



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI  
SHORT ABSTRACT OF THESIS

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The study of the integer-order differential equations has always been in the limelight for its importance and usefulness in the mathematical modelling of a large number of physical phenomena. Researchers have nowadays found that modelling real-world problems through fractional-order governing equations captures various phenomena in a more realistic way, which the models governed by integer-order ones lack. Notwithstanding the fact that not sufficient studies have been conducted in the area of fractional-order differential equations from an application point of view, it is fair to note that modelling physical phenomena by considering such equations has acquired more attention in comparison to earlier times.

In various mathematical modelling of biological problems, it has been found that there are some attributes which the integer-order model cannot depict. The difference is quite vivid when they tried to validate their model by fitting the experimental data to their model. As the fractional models are renowned for their special ability in capturing the experimental data in a more accurate manner and depicting the biological phenomena more profoundly in most instances, we intend to apply the same methodology to investigate those biological phenomena where integer-order models were not capable of meeting the expectations of the researchers.

In this thesis, the fractional-order modelling of five problems is taken up in connection with ESR (Erythrocyte Sedimentation Rate) Test with non-zero uniform average blood velocity and concentration gradient of blood nutrients, mass transport in brain cells (also for the integer-order model), blood flow under MHD effect through a porous medium, and ion diffusion in the extracellular microenvironment of the rat cerebellum. We emphasize on the fact that the fractional-order models are more accurate as compared to their integer-order counterparts. Validation against experimental data and several other findings point toward this.