International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-2, December 2019

Chemical Reaction Influence on General Fluid

Vedavathi. N, Balamurugan. K.S, Dharmaiah.G, Venkata Subrahmanyam Sajja,
Sreenivasa Kumar. M.

Abstract: ***This paper focuses on unsteady, two-dimensional, flow boundary layer of a incompressible viscous electrically conducting and absorbing heat fluid along a semi-infinite vertical moving permeable plate in the presence of Chemical reaction and radiation effects. The dimensionless equations are analytically solved using perturbation procedure. The effects of the different flow fluid parameters on velocity, temperature and concentration fields with in the boundary layer have been examined with the help of graphs.***

Keywords: ***Chemical reaction, MHD, Radiation, convective flow.***

I. INTRODUCTION

The cooperation of lightness with warm radiation has in expanded significantly the most recent decade because of its significance in numerous pragmatic applications. Warm radiation impact is significant under numerous isothermal and non-isothermal circumstances. The assessment of the advancement of a radiative liquid is of critical hypothetical energy, similarly as it appears in a couple of associated issues [1-3]. Convection in permeable media has increased noteworthy consideration lately as a result of its significance in designing applications, for example, geothermal frameworks, strong network heat exchangers, warm protections, cooling of atomic reactors, sun oriented control authorities, vitality effective drying forms, cooling of electronic types of gear and regular convection in earth's covering. Different trails, numerical and theoretical examinations of characteristic convective penetrable stream over vast plate have been accounted for in the writing [4-7]. The consolidated impacts are vital to designers and researchers on account of its practically all inclusive event in many places in science, and thus got of significant measure of consideration lately.

The investigation of concoction response with moving heat in permeable has significant building applications e.g., forbidden reactors and union of earthenware materials. We have 2 sorts of responses. Response happened homogeneously consistently all through the given stage, where as heterogeneous response happens in a limited district or inside the limit stage. The impact of a synthetic response relies upon whether the response is heterogeneous. A compound response is said to be first-request, if the pace of retort is directly forward corresponding to spotlight itself. In numerous mechanical procedures including stream. Procedures happen in various modern applications, for example, the polymer generation and the assembling of earthenware production or dish sets. Then again, in the last time, hydro dynamic free convection streams including warmth and mass move with synthetic response got a unique consideration [8-17].

The fundamental goal of paper is to explore impacts of warm, synthetic response, warmth basis/go down constraint of an electrically directing an infinite surface permeable exposed. The conduct of the focus, temperature and speed were examined for varieties n administering symbols.

II. MATH ANALYSATION WITH RESULT ANALYSIS

Shaky 2-dimensional stream of thick, directing and engrossing liquid a semi-limitless penetrable, inserted permeable middling; exposed to a standardized transverse attractive pasture within sight warm, fixation lightness impacts accepted.

The governing Eq's considered as:

$$\frac{\partial v'}{\partial y'} = 0 \tag{1}$$

$$\frac{\partial u'}{\partial t'} + v'\frac{\partial u'}{\partial y'} - \left[\begin{array}{l} g\beta(T'-T'_\infty)+g\beta^*(C'-C'_\infty)+ \\ \nu\frac{\partial^2 u'}{\partial y'^2}-\frac{\nu}{K'}u'-\frac{\sigma B_0^2}{\rho}u'-\frac{1}{\rho}\frac{\partial p'}{\partial x'} \end{array}\right] = 0 \tag{2}$$

$$\frac{\partial T'}{\partial t'} + v'\frac{\partial T'}{\partial y'} - \left[\begin{array}{l} \frac{1}{\rho C_p}\left[k\frac{\partial^2 T'}{\partial y'^2}-Q_0(T'-T'_\infty)\right] \\ +Q'_l(C'-C'_\infty)-\frac{1}{\rho C_p}\frac{\partial q_r}{\partial y'} \end{array}\right] = 0 \tag{3}$$

$$\frac{\partial C'}{\partial t'} + v'\frac{\partial C'}{\partial y'} - \left[D\frac{\partial^2 C'}{\partial y'^2}-K'_r(C'-C'_\infty)\right] = 0 \tag{4}$$

The conditions are

Revised Manuscript Received on December 30, 2019.
* Correspondence Author

Vedavathi. N*, Department of Mathematics, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, AP - 522502, India.

