NUMERICAL SOLUTION OF FLUID FLOW THROUGH A ROTATING RECTANGULAR STRAIGHT DUCT WITH MAGNETIC FIELD

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ABSTRACT

In this paper fluid flow through a rotating rectangular straight duct in the presence of magnetic field under various flow conditions is investigated by using numerical techniques. Although the Spectral method is applied as a main numerical tool, the Chebyshev polynomial, the Collocation method and the Newton-Raphson method are also used as secondary tools. The Magnetohydrodynamics incompressible viscous steady fluid flow through a straight duct of rectangular cross-section rotating at a constant angular velocity about the center of the duct cross-section is investigated numerically to examine the combined effects of Magnetic parameter (M_g), Taylor number (T_r), Pressure Gradient Parameter (D_n) and aspect ratio $(\gamma)=\frac{b}{a}$ where a is the half width of the duct cross-section, b is the half height of the duct, Ω is the angular velocity, μ is the viscosity, υ is the kinematic viscosity. One of the interesting phenomena of the flow is the solution curve and the flow structure. The flow structures in case of rotation of the duct axis and the Pressure Gradient with large Magnetic force number as well as large Taylor number have been examined while other parameters remain constant. The calculation are carried out for $5 \le M_g \le 50000, 50 \le T_r \le 100000, D_n =$ 500, 1000, 1500 and 2000 where the aspect ratio $\gamma = 2.0$. For high magnetic parameter and large Taylor number, almost all the fluid particles strength is weak. The maximum axial flow will be shifted to the center from the wall and turn into the ring shape.

KEYWORDS: Rotating Rectangular Straight Duct, Magnetohydrodynamics, Duct Cross-Section