_2 = \frac{-RP_r}{a_2 - a_4}$$

$$b_6 = \frac{a_6 b_2 + a_7}{a_2 - a_8}$$

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