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**EFFECTS OF COMBINED TEMPERATURE- AND DEPTH-DEPENDENT VISCOSITY AND HALL CURRENT ON AN UNSTEADY MHD LAMINAR CONVECTIVE FLOW DUE TO A ROTATING DISK**

[**KH. Abdul Maleque**](https://www.tandfonline.com/author/Maleque%2C%2BKH%2BAbdul)

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**Abstract**

The present study investigates the effects of mixed temperature- and depth-dependent viscosity and Hall current on an unsteady flow of an incompressible electrically conducting fluid on a rotating disk in the presence of a uniform magnetic field. We assume that the fluid viscosity strongly depends on temperature and depth, which may be directly applicable to the earth's mantle and a uniform mid-ocean ridge basalt reservoir in whole mantle flow. The system of axial symmetric nonlinear partial differential equations governing the unsteady flow and heat transfer is written in cylindrical polar coordinates and reduced to nonlinear ordinary differential equations by introducing suitable similarity parameters. Solutions for the flow and temperature fields are obtained numerically assuming large Prandtl number by using Runge-Kutta and shooting methods. The nature of radial, tangential, and axial velocities and temperature in the presence of a uniform magnetic field is presented for changing various nondimensional parameters at different layers of the medium. The coefficients of skin frictions and the rate of heat transfer are calculated at different parameters. Comparison has been made for steady flow (*C* = 0) and shows excellent agreement with Sparrow and Gregg ([1959](https://www.tandfonline.com/doi/abs/10.1080/00986440903288492)), hence encouragement for the use of the present numerical computations.

**Keywords:**

[Hall effect](https://www.tandfonline.com/keyword/Hall%2BEffect)[MHD laminar flow](https://www.tandfonline.com/keyword/MHD%2BLaminar%2BFlow)[Rotating disk](https://www.tandfonline.com/keyword/Rotating%2BDisk)[Temperature- and depth-dependent viscosity](https://www.tandfonline.com/keyword/Temperature-%2BAnd%2BDepth-dependent%2BViscosity)