Balamurugan. K.S., Department of Mathematics, RVR & JC College of Engineering, Chowdavaram, Guntur, Andhra Pradesh, 522019, India.

Dharmaiah. G, Department of Mathematics, Narasaraopeta Engineering College, Yellamanda, Narasaraopet, Andhra Pradesh, 522601, India.

Venkata Subrahmanyam. Sajja, Department of Mathematics, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, AP - 522502, India.

M. Sreenivasa Kumar, Professor, Department of Mechanical Engineering, Narasaraopeta Engineering College, Yellamanda, Narasaraopet, A.P., 522601, India.

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

The non-dimensional Quantities are

$$y=\frac{v_0 y'}{\nu},\ u=\frac{u'}{U_0},\ v=\frac{v'}{v_0},\ t=\frac{t'v_0^2}{\nu}, U_\infty=\frac{U'_\infty}{U_0}, U_p=\frac{u'_p}{U_0}$$

$$\theta=\frac{T'-T'_\infty}{T'_w-T'_\infty}\quad,\quad C=\frac{C'-C'_\infty}{C'_w-C'_\infty}\quad,\quad Sc=\frac{\nu}{D}\quad,$$

$$Gr=\frac{g\beta\nu(T'_w-T'_\infty)}{v_0^3}\quad,\quad Gm=\frac{g\beta^*\nu(C'_w-C'_\infty)}{v_0^3}\quad,$$

$$Q=\frac{\nu Q_0}{\rho C_p v_0^2}, Q_l=\frac{\nu Q'_l\left(C'_w-C'_\infty\right)}{\left(T'_w-T'_\infty\right)v_0^2}\quad n=\frac{\nu n'}{v_0^2}$$

$$M=\frac{\sigma B_0^2\nu}{\rho v_0^2}\ K=\frac{K'v_0^2}{\nu^2}, K_r=\frac{K'_r\nu}{v_0^2},,\ R=\frac{4\sigma^* T_\infty^3}{K_s}, \Pr=\frac{\nu\rho C_p}{k} \tag{6}$$

We have

$$\frac{\partial u}{\partial t}-\left[1+\varepsilon Ae^{nt}\right]\frac{\partial u}{\partial y}=\frac{dU_\infty}{dt}+Gr\theta+GmC+\frac{\partial^2 u}{\partial y^2}+N\left[U_\infty-u\right] \tag{7}$$

$$\frac{\partial\theta}{\partial t}-\left[1+\varepsilon Ae^{nt}\right]\frac{\partial\theta}{\partial y}=\frac{1}{\Pr}\left[1+\frac{4R}{3}\right]\frac{\partial^2\theta}{\partial y^2}-Q\theta+Q_lC \tag{8}$$

$$\frac{\partial C}{\partial t}-\left(1+\varepsilon Ae^{nt}\right)\frac{\partial C}{\partial y}=\frac{1}{Sc}\frac{\partial^2 C}{\partial y^2}-K_rC \tag{9}$$

The transformed conditions are:

$$\begin{aligned} &u=U_p,\ \theta=1+\varepsilon e^{nt},\ C=1+\varepsilon e^{nt} \quad \text{at} \quad y=0 \\ &u\to U_\infty=1+\varepsilon e^{nt},\ \theta\to 0,\ C\to 0 \ \text{as} \ y\to\infty \end{aligned} \tag{10}$$

Equations (7) – (9) can be solved using the following:

$$\begin{aligned} &u=u_0+\varepsilon e^{nt}u_1+\ldots\ldots\ldots\ldots \\ &\theta=\theta_0+\varepsilon e^{nt}\theta_1+\ldots\ldots\ldots\ldots \\ &C=C_0+\varepsilon e^{nt}C_1+\ldots\ldots\ldots\ldots \end{aligned} \tag{11}$$

The solutions of the problem is

$$\begin{aligned} &u=N_1+\varepsilon e^{nt}N_2, \\ &\theta=N_3+\varepsilon e^{nt}N_4, \\ &C=N_5+\varepsilon e^{nt}N_6 \end{aligned} \tag{12}$$

