ANALYSIS OF THE IMPACT OF THERMAL RADIATION AND VELOCITY SLIP ON THE MELTING OF MAGNETIC HYDRODYNAMIC MICROPOLAR FLUID-FLOW OVER AN EXPONENTIALLY STRETCHING SHEET

by

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The belongings of radiation and velocity slip on MHD stream and melting warmth transmission of a micropolar liquid over an exponentially stretched sheet which is fixed in a porous medium with heat source/sink are accessible. Homothety transforms the major PDE into a set of non-linear ODE. Then, by varying the boundary value problem to the initial value problem first, we get a numerical solution the non-linear system of equations. It has been observed that related parameters have a significant effect on flow and heat transfer characteristics, which are demonstrated and explained in aspect done their figures. Velocity and temperature decrease by an extension in the magnetic aspect, and the angular velocity increase but the reverse effects come in melting, microrotation, and mixed convection parameters. The surface resistance coefficient as well as couple stress both decreases with amplification in the Eckert number microrotation, material, radiation, and heat source/sink parameter but the heat transport coefficient increase.

Key words: *melting warmth transmission, exponential extending, heat source/sink, micropolar fluid stream, thermal radiation*

Introduction

Research on micropolar fluids is a popular investigation field because of its abundant trade and trading requests. Micropolar fluid is a deferment of minor form fluid and colloidal liquid elements. Most studies relate to normal non-slip boundary conditions. However, it can be difficult to avoid slipping at the border. For microscale devices and low pressure dilute gases, slip at the boundary is applied. Also, in the case of homogeneous fluids, slippage occurs at the boundaries. Slip can occur at the boundaries of emulsions, foams, *etc*. It has a wide range of requests in several thermal difficulties in industrial and trade schemes. Slipup borderline conditions are especially beneficial for the stream of non-Newtonian fluids in the food transport

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process. Magyari and Keller [1] described the exponentially extending stream on a continuous surface and the thermal boundary-layer by an exponential temperature supply. Elbashbeshy [2] found numerically similar solutions to the laminal borderline coat equivalences that represent the warmth and stream of a resting liquid obsessed via an exponentially elongating pan that receives pull. Bidin and Nazar [3] give Laminar flow of incompressible viscous fluid with heat radiation on an exponentially elongating sheet 2-D boundary laminar flow and heat transfer were investigated. Ishak *et al*. [4] Studied the outcome of radioactivity on the MHD borderline laminal flow of gluey liquid on an exponentially elongating pane. Yacob *et al.* [5] investigated the border line coating in an action fact stream of the micropolar liquid towards the flat-lined stretch pane. Bhattacharyya *et al*. [6] investigated the outcome of heat radiation on the stream of micropolar liquid and heat transfer through the porous shrink sheet. Mukhopadhyay [7] discussed the border line coating stream and warmth transmission a spongy exponential elastic pane in the attendance of a magnetic field is investigated. Hayat *et al*. [8] analyzed the heat transfer of melting in the double diffusion stagnation point flow convection. Turkyilmazoglu [9] studied the Heat transport and flow of a micro polar fluid through the porous shrink sheet is being studied. Hafidzuddin *et al*. [10] examined heat transfer and steady flow of a laminar boundary-layer more than a leaky exponentially extending/lessening pane with generalized slip velocity. Adegbiem *et al*. [11] discussed the flow of the micropolar fluid's 2-D boundary-layer generated toward the stagnation point on the surface extending horizontally and linearly is being investigated. Das and Duari [12] investigated the possession of micropolar nanofluids on a stable inaction fact stream by warmth and mass handover constrained by a vertically elongated sheet. Ibrahim [13] examined the secondary slipup stream and magnetic arena of the border line coat stream of the micropolar liquid passing through the elastic sheet were investigated. Soid *et al*. [14] numerically analyzed the flow of stagnation points on a stretchable sheet immersed in a micropolar fluid. Ghosh *et al*. [15] studied the unsteady boundary laminar flow of nanofluids on stretch planes and analyze heat transfer due to melting. Mandal and Mukhopadhyay [16] investigated the non-linear convection's effect on the border line coating stream of an exponentially elongating micropolar liquid on a sheet in the presence of exponentially moving free currents. Singh *et al*. [17] presented the HATM, an efficient hybrid computational technique for investigating Jeffery-Hamel stream. Ali *et al*. [18] demonstrated the effect of the magnetic dipole on the warmth transmission phenomenon of various nanoparticles Fe (ferromagnetism) and Fe_3O_4 (ferrimagnetism) disseminated in base fluid (60% water + 40% ethylene glycol) on the flow of micropolar fluid on elastic sheet studied. Fatunmbi *et al*. [19] investigated the flow, heat, and mass transfer of magnetic micropolar-reactive fluids on non-linear stretchable sheets in saturated non-Darcy porous media. Kumar *et al*. [20] examined the numerical study of the conductive MHD non-linear convection of the micropolar fluid on the slanderous stretchable surface. Kumar *et al*. [21] The heat transfer characteristics of the MHD free convection stagnant flow of the micropolar liquid due to the expansion and contraction of the exponentially curved sheet were investigated. Nadeem *et al*. [22] investigated the effect of the flow of unsteady bio convective nanomaterial micropolar fluids on an exponentially elongating surface under multi-slip conditions. Ramadevi *et al*. [23] offered a numerical analysis of the micropolar fluid's 2-D MHD non-linear radiation flow towards the stretch plane. Yasmin *et al*. [24] paid their attention the investigation of MHD in the presence of thermal radiation that combines mixed convection and slips conditions. Tassaddiq *et al*. [25] modelling for many physical phenomena is greatly influenced by the usage of a fractional operator involving Mittag-Leffler function. Ali *et al.* [26] discovered the necessity for suction and injection of gravity-modulated miscellaneous convection in the flow of micropolar fluids with tilted sheets in the company of magnetic arenas and thermal radioactivity. Khader and Sharma [27] investigated the belongings of heat radiation and non-uniform heat sources/sinks on the stream of unsteady MHD micropolar fluid through a stretch/sharking sheet. Sajid *et al*. [28] investigated an incompressible micropolar Prandtl fluid-flowing over a porous stretch sheet. Mandal *et al*. [29] used an exponentially stretched sheet to demonstrate the belongings of speed slide and radioactivity on MHD stream and melt warmth transmission of a micropolar liquid. Singh *et al*. [30] inspected the thin film stream of a third-grade liquid down an inclined plane.

