Chapter 16

Mathematical Model of Blood Plasma Flow through Pulmonary Capillaries

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Abstract

The transport of blood plasma through pulmonary capillaries plays a crucial role in the exchange of oxygen and carbon dioxide within the human respiratory system. Understanding the dynamics of plasma flow in the presence of external forces is important for studying physiological processes and biomedical applications. In the present study, a mathematical model is developed to investigate the unsteady laminar flow of blood plasma in the lung mechanism under the influence of an applied magnetic field. Blood plasma is treated as a viscous, incompressible and electrically conducting fluid flowing through a permeable medium representing the pulmonary tissue. The governing equations of continuity, momentum, energy and mass transfer are formulated using the principles of magnetohydrodynamics. These equations are converted into dimensionless form using suitable non-dimensional parameters such as the Grashof number, Hartmann number, Prandtl number and Schmidt number. An analytical solution is obtained using the perturbation method. The influence of various physical parameters on plasma velocity, temperature and oxygen concentration distributions is analyzed graphically. The results indicate that magnetic field strength, buoyancy effects and permeability of lung

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