



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI  
SHORT ABSTRACT OF THESIS

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Thesis Title: On the existence, uniqueness and approximate controllability of some classes of differential equations with different types of fractional derivatives

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**SHORT ABSTRACT**

The research reported in this thesis deals with the analysis of a number of differential equations of fractional order, viz., Cauchy type non-autonomous fractional differential equation, Volterra-Fredholm integro fractional differential equation of neutral type, nonlinear integro fractional differential equation of Sobolev type with finite delay, instantaneous impulsive fractional differential equation with some generalized integral conditions. More precisely, our aim is to prove the existence and uniqueness results for these problems. Further, we also establish the approximate controllability of a class of nonlinear fractional differential equations.

The first problem consists of a classical initial value problem concerned with nonautonomous fractional differential equations with Hilfer fractional derivatives and another one containing nonlocal initial conditions. By using fixed point theorems, sufficient conditions for the existence of mild solutions are obtained and some examples are also considered to illustrate the obtained theory. The existence and uniqueness of integral solutions of a class of non densely defined mixed Volterra-Fredholm integro neutral fractional differential equation is also studied and the results are obtained by using semigroup theory, fixed point theorems and Kuratowski measure of noncompactness. In another problem, a Volterra fractional differential equation of Sobolev type with finite delay is considered. The existence results for mild solutions are proved by using fixed point theorems and Hausdorff measure of noncompactness. Further, the existence of solutions of a class of impulsive fractional differential equation with Erdélyi-Kober type boundary conditions and multiple base points is established. The results are obtained by using various properties of fractional calculus and different fixed point theorems. Some examples are presented to illustrate the obtained results wherever possible.

The last part of the thesis discusses the approximate controllability of a class of Hilfer fractional control system with analytic semigroup where the nonlinear term depends both on the state and control. The existence and uniqueness of the mild solution is established with the help of a generalized contraction theorem, and the sufficient conditions for the approximate controllability are obtained by using suitable assumptions on the functions involved.