Construction of the problem

Deliberate a steady 2-way stream of not compressible and electrical leading small-molecule fluid concluded a sheet that is pushed exponentially dissolves at a constant rate into warm liquid when there is a slip, fig. 1. Imposed an attractive arena of as set $B = B_0 e^{x/2L}$, B^0 is a constant in the vertical track of motion. The sheet is pushed exponentially with speed $U_w = ae^{x/L}$, when $a > 0$ is always growing. The core equations for the MHD stream of small-molecule liquid and warmth transportation below border coat estimates:

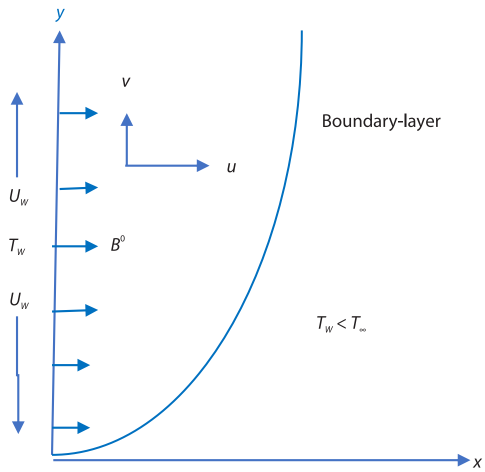


Figure 1. Sketch of the physical flow problem

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}=0 \tag{1}$$

$$u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}=\left(\upsilon+\frac{k}{\rho}\right)\frac{\partial^2 u}{\partial y^2}+\frac{k}{\rho}\frac{\partial M^*}{\partial y}-\frac{\sigma}{\rho}B^2u-\frac{\upsilon}{k^*}u-\frac{C_b}{\sqrt{K^{**}}}u^2+g\beta\left(T-T_\infty\right) \tag{2}$$

$$u\frac{\partial M^*}{\partial x}+v\frac{\partial M^*}{\partial y}=\frac{\gamma}{\rho j}\frac{\partial^2 M^*}{\partial y^2}-\frac{k}{\rho j}\left(2M^*+\frac{\partial u}{\partial y}\right) \tag{3}$$

$$u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}=\frac{k^{**}}{\rho C_p}\frac{\partial^2 T}{\partial y^2}-\frac{1}{\rho C_p}\frac{\partial q_r}{\partial y}+\frac{(\mu+k)}{\rho C_p}\left(\frac{\partial u}{\partial y}\right)^2+\frac{\sigma}{\rho C_p}B^2u^2+\frac{Q^*\left(T-T_\infty\right)}{\rho C_p} \tag{4}$$

Viscid dissipative hotness is insignificant as the stream is laminar. Additionally, the strain effort outcome is deserted here. The u and v are the speed correspondingly in the stream way (x way) and a cross-way (y way), M^* is the micro rotation part stand-in concerning the x-y plane, μ, ρ, υ designate the correspondingly the factor of glueyness, thickness, and kinematic gluiness of fluid, σ is the electric conduction, j, γ, $K = \kappa/\mu$ designate one-to-one micro-inertia per unit mass, gluiness because of rotation slope and substantial constraint where k is the vortex glueyness, β is the volumetric factor of current development, g is acceleration because of gravity, T, T_w, T_∞ designate one-to-one the thermal of liquid, dissolve surface and free-stream where $T_\infty > T_w$, L is the reference length, C_p is the specific heat, k^* is used for porosity factor, C_b is the drug factor, k^{**} is the typical thermal conductivity and Q is the warmth source/sink factor.

$$\gamma = \left(\mu + \frac{k}{2}\right) j = \mu\left(1 + \frac{K}{2}\right) j\,,\;\; j = \frac{2L\upsilon \mathrm{e}^{-x/L}}{a} \tag{5}$$

Suitable circumstances at the borderline:

$$u = U_w + U_{\text{slip}},\;\; M^* = -N\frac{\partial u}{\partial y},\;\; T = T_w,\;\; k^{**}\frac{\partial T}{\partial y} = \rho\left[\xi + c_s\left(T_w - T_0\right)\right]v \;\text{ at }\; y = 0 \tag{6a}$$

$$u \to 0,\;\; M^* \to 0,\;\; T \to T_\infty,\;\text{ as }\; y \to \infty \tag{6b}$$