Attractive impact field on speed distributions in the limit layer portrayed on the impact of expanding the estimation of radiation parameter of speed indicated Fig.1. We can see increment in the lightness power quickens the stream rate. Fig. 2 shows the speed distributions for various estimations for R, obviously as R builds the pinnacle estimations of the speed will in general increment. Figure 3 show the impacts of Sc on speed profiles. As the Sc expands the speed documented reductions. This causes the speed lightness impacts to diminish acquiescent a decrease on liquid speed. The impact of expanding the estimation heat parameter diminish limit layer as appeared in Fig. 4. When warmth is ingested lightness power diminishes, impedes stream rate and are offering ascend - diminish in the speed distributions. Fig. 5 show speed distributions for various estimations of Pr. Arithmetical outcomes tells us, an impact of expanding estimations Pr diminishing speed. Figure 6 and 16 shows the speed and focus appropriation u adjacent to y for various Kr estimations. The speed and focus are decline with builds Kr. Speed begins from least an incentive at the surface and increment until which achieves pinnacle worth; afterward begins diminishing till which scopes to base an incentive toward the finish of the limit layer for every one of the estimations of attractive parameter in fig.7. An impact with attractive pasture is progressively conspicuous on purpose about pinnacle esteem for example the pinnacle esteem definitely diminishes with increments in the estimation of attractive field, in light of the fact that the nearness of attractive; leading liquid present a power is said to be the Lorentz power. Such kind, opposing power hinders the liquid speed as appeared in this figure. For the instance of various estimations of Gr, the speed distributions are appeared in Fig. 8. True to form, it is seen that an expansion in Gr prompts increment in the estimations of speed because of improvement in lightness power. Average speed distributions for different estimations about Gm, while every single other parameter are kept at some fixed qualities in fig. 9. The speed conveyance accomplishes a particular most extreme incentive on region and afterward decline appropriately too move towards the esteem. True to form, the liquid speed increments and the pinnacle esteem increasingly particular because of increment in the focus lightness impacts spoke to Gm. Fig. 10 shows speed distributions of various estimations porous ness K, unmistakably as it expands; pinnacle speed estimations will in general increment. The impact of assimilation of Q_1 of temperature distribution is appeared in Fig.11. An impact of assimilation radiation was expanding temperature on limit layer; transmitted warmth was consumed. A temperature distribution for various estimations of R tells in fig. 12. Obviously, R builds pinnacle estimations; temperature will in general increment. Temperature decline through increment here Q since when warmth is retained, the lightness power diminishes the temperature profiles from fig.13. Figures 14 represent the temperature distributions for various estimations of Pr. Clearly, temperature decline; an expanding Pr. Fig. 15 show the impacts of Sc on the fixation profiles separately. As the Sc expands the fixation diminishes.

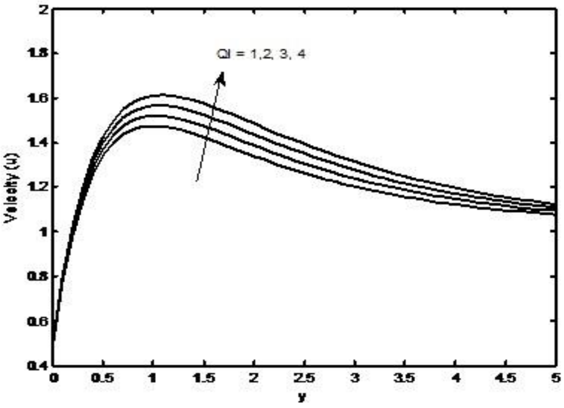

Fig. 1. Q_l ↔ u(y,t).

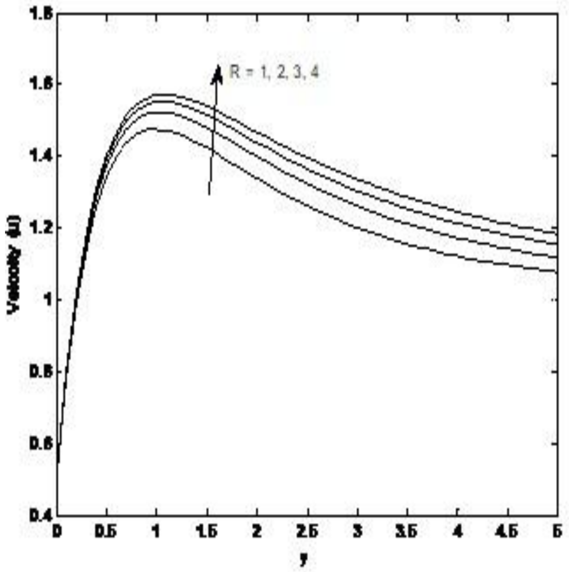

Fig. 2. R ↔ u(y,t).

