Bibliography

[1] Oldroyd , J.G., Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences, 200, 523-541 (1950). http://dx.doi.org/10.1098/rspa.1950.0035.

[2] Oldroyd , J.G., Proceedings of the Royal Society of London A, 245, 278-297(1958).https://doi.org/10.1098/rspa.1958.0083.

[3] Walters, K., The motion of an elastico-viscous liquid contained between co-axial cylinders, Q. J. Mech. Appl. Math. 13 444-456 (1960).

[4] Walters, K., The solutions of flow problems in the case of materials with memories, J. Mecanique. 1 473-478 (1962).

[5] Soundalgekar, V.M., Free Convection Efffects on Steady MHD flow past a vertical porous plate, Journal of Fluid Mechanics, 66(3), 541-551 (1974). https://doi.org/10.1017/S0022112074000358.

[6] Johri, A.K., and Sharma, J.S., Free Convection Laminar Flow of an Incompressible Viscoelastic Fluid, Proceeding of the Indian National Science Academy., A(4), 326-333, (1980).

[7] Jha, K.B., Free-convective flow of non-Newtonian fluid with heat sources, Astrophysics and Space Science, 175(2), 225-228 (1991). https://doi.org/10.1007/BF00644284.

[8] Nanousis, N., Unsteady magnetohydrodynamic flows in a rotating elasto-viscous fluid, Astrophysics and Space Science, 199(2), 317-321, (1993). DOI:10.1007/BF00613205.

[9] Ariel, P.D., Flow of Viscoelastic fluids through a prous channel-I, International Journal for Numerical Methods in Fluids, 17(7), 605-633 (1993). https://doi.org/10.1002/fld.1650170705.

[10] Kim, E., Natural convection along a wavy vertical plate to non-Newtonian fluids, International Journal of Heat and Mass Transfer, 40(13), 3069-3078 (1997).

[11] Andrienko Y.A., Siginer, D.A. and Yanovsky, Y.G., Resonance behaviour of voscoelastic fluids in poiseulle flow and application to flow enhancement, International Journal of Non-linear Mechanics, 35 (1), 95-102 (2000).

[12] Helmy, K.A., Idriss, H.F. and Kaseem, S.A., An integral method for the solution of the boundary layer equation for power-law MHD fluid, Indian Journal of Pure and Applied Mathematics, 32(6), 859-870, (2001).

[13] Sajid, M., Pop, I. and Hayat, T., Fully developed mixed convection flow of a viscoelastic fluid between permeable vertical plates, Computers & Mathematics with Applications, 59(1), 493-498, (2010).

[14] Eldabe N.T.M., Moatimid G.M., Ali H.S., Magnetohydrodynamic flow of non-Newtonian visco-elastic fluid through a porous medium near an accelerated plate, Canadian Journal of Physics, 81(11), 1249–1269, (2003).

[15] Groşan, T., Postelnicu, A., and Pop, I., Free Convection Boundary Layer over a Vertical Cone in a Non-Newtonian Fluid Saturated Porous Medium with Internal Heat Generation, Technische Mechanik, Band 24, Heft, 491-104, (2004).

[16] Liu, I.C., Unsteady unidirectional MHD flows of a non-Newtonian fluid saturated in a porous medium, Journal of the Chinese Institute of Engineers, 28:4, 569-578, (2005), DOI: 10.1080/02533839.2005.9671026

[17] Chaudhary, R.C. and Jain, P., Hall effect on MHD mixed convection flow of a viscoelastic fluid past an infinite vertical porous plate with mass transfer and radiation, Theoretical Applied Mechanics., Belgrade,Vol.33, No.4, pp. 281–309, (2006).

[18] Veena, P.H., Pravin, V.K., Shahjahan, S.M., Non-Similar solutions for Heat and mass Transfer Flow in an Electrically Conducting Visco-Elastic Fluid Over a stretching Sheet Embedded in a Porous Medium, International Journal of Modern Mathematics, 2 (1), pp. 9-26, (2007).

[19] Reza, M. and Gupta, A.S, Momentum and heat transfer in the flow of a viscoelastic fuid past a porous flat plate subject to suction or blowing, World Academy of Science, Engineering and Technilogy, 47, pp. 380-383 (2008).

[20] Prakash, O., Kumar, D. and Dwivedi, Y.K., Effects of Thermal Diffusion and Chemical Reaction on MHD Flow of Dusty Visco-Elastic (Walter's Liquid Model-B) Fluid, Journal of Electromagnetic Analysis and Applications, 2(10), Paper ID 2976,581-587 (2010). doi: 10.4236/jemaa.2010.210075.

[21] Chang, Tong-Bou., Mehmood, Ahmer., Bég, O., Anwar.,et al., Numerical study of transient free convective mass transfer in a Walters-B viscoelastic flow with

wall suction, Communications in Nonlinear Science and Numerical Simulation, 16 (1), 216-225 (2011). https://doi.org/10.1016/j.cnsns.2010.02.018.

[22] Reddy M.J., Reddy, J. and Sivaiah, G., Mass transfer effects on MHD unsteady free convective Walter's memory flow with constant suction and heat sink through porous media, Advances in Applied Science Research, 3 (2):1137-1143 (2012).

[23] Choudhury, R., and Das, U., Heat Transfer to MHD Oscillatory Viscoelastic.Flow in a Channel Filled with Porous Medium, Physics Research International, 879537, (2012). https://doi.org/10.1155/2012/879537.

[24] Choudhury, R., and Das, B., Three dimensional visco-elatic flow with heat and mass transfer past a vertical pprous plate in presence of variable suction,WSEAS transaction on Mathematics,13, 714-725, (2014).

[25] Choudhury, R., and Das, B., Influence of visco-elasticity on MHD heat and mass transfer flow through a porous medium bounded by an inclined surface with chemical reaction, International Journal of Heat and Technology, 34 (2), 332-338, (2016).

[26] Choudhury, R., and Dey, D., Unsteady Thermal Radition Effects on MHD Convective Slip Flow of Visco-Elastic Fluid Past a porous Plate Embedded in Porous Medium, International Journal Of Applied Mathematics & Statistics., 57(2), 215-226, (2018). https://doi.org/10.1016/j.aej.2017.01.039.