The slip speed is

$$U_{\text{slip}} = \alpha\left(x\right)\frac{\partial u}{\partial y},\;\; \alpha\left(x\right) = A\mathrm{e}^{-x/2L}$$

where A is the constant, ξ – the fluid's latent warmth, and c_s – the surface's warmth ability. Here, $N(0 \le N \le 1)$ is a constant. The $N = 0$ is the materially influential attention, $N = 0.5$ is the delicate attention, and whole $N = 1$ is measured to mock-up turbulent streams. Through the Rosseland guess for emission we get:

$$q_r = -\frac{4}{3}\frac{\sigma^*}{k^{***}}\frac{\partial T^4}{\partial y}$$

where σ^*, k^{***} are the one-to-one the Stefan-Boltzman constant, average assimilation factor. Expansion of T^4 regarding T_∞ by Taylor series and ignoring terms of larger orders, we obtain

$$T^4 = 4TT_\infty^3 - 3T_\infty^4$$

Later, the eq. (4) become:

$$u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y} = \frac{k^{**}}{\rho C_p}\frac{\partial^2 T}{\partial y^2} + \frac{16\sigma^* T_\infty^3}{3\rho C_p k^{***}}\frac{\partial^2 T}{\partial y^2} + \frac{\left(\mu + k\right)}{\rho C_p}\left(\frac{\partial u}{\partial y}\right)^2 + \frac{\sigma}{\rho C_p}B^2 u^2 + \frac{Q^*\left(T - T_\infty\right)}{\rho C_p} \tag{7}$$

Likeness changes are measured:

$$\eta = y\sqrt{\frac{a}{2\upsilon L}}\mathrm{e}^{x/2L},\;\; u = a\mathrm{e}^{x/L} f'\left(\eta\right),\;\; v = -\sqrt{\frac{a\upsilon}{2L}}\mathrm{e}^{x/2L}\left[f\left(\eta\right) + \eta f'\left(\eta\right)\right]$$
$$M^* = \frac{a^{3/2}}{\sqrt{2La}}\mathrm{e}^{3x/2L}h\left(\eta\right),\;\; T = T_\infty + \left(T_w - T_\infty\right)\theta\left(\eta\right) \tag{8}$$

Normal satisfaction of eq. (1). The leading differential eqs. (2), (3), and (7), then are abridged to the successive construction of involved, non-linear ODE:

$$\left(1 + K\right)f''' + ff'' - \left(M + K_p\right)f' - \left(2 + K_{pp}\right)f'^2 + Kh' + \lambda\theta = 0 \tag{9}$$

$$\left(1 + \frac{K}{2}\right)h'' + fh' - 3f'h - K\left(2h + f''\right) = 0 \tag{10}$$

$$\left(1 + \frac{4}{3}\mathrm{Ra}\right)\theta'' + \mathrm{Pr}\left[\left(1 + K\right)\mathrm{Ec}f''^2 + M\mathrm{Ec}f'^2 + f\theta' + \delta\theta\right] = 0 \tag{11}$$

The reformed borderline circumstances convert:

$$f'\left(0\right) = 1 + \alpha f''\left(0\right),\;\; h\left(0\right) = -Nf''\left(0\right),\;\; \mathrm{Pr}f\left(0\right) + Me\theta'\left(0\right) = 0,\;\; \theta\left(0\right) = 1 \;\text{ as }\; \eta \to 0 \tag{12}$$

$$f'(\infty)\to 0,\ h(\infty)\to 0,\ \theta(\infty)\to 0 \quad as \quad \eta\to\infty \tag{13}$$

prime represents derivatives in terms of η

$\Pr=\dfrac{\mu C_p}{k^{**}}$ is the Prandtl number, $M=\dfrac{2\sigma B_0^2 L}{\rho a}$ is the magnetic parameter,

$\alpha=\sqrt{\dfrac{a}{2\nu L}}L$ is the slip parameter, $Ra=\dfrac{4\sigma^* T_\infty^3}{3k^{**}k^{***}}$ is the radiation parameter,

$Me=\dfrac{k^{**}C_p(T_\infty-T_w)}{\rho[\xi+C_s(T_\infty-T_0)}$ is the melting parameter, $K_p=\dfrac{\upsilon 2L}{K^* U_w}$ is the porousness restriction,

$\lambda=\dfrac{\mathrm{Gr}}{\mathrm{Re}^2}$ is mixed convection restriction where $\mathrm{Gr}=\mathrm{g}\beta(T_w-T_\infty)\dfrac{(2L)^3}{\upsilon^2}$ is local Grashof numeral

and $\mathrm{Re}=\dfrac{2LU_w}{\upsilon}$ is the local Reynolds numeral, $K_{pp}=\dfrac{C_b 2L}{\sqrt{K}}$ is the Forchheimer numeral,

$\mathrm{Ec}=\dfrac{U_w^2}{Cp(T_w-T_\infty)}$ is the Eckert number, and $\delta=\dfrac{Q^* 2L}{\rho C_p U_w}$ is the warmth source/sink limitation

The three physical dealings of our devotion are the surface resistance coefficient C_f couple stress C_s, and warmth transportation factor C_t:

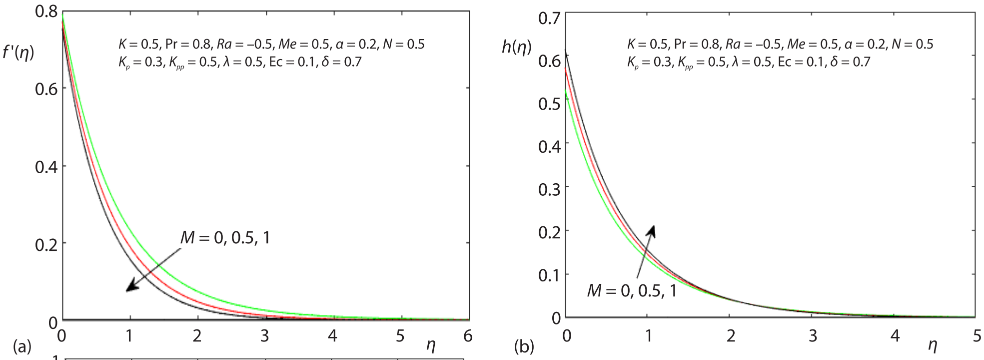
$$C_f=\frac{\tau_w}{\rho U_w^2},\ \tau_w=\left((\mu+K)\frac{\partial u}{\partial y}+KM^*\right)_{y=0} \tag{14}$$

$$C_s=\left(\mu+\frac{K}{2}\right)j\left(\frac{\partial M^*}{\partial y}\right)_{y=0},\ C_t=[-k^{**}\left(\frac{\partial T}{\partial y}\right)+q_r]_{y=0} \tag{15}$$

Now fourth order Runge-Kutta way with shooting technique is followed for stepwise integration and calculations are passed out on MATLAB computer software.

Influence of diverse restrictions

The way of acting of speed, micro rotation, and thermal for various ethics of M are shown in figs. 2(a)-2(c). The relevance of increasing M ethics is that they lower velocity, fig. 2(a), and temperature, fig. 2(c), however, they have the reverse impact in microrotation, fig. 2(b). Figures 3(a) and 3(b) be evidence for the speed and microrotation flow for a variety of K ethics. The fluid speed, fig. 3(a), and micro rotation fig. 3(b) both increase as K increases. Figures 4(a) and 4(b) show the microrotation and temperature flora for different Prandtl number values. As Prandtl number grows, the microrotation, fig. 4(a), increases while the temperature, fig. 4(b), decreases. The behavior of velocity and temperature for Ra levels is revealed in figs. 5(a) and 5(b). Reduce the fluid velocity as Ra rises, fig. 5(a) and temperature, fig. 5(b). The way of acting of speed, microrotation, and thermal for numerous values of Me can be found in figs. 6(a)-6(c). The importance of increasing Me values is to rise velocity, fig. 6(a), and temperature, fig. 6(c), but to decrease microrotation, fig. 6(b). For values, of α, figs. 7(a) and 7(b) reveal the relationship between speed and microrotation. Diminish the liquid speed, fig. 7(a) and microrotation, fig. 7 (b) as α grows. The way of acting of speed, micro rotation, and thermal for various ethics of N are shown in figs. 8(a)-8(c). The importance of increasing N ethics is that



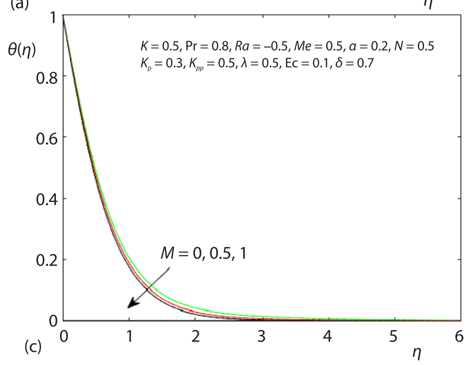


Figure 2. (a) Velocity $f'(\eta)$ against η for unlike facts of magnetic restriction M, (b) angular velocity $h(\eta)$ against η for unlike facts of magnetic restriction M, and (c) temperature $\theta(\eta)$ related to η for unlike facts of magnetic restriction M

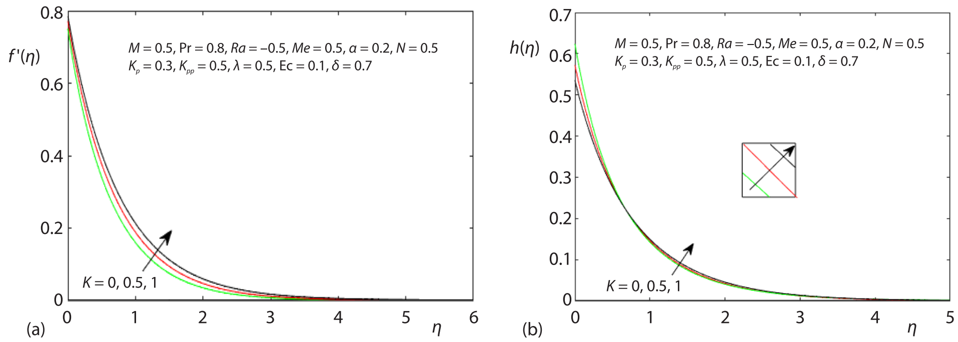


Figure 3. (a) Velocity $f'(\eta)$ against η for unlike facts of material restriction K and (b) angular velocity $h(\eta)$ against η for unlike facts of material restriction K