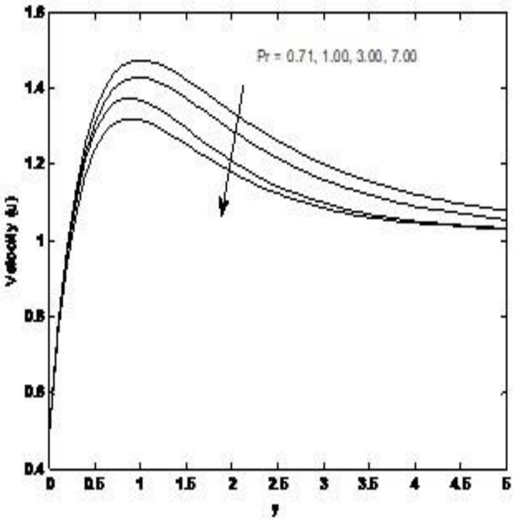

Fig. 5. Pr ↔ u(y,t).

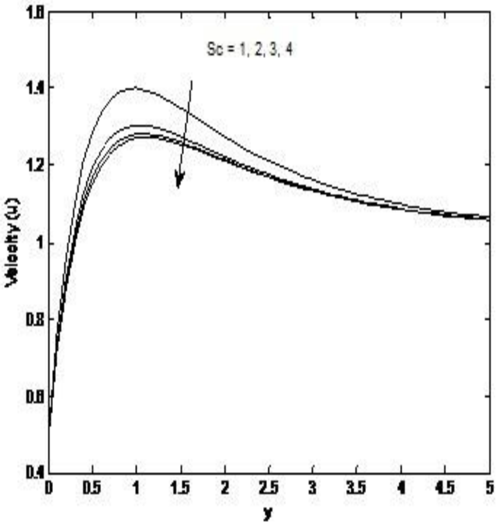

Fig. 3. Sc ↔ u(y,t).

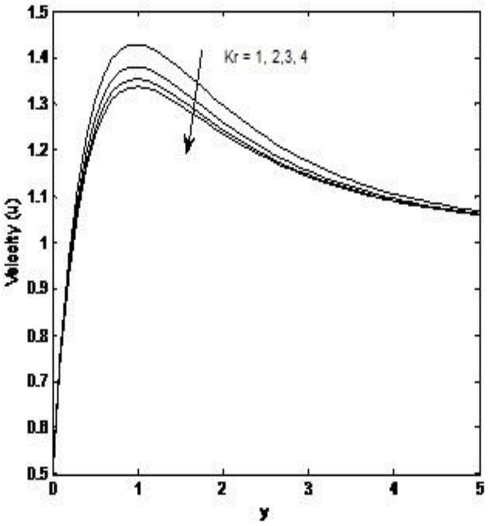

Fig. 6. Kr ↔ u(y,t).

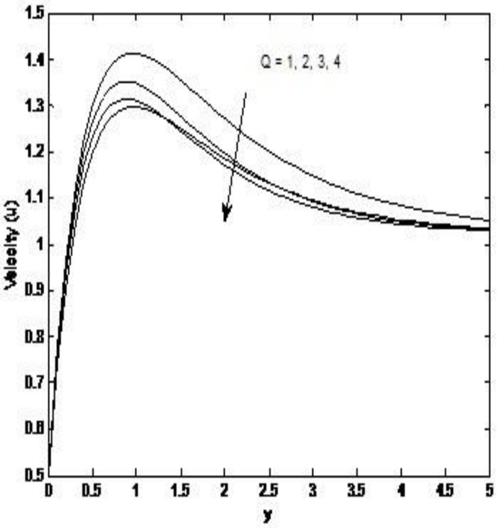

Fig. 4. Q ↔ u(y,t).