[27] Dey, D.,Viscoelastic fluid flow through an annulus with relaxation, retardation effects and external heat source/sink, Alexandria Engineering Journal, Volume 57, Issue 2, Pages 995-1001, (2018), https://doi.org/10.1016/j.aej.2017.01.039.

[28] Chen, Xuehui., Weidong, Yang., Zhang, Xinru., et.al., Unsteady boundary layer flow of viscoelastic MHD fluid with a double fractional Maxwell model. Applied Mathematics Letters. 95. 143-149, (2019). https://doi.org/10.1016/j.aml.2019.03.036.

[29] Khan, S.A., Nie, Y.,and Ali, B., Multiple slip effects on MHD unsteady viscoelastic nano-fluid flow over a permeable stretching sheet with radiation using the finite element method, SN Applied Sciences, **2**, 66 (2020). https://doi.org/10.1007/s42452-019-1831-3

[30] Victor C., Ibezim, Robert J., Poole, David J.C. Dennis, Viscoelastic fluid flow in microporous media, Journal of Non-Newtonian Fluid Mechanics, Volume 296, 104638, ISSN 0377-0257, (2021). https://doi.org/10.1016/j.jnnfm.2021.104638.

[31] Raisinghania, M.D., *Fluid Dynamics With Complete Hydrodynamics and Boundary Layer Theory*, Revised Ed, S.Chand, 2017.

[32] Schlichting, H., *Boundary Layer Theory*, Seventh Ed, McGraw Hill Education (India), 2018.

[33] Kundu, P.K., Cohen, I.M., and Dowling, D.R., *Fluid Mechanics*, Sixth Ed, Elsevier, 2016.

[34] Chhabra, R.P., *Non-Newtonian Fluids: An Introduction*, *Rheology of Complex Fluids*. Springer, New York, NY. https://doi.org/10.1007/978-1-4419-6494-6_1, 2010.

[35] Chhabra, R.P., and Richardson, J.F., *Non-Newtonian Flow and Applied Rheology*, Second Ed, Butterworth- Heinemann, https://doi.org/10.1016/B978-0-7506-8532-0.X0001-7, 2008.

[36] Blasius, H. Grenzschichten in Fliissigkeiten mit kleiner Reibung. Z. Math. U. Phys., 56, 1-37, (1908).

[37] Pohlhausen, E. Oer Warmeaustausch zwischen festen Korpem und Fliissigkeiten mit kleiner Reibung und kleiner Warmeleitung. Z. Angew. Math. Mech., 1,151-121, (1921).

[38] Kusukawa, K.I.,Suwa, S., Nakagawa, T.R.M., An Iteration Method to Solve the Boundary Layer Flow past a Flat Plate, Journal of Applied Mathematics and Physics, 2 (4), 35-40, (2014).

[39] Cheng, P., and Minkowycz, W.J., Free convection about a vertical flat plate embedded in a porous medium with application to heat transfer from a disk, Journal of Geophysical Research., 88, 2040-2044, (1977).

[40] Rabadi, N.J., and Hamdan, E.M., Free convection from inclined permeable walls embedded in variable permeability porous media with lateral mass flux, Journal of Petroleum Science and Engineering, 26 (1), 241-251, (2000).DOI:10.1016/S0920-4105(00)00038-3.

[41] Mukhopadhyay, S., and Layek, G.C., Radiation effect on forced convective flow and heat transfer over a porous plate in a porous medium, Meccanica, 44, 587-597 (2009).

[42] Ishak, A., Similarity solutions for flow and heat transfer over a permeable surface with convective boundary conditions, Applied Mathematics and Computation, 217, 837-846, (2010).

[43] Bhattacharyya, K., Layek, G.C., and Reddy, R. S., Slip Effect on Boundary Layer Flow on a Moving Flat Plate in a Parallel Free Stream, International Journal of Fluid Mechanics Research, 39, 438-447, (2012).

[44] Bhattacharyya, K., and Layek, G. C., MHD slip flow and diffusion of reactive solute past a permeable flat plate with suction/ injection, Frontiers of Chemical Science and Engineering, 5(4), 471–476, (2011).

[45] Abbas, Z., Wang, Y., Hayat, T., et. al., Slip effects and heat transfer analysis in a viscous fluid over an oscillatory stretching surface, International Journal of Numerical Methods for Heat and Fluid Flow, 59, 443–458, (2009).

[46] Khan, W.A., Khan, Z.H.,and Rahi, M., Fluid flow and heat transfer of carbon nanotubes along a flat plate with navier slip boundary, Applied Nanoscience, 4, 633–641, (2014).

[47] Ambreen, A.K., Hafsa, U., Vafai, K., et.al., Study of peristaltic flow of magnetohydrodynamics Walter's B fluid with slip and heat transfer, International. Journal of Science and Technology, 23, 2650-2662, (2016).

[48] Sarojamma, G., Sreelakshmi, K., and Vajravelu, K., Effects of dual stratification on non-orthogonal non-Newtonian fluid flow and heat transfer, International Journal of Heat and Technology, 36(1), 207-214, (2018). https://doi.org/10.18280/ijht.360.

[49] Izadi, M., Mehryan, S.A.M., Chamkha, A.J., et.al., The impacts of heat generation/absortion and partial slip on boundary layer flow and heat transfer of a nonofluid comprising of self-impelled motile microorganisms passing a stretching sheet. Mathematical Modelling of Engineerin,g Problems, 6(1), 10-20, (2019). https://doi.org/10.18280/mmep.060102.

[50] Howarth, L., On the solution of the laminar boundary layer equations, Proceedings of the Royal Society of London, 164, 547–579, (1938).

[51] Bhattacharyya, K., and Layek, G. C., MHD Boundary Layer Flow of Dilatent Fluid in a Divergent channel with Suction or Blowling, Chinise Physics Letters,28, Article ID: 084705, (2011). http://dx.doi.org/10.1088/0256-307X/28/8/084705.

[52] Crane L. J., Flow past a stretching plate. Journal of Applied Mathematics and Physics., 21, pp.645–647, (1970).

[53] Gupta, P.S., Gupta, A.S., Heat and mass transfer on a stretching sheet with suction or blowing, The Canadian Journal of Chemical Engineering, 55 (6), 744–746, (1977).