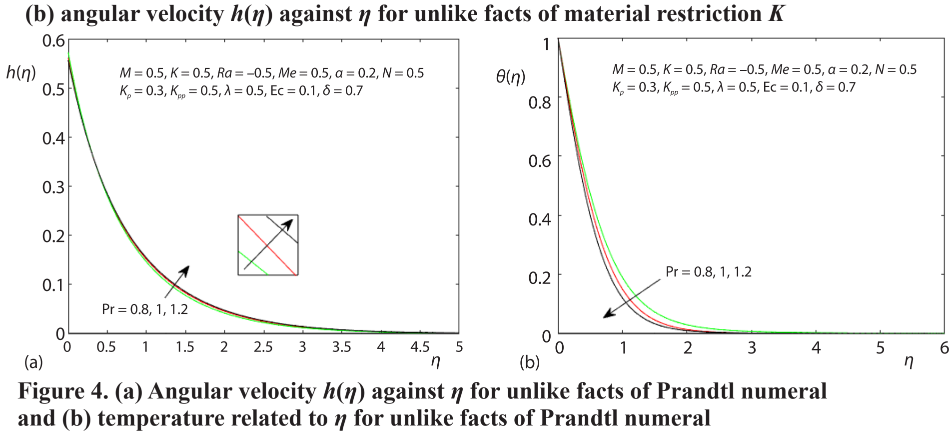


Figure 4. (a) Angular velocity $h(\eta)$ against η for unlike facts of Prandtl numeral and (b) temperature related to η for unlike facts of Prandtl numeral

they increase velocity, fig. 8(a), and temperature, fig. 8(c), but they decrease microrotation, fig. 8(b). Figures 9(a) and 9(b) show the velocity and microrotation way of behaving for different K_p values. Lower fluid velocity, fig. 9(a), and growth microrotation, fig. 9(b), as K_p rise. For values of K_{pp}. Figures 10(a) and 10(b) reveal the relationship of speed and micro rotation. Lessening fluid speed, fig. 10(a) and increase microrotation, fig. 10(b), as K_{pp} increases. The way of acting of speed, micro rotation, and thermal for various values of λ are available in figs. 11(a)-11(c).

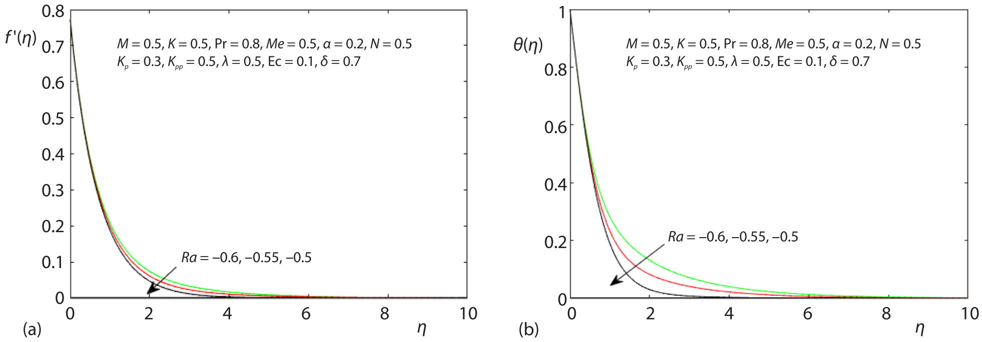
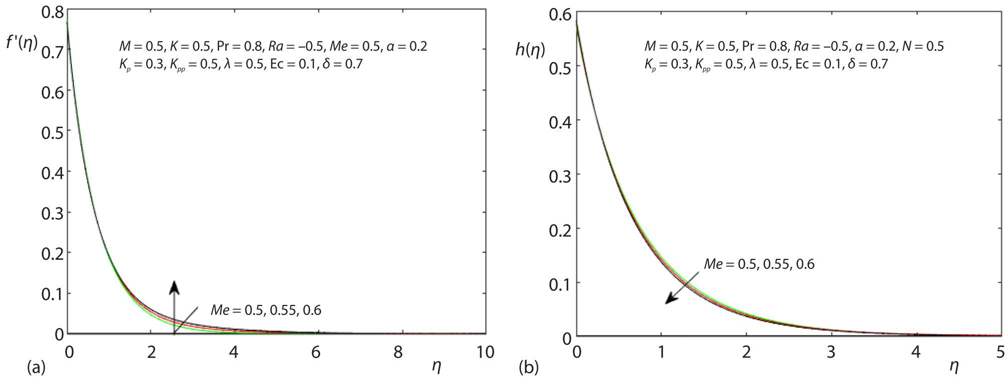


Figure 5. (a) Velocity $f'(\eta)$ against η for unlike facts of radiation restriction Ra (b) temperature related to η for unlike facts of radiation restriction Ra



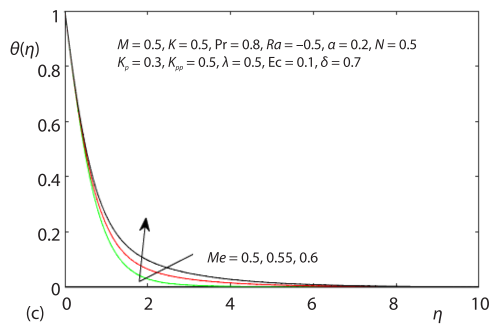


Figure 6. (a) Velocity $f'(\eta)$ against η for unlike facts of melting restriction *Me*, (b) angular velocity $h(\eta)$ against η for unlike facts of elting restriction *Me*, and (c) temperature $\theta(\eta)$ related to η for unlike facts of melting restriction *Me*

The importance of increasing standards of λ is to increase speed, fig. 11(a), and temperature, fig. 11(c), but to decrease microrotation, fig. 11(b). The way of acting of speed, microrotation, and thermal for numerous values of Eckert number can be found in figs. 12(a)-12(c). The relevance of increasing Eckert number values is that they lower velocity, fig. 12(a), and