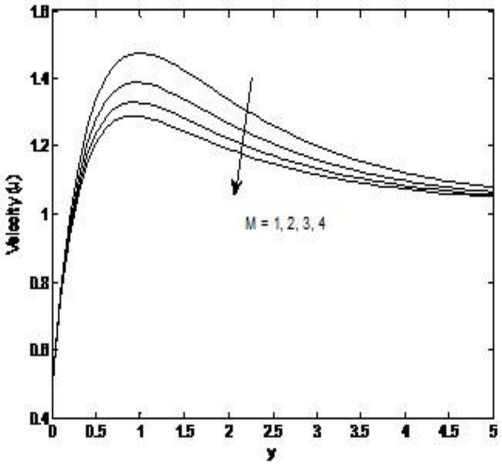

Fig. 7. M ↔ u(y,t).

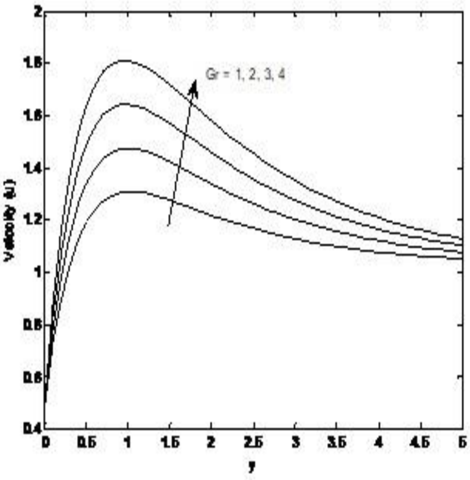

Fig. 8. Gr ↔ u(y,t).

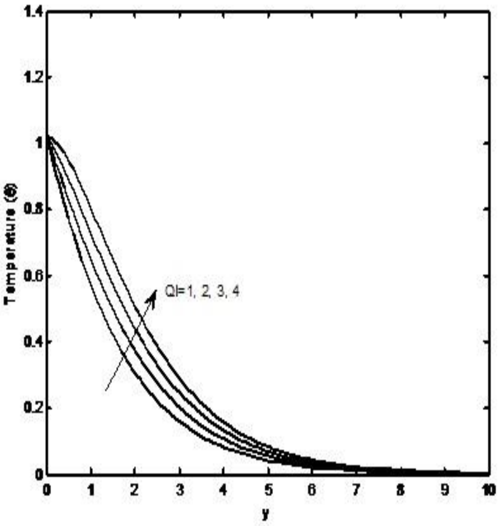

Fig. 11. Ql ↔ θ(y,t).

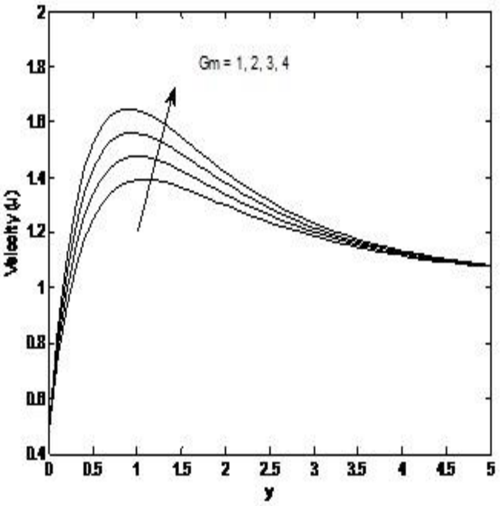

Fig. 9. Gm ↔ u(y,t).

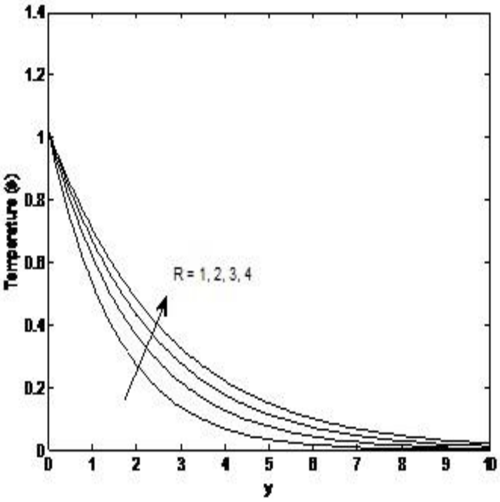

Fig. 12. R ↔ θ(y,t).