[54] Magyari, E., and Keller, B., Heat and mass transfer in the boundary layers on an exponentially stretching continuous surface, Journal of Physics D: Applied Physics, 32,577–85, (1999).

[55] Elbashbeshy, E.M.A., Heat transfer over an exponentially stretching continuous surface with suction, Archives of Mechanics, 53,643–51, (2001).

[56] Bidin, B., and Nazar, R., Numerical solution of the boundary layer flow over an exponentially stretching sheet with thermal radiation, European Journal of Scientific Research, 33(4),710–717, (2009).

[57] El-Aziz, M.A., Viscous dissipation effect on mixed convection flow of a micropolar fluid over an exponentially stretching sheet, Canadian Journal of Physics, 87, 359–368, (2009).

[58] Ishak, A., MHD boundary layer flow due to an exponentially stretching sheet with radiation effect. Sains Malaysiana, 40, 391–3955, (2011).

[59] Ariel, P.D., Hayat, T., and Asghar, S., The flow of an elastico-viscous fluid past a stretching sheet with partial slip, Acta Mechanica, 187, 29–35, (2006).

[60] Abbas, Z., Wang, Y., Hayat T., and Oberlack M., Slip effects and heat transfer analysis in a viscous fluid over an oscillatory stretching surface, International Journal for Numerical Methods in Fluids, 59, 443–458, (2009).

[61] Mukhopadhyay, S., Slip effects on MHD boundary layer flow over an exponentially stretching sheet with suction/blowing and thermal radiation. Ain Shams Engineering Journal, 4, 485–491, (2013).

[62] Nagalakshmi, C., Nagendramma, V., and Leelaratnam, A., MHD Visco-Elastic Fluid Flow over a Stretching Sheet with Suction/Injection, International Journal of Research in Science & Engineering, 97-107, (2017).

[63] Krishnamurthy, M.R., Prasannakumara, B.C., Gireesha, B.J., *et.al*., Effect of viscous dissipation on hydromagnetic fluid flow and heat transfer of nanofluid over an exponentially stretching sheet with fluid-particle suspension, Cogent Mathematics, 2, 1050973, (2015).
https://doi.org/10.1080/23311835.2015.1050973.

[64] Mahantesh, M., Nandeppanavar, M., Kemparaju, C., and Shakunthala, S., MHD stagnation point slip flow due to a non-linearly moving surface with effect of non-uniform heat source, Nonlinear Engineering, 8, 270–282, (2019).

[65] Blasius, H., Grenzschichten in Fl¨ussigkeiten mit kleiner Reibung, Zeitschrift f¨ur Mathematik und Physik 56, 1–37, (1908).

[66] Abu-Sitta, A.M.M., A note on a certain boundary-layer equation, Applied Mathematics and Computation, 64 (1) , 73–77, (1994).

[67] Wang L., A new algorithm for solving classical Blasius equation, Applied Mathematics and Computation 157(1), (2004) 1–9, (2004).

[68] Bhattacharyya, K., Mukhopadhyay, S., and Layek, G. C, MHD boundary layer slip flow and heat transfer over a flat plate, Chinese Physics Letters, 28 (2), Article ID:024701, (2011).

[69] Hayat, T., Anwar, M.S., Farooq, M., et.al., Mixed Convection Flow of Viscoelastic Fluid by a Stretching Cylinder with Heat Transfer, PLOS ONE, 10 (3), (2015).

[70] Rashidi, M., Ali, M., Freidoonimehr, N., et.al., Mixed Convective Heat Transfer for MHD Viscoelastic Fluid Flow over a Porous Wedge with Thermal Radiation, Advances in Mechanical Engineering, Article ID 735939, (2014). https://dx.doi.org/10.1155/2014/73593.

[71] Chambr´e, P.L., and Young, J.D., On the diffusion of a chemically reactive species in a laminar boundary layer flow, Physics of Fluids, 1(1), 48–54, (1958).

[72] Ishak, A., Nazar, R., andPop, I., Boundary layer on a moving wall with suction and injection, Chinese Physics Letters, 24 (8), 2274-2276, (2007).

[73] Chamkha, A. J., Aly, A.M., and Mansour, M.A., Similarity solution for unsteady heat and mass transfer from a stretching surface embedded in a porous medium with suction/injection and chemical reaction effects, Chemical Engineering Communications, 197 (6), 846–858, (2010).

[74] El-Aziz, M.A., Unsteady fluid and heat flow induced by a stretching sheet with mass transfer and chemical reaction, Chemical Engineering Communications, 197 (10), 1261–1272, (2010).

[75] Bhattacharyya, K., and Layek, G.C., Chemically reactive solute distribution in MHD boundary layer flow over a permeable stretching sheet with suction or blowing, Chemical Engineering Communications, 197 (12), 1527–1540, (2010).

[76] Ibrahim, S.Y., and Makinde, O.D., Radiation effect on chemically reacting magnetohydrodynamics (MHD) boundary layer flow of heat and mass transfer through a porous vertical flat plate, International Journal of Physical Sciences, 6 (6), 1508–1516, (2011).

[77] Bhattacharyya, K., and Uddin, Md. S., Reactive Solute Diffusion in Boundary Layer Flow through a Porous Medium over a Permeable Flat Plate with Power-Law Variation in Surface Concentration, Journal of Engineering, Article ID 840596, (2013). http://dx.doi.org/10.1155/2013/840596.

[78] Eldabe, N.T.M., Sedki, A.M., and Youssef, I.K., Numerical Solutions for Boundary Layer Fluid Flow with Mass Transfer over a Moving Permeable Flat Plate Embedded in Porous Medium with Variable Wall Concentration in Presence of Chemical Reaction, American Journal of Computational and Applied Mathematics, p-ISSN: 2165-8935 e-ISSN: 2165-8943, 4(4), 141-153, (2014). doi: 10.5923/j.ajcam.20140404.04.

[79] Banerjee, A., Mahato, S.K., and Bhattacharyya, K., Mass diffusion with chemical reaction in boundary layer flow due to an exponentially expanding sheet with variable wall concentration, Acta Technica, 63 (2), 157–168, (2018).

[80] Nayak, M.K., Dash, G.C., Singh, L.P., Heat and mass transfer effects on MHD viscoelastic fluid over a stretching sheet through porous medium in presence of chemical reaction, Propulsion and Power Research, 5(1), 70–80, (2016).