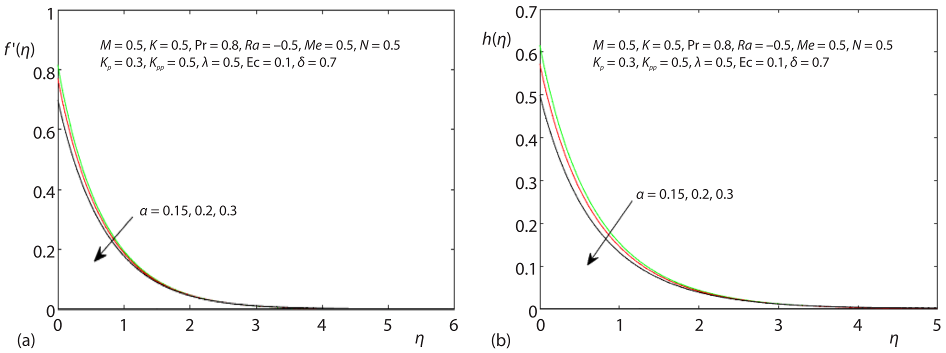
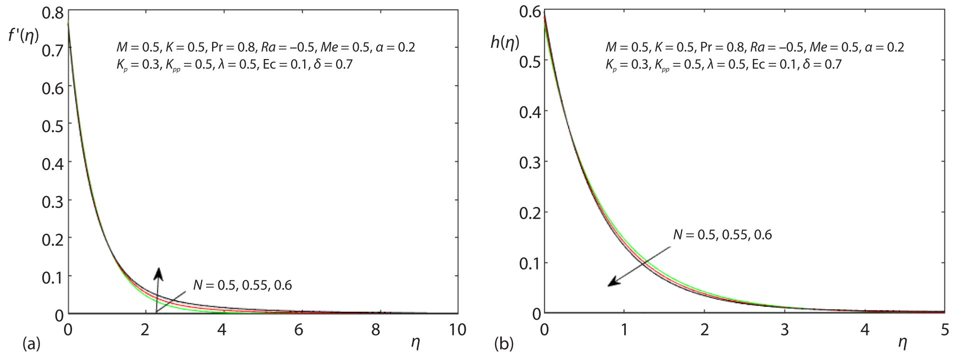


Figure 7. (a) Velocity $f'(\eta)$ against η for unlike facts of slip restriction α and (b) angular velocity $h(\eta)$ against η for unlike facts of slip restriction α



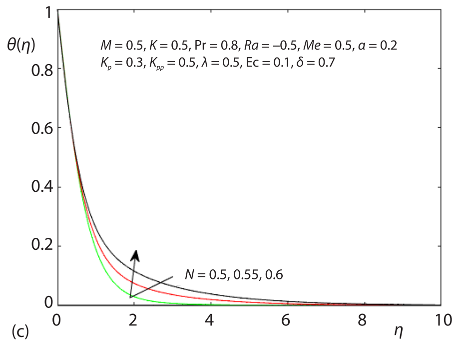


Figure 8. (a) Velocity $f'(\eta)$ against η for unlike facts of microrotation restriction N, (b) angular velocity $h(\eta)$ against η for unlike facts of microrotation restriction N, and (c) temperature $\theta(\eta)$ related to η for unlike facts of microrotation restriction N

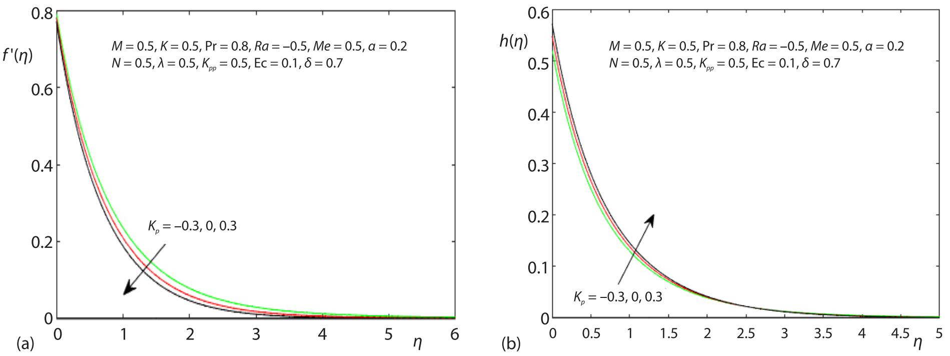


Figure 9. (a) Velocity profiles $f'(\eta)$ against η for unlike facts of permeability restriction K_p and (b) angular velocity $h(\eta)$ against η for unlike facts of Permeability restriction K_p

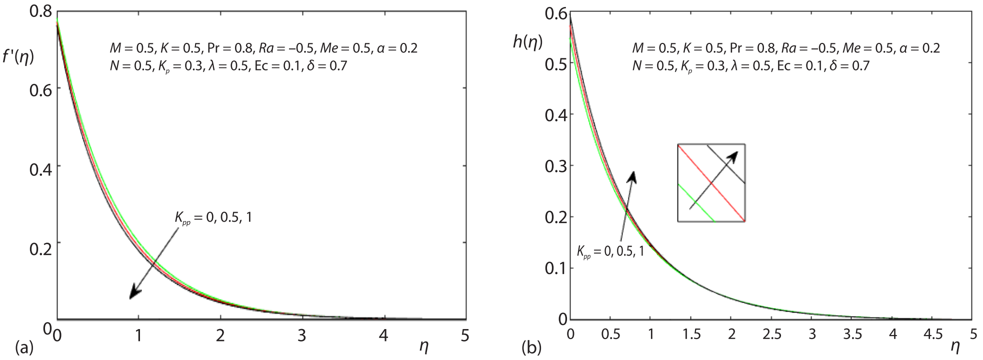


Figure 10. (a) Velocity profiles $f'(\eta)$ against η for unlike facts of Forchheimer number K_p and (b) angular velocity $h(\eta)$ against η for unlike facts of Forchheimer number K_p