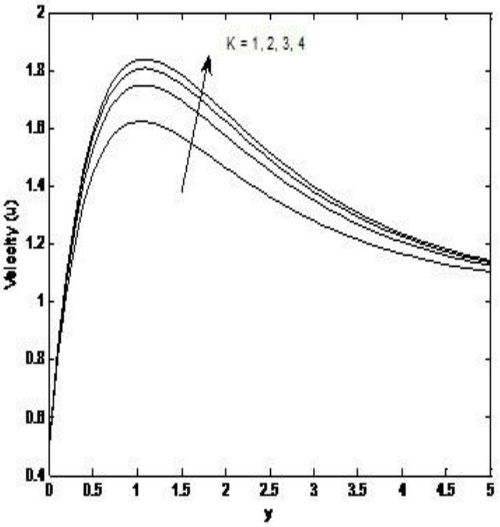

Fig. 10. K ↔ u(y,t).

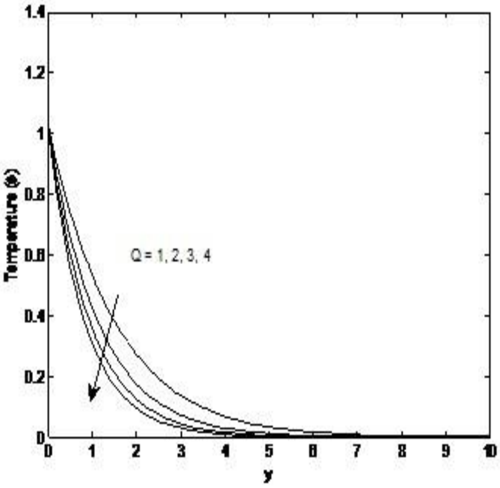

Fig. 13. Q ↔ θ(y,t).

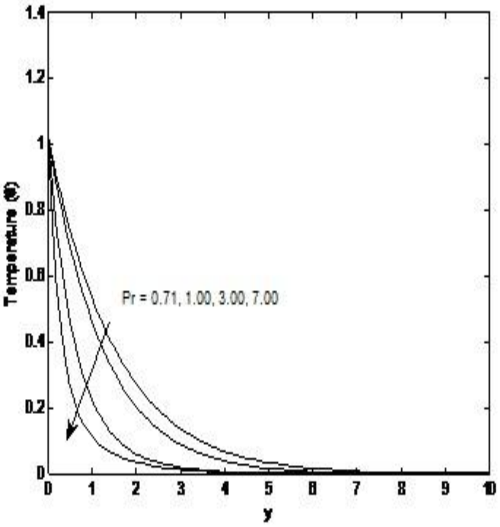

Fig. 14. Pr ↔ θ(y,t).

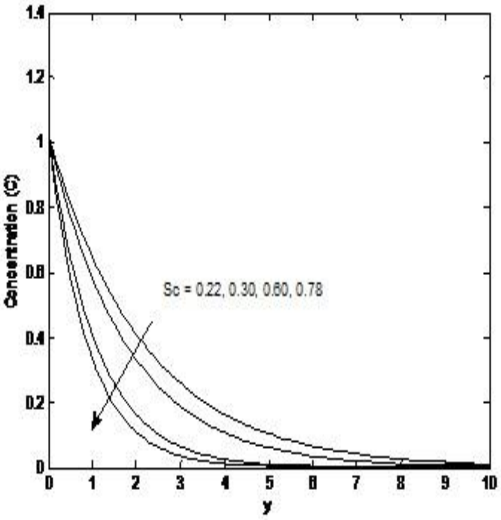

Fig. 15. Sc ↔ C(y,t).

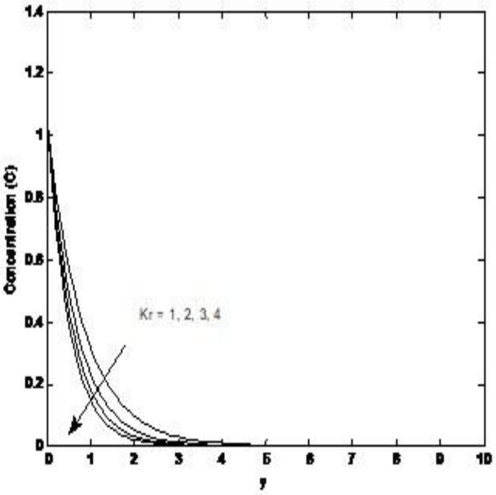

Fig. 16. Kr ↔ C(y,t).