[81] Singh, K., and Kumar, M., Influence of Chemical Reaction on Heat and Mass Transfer Flow of a Micropolar Fluid over a Permeable Channel with Radiation and Heat Generation, Journal of Thermodynamics, Article ID 8307980, 1-10, (2016). http://dx.doi.org/10.1155/2016/8307980.

[82] Mjankwi, M.A., Masanja, V.G., Mureithi, E.W., et.al., Unsteady MHD Flow of Nanofluid with Variable Properties over a Stretching Sheet in the Presence of Thermal Radiation and Chemical Reaction, International Journal of Mathematics and Mathematical Sciences, 2, Article ID 7392459, 1-14, (2019) https://doi.org/10.1155/2019/7392459

[83] Misra, S., and Govardhan, K., Influence of Chemical Reaction on the Heat and Mass Transfer of Nanofluid Flow over a Nonlinear Stretching Sheet, A Numerical Study. International Journal of Applied Mechanics and Engineering, 25(2), 103-121, (2020). DOI: 10.2478/ijame-2020-0023.

[84] Jabeen, K., Mushtaq, M., and Akram Muntazir, R.M., Analysis of MHD Fluids around a Linearly Stretching Sheet in Porous Media with Thermophoresis, Radiation, and Chemical Reaction, Mathematical Problems in Engineering, Article ID 9685482, 1-14. (2020) https://doi.org/10.1155/2020/9685482

[85] Jeffery, G.B., The Two-dimensional steady motion of a viscous fluid, The London, Edinburg, and Dublin Philosophical Magazine and journal of science, 29 (172), 455-465, (1915).

[86] Srivastava, A.C., The effects of magnetic field on the flow between two non-parallel planes, Proceeding of Fifth Congress Theoretical and Applied. Mechanics., 79-84, (1959).

[87] Millsaps, K., and Pohlhausen, K., Thermal distribution in Jeffery-Hamel flow between non-parallel plane walls, Journal of Aeronitical Science, 20, 187-196, (1953).

[88] Rosenhead (Ed), L., Laminar boundary layers, Oxford,Journal of Fluid Mechanics,18(3),pp.447-480,(1963).
https://doi.org/10.1017/S0022112064210350.

[89] Terril, R.M., Slow laminar flow in a converging or diverging channel with suction at one wall and blowing at the other wall, Z. Angew. Math. Phys., 16, 306-308, (1965).

[90] Falkner, V.M. and Skan, S. W., Some approximate solution in boundary layer, Philosophical Magazine, 12, 865, (1931).

[91] Phukan, D.K., Hydromagnetic divergent channel flow of a Newtonian electrically conducting fluid, The Bulletin, GUMA, 4, 43-50, (1998).

[92] Mahapatra, T.R., Dholey, S., and Gupta, A.S., Magnetohydrodynomic laminar flow of a viscous fluid in a converging or diverging channel with suction at one wall and equal blowing at the other wall, The Bulletin, GUMA, 11, pp. 1-20, (2010).

[93] Sanyal, D., Kalita, C., and Adhikari, A., Two dimensional laminar MHD boundary layer flow past a wedge with slip velocity., The Journal of Indian Academy of Mathematics, 28 (2), 361-372, (2006).

[94] Alam, M.S., and Khan, M.A.H., Critical behaviour of the MHD flow in convergent-divergent channels, Journal of Naval Architecture and Marine Engineering, 7(2), 83 – 93, (2010).

[95] Choudhury, R., and Dey, D., Hydromagnetic convergent channel flow of a visco-elastic electrically conducting fluid with slip velocity, International Journal of Mathematical Science. & Engineering Applications., 5 (II), 193-202, (2011).

[96] Hosseini, R., Poozesh, S., and Dinarvand, S., MHD Flow of an Incompressible Viscous Fluid through Convergent or Divergent Channels in Presence of a High Magnetic Field, Journal of Applied Mathematics, Volume 1, Article ID 157067, 1-3, (2012). DOI:10.1155/2012/157067.

[97] Alam, M.S., and Khan, M.A.H., MHD effects on mixed convection flow through a diverging channel with circular obstacle, Procedia Engineering 90, 403 – 410, (2014).

[98] He, J.H., An elementary introduction to the homotopy perturbation method, Computers & Mathematics with Applications, Volume 57, Issue 3, pp. 410-412, (2009).

[99] He, J.H., Approximate analytical solution for seepage flow with fractional derivatives in porous media, Computer Method in Applied Mechanics and Enginering , 167 (1-2), 57-68, (1998). https://doi.org/10.1016/S0045-7825(98)00108-X.

[100] He, J.H., A review on some new recently developed nonlinear analytical techniques, International Journal of Non-linear Sciences and Numerical Simulation, 1, pp.51-70, (2000).

[101] Ariel, P.D., Hayat, T., and Asghar, S., Homotopy perturbation method and axisymmetric Flow over a stretching sheet, International Journal of Non-linear Sciences and Numerical Simulation, 7(4), pp. 399-406, (2006).

[102] Belendez, A., Belendez, T., Márquez, A.,et.al., Application of He's homotopy perturbation method to conservative truly nonlinear oscillators, Chaos, Solitons & Fractals, 37(3), pp. 770-780, (2008).

[103] Ganji, D.D., and Rajabi, A., Assessment of homotopy-perturbation and perturbation methods in heat radiation equations, International Communication in Heat and Mass Transfer, 33, pp. 391-400, (2006).

[104] Siddiqui, A.M., Zeb, A., Ghori, Q.K., et.al., Homotopy perturbation method for heat transfer flow of a third-grade fluid between parallel plates, Chaos, Solutions & Fractals, 36(1), pp. 182-192, (2008).

[105] He, J.H., Homotopy perturbation method for bifurcation on nonlinear problems, International Journal of Non-linear Sciences and Numerical Simulation, 6, pp. 207-208, (2005).

[106] Schlichting, H., Boundary layer theory (6^{th} edition), McGraw-Hill, New York, (1968).

[107] Chiam, T.C., Hydromagnetic flow over a surface stretching with a power-law velocity, International Journal of Engineering Science, 33, 429-435, (1995).