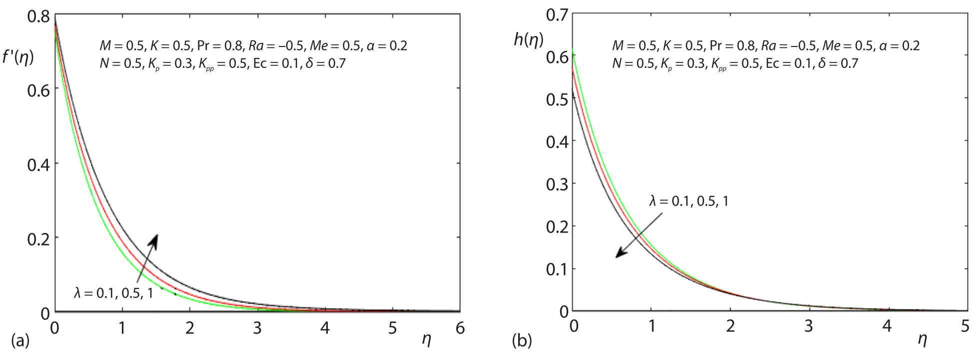
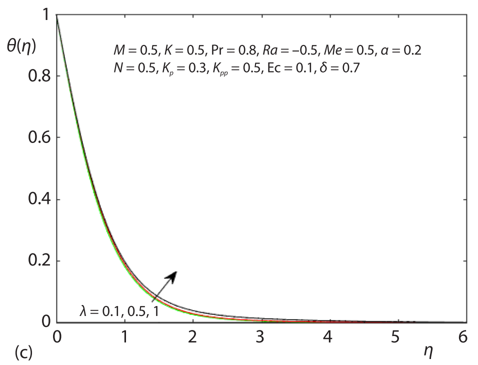


Figure 11. (a) Velocity $f'(\eta)$ against η for unlike values of mixed convection restriction λ, (b) angular velocity $h(\eta)$ against η for unlike facts of mixed convection restriction λ, and (c) temperature $\theta(\eta)$ related to η for unlike facts of mixed convection restriction λ



temperature, fig. 12(c), while increasing microrotation, fig. 12(b). The way of acting of velocity and thermal for values δ are revealed in figs. 13(a) and 13(b). Lessen the fluid velocity, fig. 13(a), and temperature, fig. 13(b), as δ grows.

Table 1. Valuation of $[-f''(0)]$ and $[-\theta(0)]$ for ordinary viscid fluid in non-attendance of slip, thermal radiation, and magnetic arena

[2]		[10]		[29]		Present study	
$[-f''(0)]$	$[-\theta(0)]$	$[-f''(0)]$	$[-\theta(0)]$	$[-f''(0)]$	$[-\theta(0)]$	$[-f''(0)]$	$[-\theta(0)]$
1.28181	0.767778	1.28182	0.767779	1.28181	0.767779	1.28181	0.767778

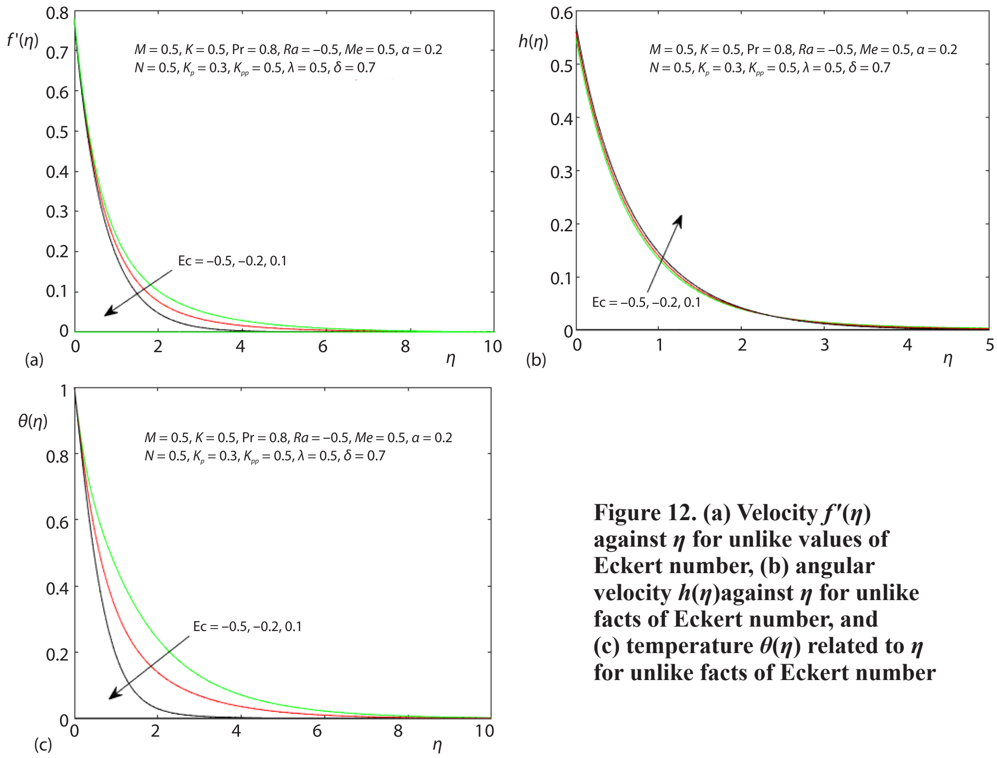


Figure 12. (a) Velocity $f'(\eta)$ against η for unlike values of Eckert number, (b) angular velocity $h(\eta)$against η for unlike facts of Eckert number, and (c) temperature $\theta(\eta)$ related to η for unlike facts of Eckert number

