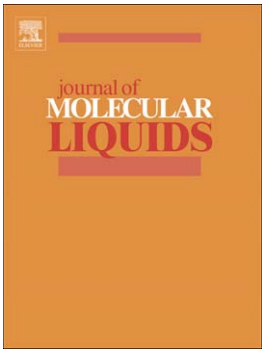


# Strong temperature dependent viscosity effects on bio-magnetic fluid flow under the action of localized magnetic field and viscous dissipation

Sadia Siddiqa, S.B. Naqvi, M.A. Hossain, N. Massarotti, A. Mauro

PII: S0167-7322(17)33504-3
DOI: doi:10.1016/j.molliq.2017.10.052
Reference: MOLLIQ 8014

To appear in: *Journal of Molecular Liquids*

Received date: 3 August 2017
Revised date: 5 October 2017
Accepted date: 10 October 2017

Please cite this article as: Sadia Siddiqa, S.B. Naqvi, M.A. Hossain, N. Massarotti, A. Mauro, Strong temperature dependent viscosity effects on bio-magnetic fluid flow under the action of localized magnetic field and viscous dissipation, *Journal of Molecular Liquids* (2017), doi:10.1016/j.molliq.2017.10.052

# Strong temperature dependent viscosity effects on bio-magnetic fluid flow under the action of localized magnetic field and viscous dissipation

Sadia Siddiqa[a,b,1] , S. B. Naqvi[c], M. A. Hossain[d], N. Massarotti[b], A. Mauro[b]

[a] *Department of Mathematics, COMSATS Institute of Information Technology, Kamra Road, Attock, Pakistan*

[b] *Dipartimento di Ingegneria, Università degli Studi di Napoli "Parthenope", Centro Direzionale, Isola C4, Napoli, Italy*

[c] *Department of Mathematics, COMSATS Institute of Information Technology, Sahiwal, Pakistan*

[d] *UGC Professor, Department of Mathematics, University of Dhaka, Dhaka, Bangladesh*

**Abstract:**In this study consideration has been given to the two-dimensional, unsteady, laminar flow of an electrically conducting bio-fluid (blood) in a rectangular channel. In this model both magnetization and electrical conductivity of blood are taken into account. The viscosity of the fluid is also assumed to be a strong function of temperature. The coupled, nonlinear system of equations are transformed into the stream function-vorticity-temperature formulation. These equations along with the suitable boundary conditions are solved iteratively by using the upwind scheme along with successive over relaxation method. The numerical results obtained here are illustrated in terms of streamlines, vorticity function, velocity component and temperature function contours. The results show that the flow is effected to a great extent owing to the presence of the magnetic source. It is observed that the temperature values increases due to an increase in magnetic intensity for all the contours plotted in this study. It is also noticed that variable viscosity greatly influenced the flow field and generates a lot of vortices within the vicinity of the walls.

**Keywords:** Blood, Variable viscosity, Bio-magnetic fluid dynamics, Magnetohydrodynamics, Ferrohydrodynamic, Localized magnetic field.

## Nomenclature

| | |
|---|---|
| $(\bar{u}, \bar{v})$ | Dimensional velocity components of fluid in the $(\bar{x}, \bar{y})$ directions respectively $(m/s)$ |
| $(u, v)$ | Dimensionless velocity components of fluid in the $(x, y)$ directions respectively |
| $\bar{p}$ | Dimensional pressure of the fluid $(Pa)$ |
| $p$ | Dimensionless pressure of the fluid |
| $\bar{M}$ | Magnetization $(N)$ |
| $\bar{H}$ | Dimensional magnetic field intensity $(A/m)$ |
| $H$ | Dimensionless magnetic field intensity |
| $\bar{T}$ | Dimensional temperature of the fluid $(K)$ |
| $T$ | Dimensionless temperature of the fluid |
| $(\bar{x}, \bar{y})$ | Dimensional Cartesian coordinates $(m)$ |
| $(x, y)$ | Dimensionless Cartesian coordinates |
| $\bar{t}$ | Dimensional time variable $(s)$ |
| $t$ | Dimensionless time variable |

[1]Corresponding Author.
Email: saadiasiddiqa@gmail.com