[108] Sakiadis, B. C., Boundary-layer behavior on continuous solid surfaces. Journal AICHE, 7, 26–28, (1961).

[109] Erickson, L. E., Fan, L. T., and Fox, V. G., Heat and mass transfer on a moving continuous flat plate with suction or injection. Industrial & Engineering Chemistry, 5, 19–25, (1966).

[110] Tsou, F., Sparrow, E. and Goldstein, R.: Flow and heat transfer in the boundary layer on a continuous moving surface. International Journal of Heat and Mass Transfer. 10, 219–235 (1967).

[111] Rashidi, M.M., Kavyani, N. and Shirley, A., Double diffusive magneto-hydrodynamic (MHD) mixed convective slip flow along a radiating moving vertical flat plate with convective boundary condition. PLOS ONE.,9 (10), (2014).

[112] Bhatti, M. M., Rashidi, M.M., and Pop, I., Entropy generation with nonlinear heat and mass transfer on MHD boundary layer over a moving surface using SLM, Nonlinear Engineering, 6(1), 43–52 (2017).DOI:10.1515/nleng-2016-0021.

[113] Martin, M.J., and Boyd, I.D., Momentum and heat transfer in laminar boundary layer with slip flow. Journal of Thermophysics and Heat Transfer, 52, 710–719, (2006).

[114] Pal, D., and Shivakumara, I. S., Mixed convection heat transfer from a vertical heated plate embedded in a sparsely packed porous medium. International Journal of Applied Mechanics and Engineering, 11, 929–939, (2008).

[115] Bhattacharyya, K., Layek, G.C., and Reddy, R.S., Slip Effect on Boundary Layer Flow on a Moving Flat Plate in a Parallel Free Stream, International Journal of Fluid Mechanics Research, 39, 438-447, (2012).

[116] Sparrow, E. M., and Cess, R.D., The effect of a magnetic field on free convection heat transfer. International Journal of Heat and Mass Transfer., 3(4), 267–274, (1961)

[117] Gupta, A.S., Laminar free convection flow of an electrically conducting fluid from a vertical plate with uniform surface heat flux and variable wall temperature in the presence of a magnetic field, Z Angew Math Phys ZAMP., 13(4), 324–333, (1962)

[118] Andersson, H. I., Slip flow past a stretching surface, Acta Mechanica, 158(1), 121–125, (2002).https://dx.doi.org/10.1007/BF01463174.

[119] Wang, C.Y., Flow due to a stretching boundary with partial slip: an exact solution of the Navier–Stokes equations, Chemical Engineering Science, 57, 3745–3747, (2002).

[120] Riley, N., Magnetohydrodynamic free convection, Journal of Fluid Mechanics, 18, 577–586 (1964).

[121] Watanabe, T., and Pop, I., Hall effects on magnetohydrodynamic boundary layer flow over a continuous moving flat plate, Acta Mech. 108, 35–47 ,(1995).

[122] Mahapatra, T. R., and Gupta, A. S., Heat Transfer in Stagnation-Point Flow towards a Stretching Sheet, Journal of Heat Mass Transfer, Vol. 38, No. 6, pp. 517-521, (2002). doi:10.1007/s002310100215.

[123] Nazar, R., Norsarahaida, A., and Pop, I., Unsteady boundary layer flow in the region of the stagnation point on a stretching sheet, International Journal of Engineering Science, 42(11-12), 1241-1253, (2004). DOI:10.1016/j.ijengsci.2003.12.002.

[124] Hayat, T., Javed, T., and Abbas, Z., MHD flow of a micropolar fluid near a stagnation-point towards a non-linear stretching surface, Nonlinear Analysis: Real World Applications, 10 (3), 1514-1526, (2009). https://doi.org/10.1016/j.nonrwa.2008.01.019.

[125] Mukhopadhyay, S., Effects of Slip on Unsteady Mixed Convective Flow and Heat Transfer Past a Stretching Surface, Chinese Physics Letters, 27(12), (2010). DOI:10.1088/0256-307X/27/12/124401.

[126] Ishak, A., Nazar, R. and Pop, I., Heat Transfer Over an Unsteady Stretching Surface With Prescribed Heat Flux. Canadian Journal of Physics, 86 (6), 853-855, (2008). https://doi.org/10.1139/p08-005.

[127] Bhattacharyya, K., Mukhopadhyay, S., and Layek, G.C., Slip effects on boundary layer stagnation-point flow and heat transfer towards a shrinking sheet. International Journal of Heat and Mass Transfer, 54 (1-3),308-313,(2011). https://doi.org/10.1016/j.ijheatmasstransfer.2010.09.041.

[128] Bhattacharyya, K., Boundary layer stagnation-point flow of Casson fluid and heat transfer towards a shrinking/stretching sheet, Frontiers in Heat and Mass Transfer, 4 (2), (2013). DOI:10.5098/hmt.v4.2.3003.

[129] Aurangzaib M. K., Bhattacharyya, K., and Shafie, S., Multiple Solutions of an Unsteady Stagnation-Point Flow with Melting Heat Transfer in a Darcy–Brinkman Porous Medium, Nonlinear Engineering, 5 (2), 99-106, (2016). DOI:10.1515/nleng-2015-0034.

[130] Seth, G.S., Singha, A.K., Mandal, M.S.,et.al., MHD stagnation-point flow and heat transfer past a non-isothermal shrinking/stretching sheet in porous medium with heat sink or source effect, International Journal of Mechanical Sciences, 134, 98-111, (2017). https://doi.org/ 10.1016/j.ijmecsci.2017.09.049.

[131] Dzulkifli, N.F., Bachok, N., Yacob, N.A.., et.al. Unsteady Stagnation-Point Flow and Heat Transfer Over a Permeable Exponential Stretching/Shrinking Sheet in Nanofluid with Slip Velocity Effect: A Stability Analysis, Journal of Applied Sciences, 8 (11), (2018). https://doi.org/10.3390/app8112172.

[132] Rosali, H., Badlilshah, M.N., Johari, Mohamat A.M., et.al., Unsteady Boundary Layer Stagnation Point Flow and Heat Transfer over a Stretching Sheet in a Porous Medium with Slip Effects. CFD Letters, 12 (10), 52-61, (2020). DOI:10.37934/cfdl.12.10.5261.