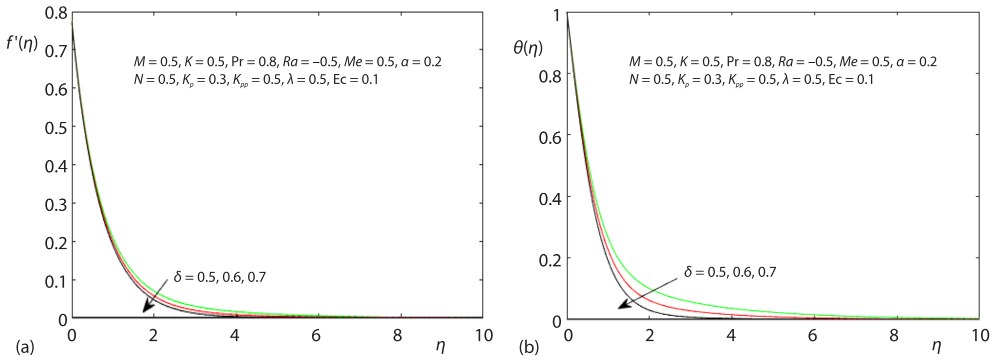


Figure 13. (a) Velocity $f'(\eta)$ against η for unlike values of heat source/sink δ and (b) temperature $\theta(\eta)$related to η for unlike facts of heat source/sink δ

Conclusions

The belongings of radiation and velocity slip on MHD stream and melting temperature transmission of a micropolar liquid done on an exponentially stretched pane which is fixed in the spongy middle by heat source/sink are examined. The significant outcomes of the investigation are studied as follows.

- Velocity, and temperature decrease with an intensification in the magnetic aspect, and the angular velocity increase but the reverse effect come in melting, microrotation, and mixed convection parameter.
- Velocity and temperature both are decreasing functions of radiation and heat source/sink parameters.

- Velocity and angular velocity both are increasing the function of the material parameter but a decreasing function of the slip parameter.
- Angular velocity and temperature both are decreasing functions of the Eckert number.
- Velocity is decreasing function of the permeability parameter but angular velocity increases
- Table 1 describe the validation part from previous study.
- Table 2 shows that the surface resistance coefficient and couple stress decrease with amplification in the M, K, Ra, K_{pp}, Ec, and δ but the heat transport coefficient increase.
- The surface resistance coefficient, couple stress, and heat transport coefficient increase with amplification in the Pr, α but the reverse effect come in Me, K_p.
- The surface resistance, as well as heat transport coefficient, are increased with amplification in the microrotation parameter but couple stress decrease.

Table 2 Encouragement of the three physical dealings is the surface resistance factor C_f combine stress C_s, and heat transportation factor C_t

	C_f	C_s	C_t		C_f	C_s	C_t
$M = 0$	–1.3067613	–0.998134	0.383688	$N = 0.5$	–1.4309988	–1.087446	0.400260
$M = 0.5$	–1.4309988	–1.087446	0.400260	$N = 0.55$	–1.4309972	–1.155794	0.425060
$M = 1$	–1.5372725	–1.166234	0.416842	$N = 0.6$	–1.4288412	–1.226019	0.445060
$K = 0$	–1.2479090	–1.056607	0.391673	$K_p = –0.3$	–1.3006988	–1.012059	0.413096
$K = 0.5$	–1.4309988	–1.087446	0.400260	$K_p = 0$	–1.3688238	–1.050984	0.405130
$K = 1$	–1.6059300	–1.120302	0.418427	$K_p = 0.3$	–1.4309988	–1.087446	0.400260
Pr = 0.8	–1.4309988	–1.087446	0.400260	$K_{pp} = 0$	–1.3683738	–1.030384	0.380706
Pr = 0.8	–1.4015250	–1.024883	0.416516	$K_{pp} = 0.5$	–1.4309988	–1.087446	0.400260
Pr = 0.8	–1.3909388	–0.998845	0.453183	$K_{pp} = 1$	–1.4860650	–1.136884	0.415360
$Ra = –0.6$	–1.4088488	–1.081809	0.239516	$\lambda = 0.1$	–1.5416363	–1.171418	0.417660
$Ra = –0.55$	–1.4200988	–1.085034	0.319994	$\lambda = 0.5$	–1.4309988	–1.087446	0.400260
$Ra = –0.5$	–1.4309988	–1.087446	0.400260	$\lambda = 1$	–1.3023738	–0.998209	0.396770
$Me = 0.5$	–1.4309988	–1.087446	0.400260	Ec = –0.5	–1.3693338	–1.061124	0.392136
$Me = 0.55$	–1.4437613	–1.124259	0.398593	Ec = –0.2	–1.3991875	–1.075450	0.397590
$Me = 0.6$	–1.4571238	–1.162334	0.397226	Ec = 0.1	–1.4309988	–1.087446	0.400260
$\alpha = 0.15$	–1.5407613	–1.189134	0.390260	$\delta = 0.5$	–1.3985113	–1.058203	0.375586
$\alpha = 0.2$	–1.4309988	–1.087446	0.400260	$\delta = 0.6$	–1.4158863	–1.073665	0.388920
$\alpha = 3$	–1.2505113	–0.920278	0.408293	$\delta = 0.7$	–1.4309988	–1.087446	0.400260

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