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A FOUR-COMPARTMENT MODEL TO ESTIMATE OXYGEN AND CARBON DIOXIDE EXCHANGE CONCENTRATIONS VIA BLOOD USING EIGENVALUE APPROACH

Ahsan Ul Haq Lone, M. A. Khanday and Saqib Mubarak

Department of Mathematics,
University of Kashmir, Srinagar - 190006, INDIA

E-mail : khanday@uok.edu.in

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Abstract: A mathematical model of oxygen and carbon dioxide transport via blood in the human body has been formulated. The model is represented by four compartments: alveolar tissue, arterial blood, tissue and venous blood. The aim of this study is to estimate the concentration profiles of oxygen and carbon dioxide over alveolar tissue, arterial blood, tissue and venous blood compartments. The formulation is based on the transport of oxygen from atmospheric air to alveolar tissue and subsequently to capillary bed through inspiration and back flow of carbon dioxide through expiration. Ordinary differential equations and balance law have been employed to formulate compartment-wise transport phenomenon of both oxygen and carbon dioxide in the respiratory tract via blood. The solution of the model has been obtained using eigenvalue approach. The model provide the information regarding absorption rate of oxygen and release rate of carbon dioxide at the respective compartments. The results obtained in this study may help clinical and bio-medical sciences to deal with respiratory ailments faced by the people living at high altitudes. The results are in agreement with those arrived at by N. S. Cherniack et al. (1968). In addition, these results may have utility in biomedical engineering and physiological research problems.

Keywords and Phrases: Oxygen tension, Carbon dioxide tension, Blood; Compartment model, Balance law, Transfer rate, Eigenvalue method.