[133] Layek, G.C., Mandal, B., Bhattacharyya, K., *et al*., Lie Symmetry Analysis of Boundary Layer Stagnation-Point Flow and Heat Transfer of Non-Newtonian Power-Law Fluids Over a Nonlinearly Shrinking/Stretching Sheet with Thermal Radiation, International Journal of Nonlinear Sciences and Numerical Simulation, 19 (3-4), pp. 415-426, (2018),. https://doi.org/10.1515/ijnsns-2017-0211

[134] Fazle, M., and Stanford, S., Multiple Slip Effects on MHD Unsteady Flow Heat and Mass Transfer Impinging on Permeable Stretching Sheet with Radiation, Modelling and Simulation in Engineering, 1-11, Article ID 3052790, (2019). https://doi.org/10.1155/2019/3052790.

[135] Alghamdi, W., Gul, T., Nullah, M., et.al., Boundary Layer Stagnation Point Flow of the Casson Hybrid Nanofluid over an Unsteady Stretching Surface, AIP Advances, 11, (2021). https://doi.org/10.1063/5.0036232.

[136] Agrawal, R., and Kaswan, P., Effect of slip condition on MHD flow and heat transfer through a permeable nonlinearly stretching sheet in a porous medium using the homotopy analysis method, Computational Thermal Sciences: An

International Journal, 13 (1), , pp. 1-15 , (2021) DOI: 10.1615/ComputThermalScien.2020033258.

[137] Mabood, F., Abbasi, A., Farooq, W.,et.al., Effects of non-linear radiation and chemical reaction on Oldroyd-B nanofluid near oblique stagnation point flow, Chinese Journal of Physics, 77, pp. 1197-1208, (2022). https://doi.org/10.1016/j.cjph.2022.03.049.

[138] Debnath, K and Saha, B.K., Solution of non-Newtonian Boundary Layer Flow in a Convergent Channel using Homotopy Perturbation Method, Transient, A Journal of Natural Sciences and Allied Subjects, 8, pp. 28-32 (2020).

[139] Debnath, K and Saha, B.K., Hydromagnetic Visco-elastic Boundary Layer Flow Past an Exponentially Stretching Sheet with Suction or Blowing, Emerging Technologies in Data Mining and Information Security- Proceedings of IEMIS 2020, 1, pp. 533-541, (2020). https://doi.org/10.1007/978-981-15-9927-9

[140] Debnath, K and Saha, B.K., Heat and Partial Slip Impact on Elastico-viscous Fluid Flow Past a Flat Permeable Plate, Mathematical Forum, 29, pp. 66-78, (2022).

[141] Debnath, K and Saha, B.K., Slip Flow and Heat Transition for Hydromagnetic Elastico-viscous Fluid past a Flat Moving Plate, Emerging Technologies in Data Mining and Information Security- Proceedings of IEMIS 2022, 1, pp. 131-140, (2022). https://doi.org/10.1007/978-981-19-4193-1

[142] Saha, B.K. and Debnath, K,. Reactive Solute Diffusion in Elastico Viscous Fluid Past a Flat Permeable Plate, High Technology Letters, 29 (7), pp. 303-310, (2023).

List of Publications

1. Reactive Solute Diffusion in Elastico Viscous Fluid Past a Flat Permeable Plate (Published: High Technology Letters, Vol 29, Issue 7, 303-310, July 2023, ISSN: 1006-6748)
2. Slip Flow and Heat Transition for Hydromagnetic Elastico-viscous Fluid past a Flat Moving Plate (Published: Emerging Technologies in Data Mining and Information Security, Springer Nature ISBN 978-981-19-4193-1, September 2022, Springer edited book Series).
3. Heat and Partial Slip Impact on Elastico-viscous Fluid Flow Past a Flat Permeable Plate (Published: Mathematical Forum, Vol 29, 66-78, 2022, ISSN: 0972-9852, 2022, UGC care listed Journal).
4. Hydromagnetic Visco-elastic Boundary Layer Flow Past an Exponentially Stretching Sheet with Suction or Blowing (Published: Emerging Technologies in Data Mining and Information Security, Vol. 1, ISBN 978-981-15-9927-9, 533-541, June 2021. Springer edited book Series).
5. Solution of non-Newtonian Boundary Layer Flow in a Convergent Channel using Homotopy Perturbation Method (Published: Transient, A Journal of Natural Sciences and Allied Subjects, ISSN: 2250-0650, Vol. VIII, 2020, 28, Peer Reviewed Journal).

First Page of Paper 1

Reactive Solute Diffusion in Elastico-Viscous Fluid Past a Flat Permeable Plate

Bikash Koli Saha[I] and Kamal Debnath[II]
[I,II]Department of Mathematics, The Assam Royal Global University, Guwahati-781035, Assam, India

Abstract- The study intends to analyze how concentration changes at a flat porous plate affect the diffusion of a solute owing to chemical reaction in an elastico-viscous fluid through a porous media. Walters Liquid (Model *B'*) is taken for Elastico-viscous fluid and the variable chemical reaction rate is considered for the solute. Using the built-in Matlab 'bvp4c' algorithm, the equations regulate the fluid motion are transformed into a self-similar form by selecting the right similarity variables. The estimated outcomes of velocity and concentration for changes in flow variables are demonstrated by plots. The graphical presentation of skin-friction coefficient for some dominant flow parameters is also plotted. The effects of various flow feature parameters is discussed from graphs to bring out possible physical reasons. The fluid flow and the diffusion process in Elastico-viscous boundary layer flow are significantly influenced due to chemical reaction with the variation of surface concentration.

Keywords: Chemical reaction, Diffusion, Elastico-viscous, Porous media, Similarity transformation, Surface concentration, Walters Liquid.

1. INTRODUCTION

The steadyfluid motionof viscous liquid past a flat surfaceattracts researchers because of its enormous technological applications. The study of such a type of flow was firstly initiated by Blasius [1]. Howarth [2] came up with a numerical solution to the Blasius problem. Abu-Sitta [3] revealed the the existence of solution of fluid motion passing through a flat surface. Later stage,many scholars [4-6] investigated various elements of boundary layer flow across a flat surface.