III. CONCLUSIONS

From the present examination the accompanying ends can be drawn.

- Growing estimation, ingestion of the radiation because of increment on lightness power quickens rate for stream.
- The impact of ingestion, radiation was build temperature, as the emanated warmth was consumed.
- As R expands, pinnacle estimations of the speed will in general increment.
- As the Schmidt number expands the speed recorded declines.
- Temperature diminishes with increment on Q since warmth is retained, lightness power diminishes on temperature distributions.
- Impact of expanding estimations, Prandtl number outcome in diminishing speed.

REFERENCES

1. G. V. Ramana Reddy, N. Bhaskar Reddy, and A. J. Chamkha, "MHD mixed convection oscillatory flow over a vertical surface in a porous medium with chemical reaction and thermal radiation," *Journal of Applied Fluid Mechanics*, vol. 9, 2016, pp. 1221-1229.
2. G. Sreedevi, D. R. V. Prasada Rao, O. D. Makinde and G. Venkata Ramana Reddy, "Soret and dufour effects on MHD flow with heat and mass transfer past a permeable stretching sheet in presence of thermal radiation," *Indian Journal of Pure and Applied Physics*, vol. 55, 2017, pp. 551-563.
3. K. Jayarami Reddy, N. P. Madhusudhana Reddy, R. K. Konijeti and D. Abhishek, "Numerical investigation of chemical reaction and heat source on radiating MHD stagnation point flow of carreau nanofluid with suction/injection," *Defect and Diffusion Forum*, vol. 388, 2018, pp. 171-189.
4. R. C. Reddy, K. J. Reddy, and K. Ramakrishna, "Effects of joule heating on mhd free convective flow along a moving vertical plate in porous medium," *Special Topics and Reviews in Porous Media*, vol. 7, 2016, pp. 207-219.
5. S. Ramalingeswara Rao, C. N. B. Rao, and K. V. Chandra Sekhara, "Double diffusive magnetohydrodynamic free convection at a vertical plate," *International Journal of Chemical Sciences*, vol. 14, 2016, pp. 978-992.
6. P. Raja kumara, "A mathematical analysis of convective heat and mass transfer pour of a non -Newtonian fluid through porous medium in a rectangular duct with heat sources," *Journal of Advanced Research in Dynamical and Control Systems*, vol. 2017, 2017, pp. 84-91
7. G. V. R. Reddy and Y. H. Krishna, "Numerical solutions of unsteady MHD flow heat transfer over a stretching surface with suction or injection," *Fluid Dynamics and Materials Processing*, vol. 14, 2018, pp. 213-222.
8. M. Dhanalakshmi, K. J. Reddy and K. Ramakrishna, "Chemical reaction and soret effects on radiating MHD boundary layer flow over a moving vertical porous plate with heat source," *Journal of Advanced Research in Dynamical and Control Systems*, vol. 9, 2017, pp. 2155-2166.
9. G. Charan Kumar, K. Jayarami Reddy, K. Ramakrishna and M. Narendradh Reddy, "Non-uniform heat source/sink and joule heating effects on chemically radiative MHD mixed convective flow of micropolar fluid over a stretching sheet in porous medium," *Defect and Diffusion Forum*, vol. 388, 2018, pp. 281-302.
10. H. Talla, P. Kumari and W. Sridhar, "Numerical study to diffusion of chemically reactive species over MHD exponentially stretching surface of a casson fluid," *International Journal of Mechanical Engineering and Technology*, vol. 9, 2018, pp. 470-481.

11. .G. Dharmaiah, Ch. Baby Rani, N. Vedavathi and K. S. Balamurugan, “Heat and mass transfer on MHD fluid flow over a semi infinite flat plate with radiation absorption, heat source and diffusion thermo effect,” *Frontiers in Heat and Mass Transfer*, vol. 11, (2018).
12. G. Dharmaiah, N. Vedavathi, Ch. Baby Rani, and K. S. Balamurugan, “MHD boundary layer flow and heat transfer of a nanofluid past a radiative and impulsive vertical plate,” *Frontiers in Heat and Mass Transfer*, vol. 11, 2018.
13. N. Vedavathi, K. Ramakrishna, G. Dharmaiah and K. S. Balamurugan, “Analytical investigations of aligned and hall effects on unsteady free convection flow past an accelerated inclined plate,” *International Journal of Mechanical and Production Engineering Research and Development*, vol. 8, 2018, pp. 661-668.
14. M. Dhanalakshmi, K. Jayarami Reddy and K. Ramakrishna, “Chemical reaction and soret effects on MHD free convection flow past a vertical porous plate with heat generation,” *International Journal of ChemTech Research*, vol. 9, 2016, pp. 587-597.
15. G. V. Ramana Reddy, N. Bhaskar Reddy and R. S. R. Gorla, “Radiation and chemical reaction effects on MHD flow along a moving vertical porous plate,” *International Journal of Applied Mechanics and Engineering*, vol. 21, 2016. pp. 157-168.
16. G. Charankumar, G. Dharmaiah, K. S. Balamurugan and N. Vedavathi, “Chemical reaction and soret effects on casson mhd fluid flow over a vertical plate,” *International Journal of Chemical Sciences*, vol. 14, 2016, pp. 213-221.
17. N. Vedavathi, G. Dharmaiah, K. S. Balamurugan and G. Charan Kumar, “Chemical reaction, radiation and dufour effects on casson magneto hydro dynamics fluid flow over a vertical plate with heat source/sink,” *Global Journal of Pure and Applied Mathematics*, vol. 12, 2016, pp.191-200.

AUTHORS PROFILE

Dr.N.Vedavathi, working as Associate professor in the Department of Mathematics, Koneru Lakshmaiah Education Foundation Deemed to be University, Vaddeswaram, Guntur dist, A.P.,. She has 27 Publications in various National and International Journals. She did her Ph.D from Dravidian University, Kuppam, A.P, India. Her current area of research on Heat and Mass transfer of nano fluids.

Dr. K. S. Balamurugan is a Senior Associate Professor in the Department of Mathematics& Humanities, RVR & JC College of Engineering, Guntur, Andhra Pradesh, India. He has over 23 years of teaching experience at various levels and 15 years of research experience. His areas of research interest are Fluid Dynamics, Magneto Hydrodynamics, Heat and Mass transfer in fluid flows and Transport of Porous Media. He has presented 30 papers in national and international conferences. He has authored and co-authored over 60 papers in reputed national and international journals. Under his guidance 3 students awarded Ph.D. He also had given expert talks in national and international conferences.

Dr. G. Dharmaiah, working as Associate Professor in the Department of Mathematics at Narasaraopeta Engineering College(Autonomous), Narasaraopet, Guntur, A.P., India. He has over 17 years of teaching experience. He assisted in teaching under graduate and post graduate courses for the Department of Mathematics in various colleges. His areas of interest are Fluid Dynamics, Heat and Mass Transfer through porous medium, Chemical Reactions in fluid flows, MHD flows and Nano fluids. He attended and presented 10 papers at various seminars/ Conferences. He has authored and co-authored over 20 papers in archival journals.

Dr. Venkata Subrahmanyam Sajja is an Associate Professor of Mathematics in Koneru Lakshmaiah Education Foundation, Guntur, India. He obtained his Ph. D. degree in Fluid Dynamics in 2016 from Dravidian University, Kuppam, Andhra Pradesh, India. He has a good number of research publications in various National and International Journals. His research interest is Fluid Dynamics.

Dr. M. Sreenivasa Kumar, *Principal, Narasaraopeta Engineering College (Autonomous), Narasaraopet*, earned his bachelor’s degree in Mechanical Engineering from S.V.Univeristy, in 1987 and Master’s Degree in Design of Machines and Mechanisms from Regional Engineering College, Nagpur (now Viswesvaraya National Institute of Technology- **VNIT**) in 1997. He has obtained his Ph.D. from University of the West of England **(UWE),** Bristol, UK, in the field of Machine Vision. He has vast experience of over 29 years in Teaching, Training, Research and Consultancy and has been Principal of reputed institutions in A.P. His areas of interest include Computer vision, Image processing, CAD/CAM, Neural networks, Digital manufacturing, Lean manufacturing system, and Intelligent systems robotics and Artificial intelligence. He has published and presented over 17 Technical papers in National and International Journals / Conferences. The number of corporate training programmes / Faculty Development Programmes / Technical talks conducted by him is more than 50. He has guided more than 30 Under-Graduate and Post-Graduate students for their projects.