The elastico-viscous fluid, which has both elastic and viscous properties, has many applications in engineering sciences. As high-velocity pressure is applied to it, it hardens and transforms from a liquid to a solid. That's why, it is now frequently used in protective equipment such as liquid body armor, liquid sports shoes, helmets, mobile cases, speed bumps, and other similar products. Hayat *et al.* [7] examined the mixed convective heat transition takingvisco-elastic liquidthrough a stretching cylinder.Rashidi *et al.* [8] investigated hydromagnetic mixed convective visco-elastic fluid motion taking thermal radiation.

The investigation of solute transport in fluid flow is critical for the progress of separation method and the theory of chemical kinetics. Many researchers [9-12] examined the impact of chemical processes on fluid as a result of stretching and contracting ofsheets. Heat transition and mass transport in a MHD chemically reactive fluid across a flat permeable plate were demonstrated by Ibrahim and Makinde [13]. Bhattacharyya and Uddin [14] examined the chemically reactive diffusion of solute through a flat permeable plate surrounded by porous medium having variable surface concentration. Eldabe*et al.* [15] investigated the chemically reactive mass transport taking variable wall concentration for a movingflat permeable plate. The mass diffusion due to chemical reaction over an expanded exponentially surface having variable wall concentration was demonstrated by Banerjee *et al.* [16].

The mass transport and heat transition mechanism through porous media has piqued the curiosity of many scholars due to its widespread use in the chemical industry, petroleum engineering, and a range of other technological operations. Furthermore, a better understanding of convection through porous media could aid in the design of insulation, grain storage, metal processing, filtration systems, catalytic reactors, heat exchangers, and other fields.Nayak *et al.* [17] illustrated how heat and mass transmission take place via a boundary layer in a chemically reactive, hydromagnetic, viscous liquid with a source/sink. Mjankwi*et al.* [18] looked at how the heat flow and mass absorption coefficient were affected by different fluid properties. Misra and Govardhan [19] studied how heat and mass transmission process affected the boundary layer for nanofluid flow. Jabeen *et al.* [20] provided a comparative study with thermal radiation and thermophoresis due to with chemically reactiveMHD flow along aporous stretching surface.

This paper deals with the solute diffusion resulting from chemical reaction in Elastico-viscous fluid through a flat permeable plate represented by Walter Liquid (Model*B'*) [21, 22] with variation in surface concentration. The variable reaction rate is considered in this study. Employing similarity variables, the resultant equations converted to self-similar forms and thus solved by the well-known MATLAB inbuilt solver 'bvp4c'.For relevant flow feature parameters, the numerically calculated results are displayed.The

First Page of Paper 2

Slip Flow and Heat Transition for Hydromagnetic Elastico-viscous Fluid Past a Flat Moving Plate

Kamal Debnath and Bikash Koli Saha

Abstract A theoretical approach has been made to investigate the hydromagnetic and slip impact on heat transport for elastico-viscous boundary layer fluid flow past a flat moving plate considering non-Newtonian fluid model Walters Liquid (Model B/). To transform equations governing fluid motion to solvable form, similarity variables are introduced to obtain the self-similar resulting equations. The specially designed solver 'bvp4c' of MATLAB for solving boundary value problems is used for numerical computation. To study the influence of hydromagnetic and slip parameters on the elastico-viscous fluid together with other flow feature parameters, the computed results are plotted for discussion purpose from physical standpoint.

Keywords Boundary layer · Elastico-viscous · Heat transfer · Hydromagnetic · Similarity variables · Velocity slip

1 Introduction

Heat transfer mechanism on moving solid surface plays a very important role in modern technology and in manufacturing industry such as production of paper, liquid film, plastic sheets extrusion, growth of crystal, polymer industry, and many more. Sakaidis [1] studied the flow behavior of boundary layer for solid moving plate with constant velocity. The transport of heat and mass under applied suction/blowing in moving surface investigated by Erickson et al. [2]. The theoretical study of above problems for continuous moving plate followed by experiment performed by Tsou et al. [3]. The hydromagnetic mixed convective fluid flow with partial slip boundary over a moving plate presented by Rashidi et al. [4]. Some connected problems on moving boundary with diversified physical conditions presented by Bhatti et al. [5].

K. Debnath · B. K. Saha (✉)
Department of Mathematics, The Assam Royal Global University, Guwahati, Assam 781035, India
e-mail: bikashkoli100@gmail.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023
P. Dutta et al. (eds.), *Emerging Technologies in Data Mining and Information Security*,
Lecture Notes in Networks and Systems 491,
https://doi.org/10.1007/978-981-19-4193-1_13

First Page of Paper 3

Mathematical Forum
Vol. 29, 2022

ISSN: 0972-9852

HEAT AND PARTIAL SLIP IMPACT ON ELASTICO-VISCOUS FLUID FLOW PAST A FLAT PERMEABLE PLATE

K. DEBNATH[1] and B. K. SAHA[2]

[1,2] *Department of Mathematics, The Assam Royal Global University, Guwahati -781035, Assam, India*

Email: [1]debnathtura@gmail.com, [2]bikashkoli100@gmail.com

Received on: 27/11/2020
Accepted on: 14/12/2020

Abstract

An investigation is initiated to examine the heat transport and slip effects on steady elastico-viscous boundary layer fluid motion past a flat permeable plate. The non-Newtonian fluid model Walters Liquid (Model B′) is taken for elastico-viscous fluid. The special forms of slip factors involving local Reynolds number are considered. Using similarity variables, the governing equations of fluid motion along with boundary conditions are reduced to self-similar form to solve by inbuilt MATLAB solver 'bvp4c'. The computed results of velocity, temperature, temperature gradient at the plate and skin-friction coefficients are plotted for discussion to find the impact of involved flow parameters. The study reveals that elastico-viscosity plays a significant role to enhance the fluid velocity, heat transport rate and friction at the surface.

Keywords: Boundary layer, elastic-viscous fluid, heat transfer, similarity variables, temperature gradient, velocity slip.

2010 AMS classification: 76A05, 76A10

First Page of Paper 4

Hydromagnetic Visco-elastic Boundary Layer Flow Past an Exponentially Stretching Sheet with Suction or Blowing

Kamal Debnath and Bikash Koli Saha

Abstract The hydromagnetic visco-elastic boundary layer flow characterized by the Walters Liquid (Model B') past an exponentially stretching sheet with suction or blowing has been investigated. Slip velocity is considered instead of no-slip conditions at the boundary. Similarity transformations are obtained by careful inspection to convert the governing partial differential equations into nonlinear self-similar ordinary differential equations. The velocity profiles and the skin-friction coefficient have been computed using MATLAB solver 'bvp4c' for various values of flow parameters involved in the solution. The velocity and the skin-friction coefficient have been plotted to observe the visco-elastic, slip velocity, magnetic and suction or blowing parameters effects in the flow field.

Keywords Boundary layer · Hydromagnetic · Similarity solution · Slip velocity · Visco-elastic

1 Introduction

Studying the boundary layer flow over a stretching sheet in a viscous fluid is significant to fluid mechanics because of its innumerous applications in technological processes. This type of flow is often observed in many manufacturing processes in industries, like, aerodynamic extrusion of plastic sheets, rolling of artificial fibers, drawing of copper wires, extraction of polymer sheet, paper production, glass blowing, metal spinning, drawing plastic films, etc.

Crane [1] investigated the flow caused by the stretching of a sheet and later on his works have been extended under different physical situations by many new researchers. A review of literature reveals that in the study of boundary layer flow past

K. Debnath · B. K. Saha (✉)
Department of Mathematics, The Assam Royal Global University, Guwahati 781035, Assam, India
e-mail: bikashkoli100@gmail.com

K. Debnath
e-mail: debnathtura@gmail.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2021

A. E. Hassanien et al. (eds.), *Emerging Technologies in Data Mining and Information Security*, Advances in Intelligent Systems and Computing 1286,
https://doi.org/10.1007/978-981-15-9927-9_51

First Page of Paper 5

RESEARCH ARTICLE

Solution of non-Newtonian Boundary Layer Flow in a Convergent Channel using Homotopy Perturbation Method

Kamal Debnath* and Bikash Koli Saha

Department of Mathematics, The Assam Royal Global University, Guwahati, Assam, India

**E-mail:* debnathtura@gmail.com

ABSTRACT

The two-dimensional boundary layer flow through a convergent channel of a non-Newtonian electrically conducting fluid characterized by Walters Liquid (Model B') in presence of transverse magnetic field has been investigated analytically using Homotopy perturbation method. Similarity solutions of the problem are obtained considering a special form of magnetic field. The velocity expression and skin friction coefficient at the wall have been attained and numerically worked out for different values of the flow parameters involved in the solution. The velocity and the skin friction coefficient have been presented graphically to observe the non-Newtonian effects for various values of the magnetic parameter across the boundary layer.

Keywords: Homotopy perturbation method, Hydromagnetic, Non-Newtonian fluid, Similarity solution, Skin-friction

INTRODUCTION

The study of hydromagnetic electrically conducting non-Newtonian fluid flow through a convergent channel possesses not only a theoretical appeal but also model of many biological and engineering problems such as plasma studies, industrial metal casting, nuclear reactors, blood flow problems, etc. The theory of such flow has many applications in aerospace, chemical, civil, environmental, mechanical and bio-mechanical engineering.

Jeffry [1] and Hemel [2] have carried out the mathematical formulations of incompressible viscous fluid flow through convergent or, divergent channel in 1915 and 1916, respectively. Srivastava [3] has extended Jeffery's work to an electrically conducting fluid in presence of transverse magnetic field. The numerical calculations of Jeffery-Hamel flows between non-parallel plane walls were performed by Millsaps and Pohlhausen [4]. The solution of two-dimensional incompressible laminar flow in a converging channel with impermeable wall has been presented by Rosenhead [5]. The slow laminar flow in a converging or diverging channel with suction at one wall and blowing at the other wall has been analyzed by Terril [6]. The two-dimensional laminar boundary layer flow of an incompressible, viscous, non-uniform stream past solid obstacles has been analysed first by Falkner and Skan [7]. Phukan [8] has investigated the convergent channel flow of a Newtonian electrically conducting fluid. Hydromagnetic laminar flow of a viscous fluid in a converging or diverging channel with suction at one wall and equal blowing at the other wall has been investigated by Mahapatra et al. [9]. The two-dimensional laminar MHD boundary layer flow past a wedge with slip velocity has been studied by Sanyal and Adhikari [10]. Alam

List of Presentations

1. “Reactive Solute Diffusion in Elastico-Viscous Boundary Layer Fluid Flow over a Flat Permeable Plate with variable Surface Concentration”, presented in International Conference On “Emerging Areas in Science and Technology (EAST-2021) organized by Royal School of Applied & Pure Sciences, The Assam Royal Global University, Guwahati, during June 1-2,2022.
2. Slip Flow and Heat Transition for Hydromagnetic Elastico-Viscous Fluid Flow Past a Flat Moving Plate”, presented in 2nd International Conference on Emerging Technologies in Data Mining and Information Security (IEMIS-2020) organized by Institute of Engineering & Management Group, Department of Computer Application and Sciences, Kolkata during July 2-4, 2021.
3. Unsteady Elastico-viscous Boundary Layer Stagnation-point Slip Flow and Heat Transition along a Stretching Surface”, presented in 65th Congress of the Indian Society for Theoretical and Applied Mechanics (ISTAM-2020) (An International Conference) organized by GITAM University, Hyderabad during December 9-11, 2020.
4. “Heat and Partial Slip Impact on Elastico-viscous Fluid Flow Past a Flat Permeable Plate”, presented in International Web Conference on Advance Research in Science, Humanities and Social Science (IWCARSHSS-2020) organized by Department of Applied Mathematics, Maharaja Bir Bikram University, Agartala during July 9-10, 2020.
5. “Hydromagnetic Visco-elastic Boundary Layer Flow Past an Exponentially Stretching Sheet with Suction or Blowing”, presented in 2nd International Conference on Emerging Technologies in Data Mining and Information Security (IEMIS-2020) organized by Institute of Engineering & Management Group, Department of Computer Application and Sciences, Kolkata during July 2-4, 2020.
6. “Solution of non-Newtonian Boundary Layer Flow in a Convergent Channel using Homotopy Perturbation Method”, presented in International Conference on New Frontiers in Engineering, Science, Law, Management, Humanities and Social Science 2020 (INFES-2020) organized by Eudoxia Research Centre at Guahati University during February 22-23, 2020.