INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
PhD-17 SHORT ABSTRACT OF THESIS

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Programme of Study	:	Ph.D.

Thesis Title: Study of Certain Classes of ψ-Hilfer Fractional Differential Equations: Qualitative Properties and Some Applications

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Thesis Submitted to the Academic Division	:	Mathematics
Date of completion of Thesis Viva-Voce Exam	:	06-04-2026
Key words for description of Thesis Work	:	Fractional Differential Equations, ψ-Hilfer Fractional Derivative, Ulam–Hyers Stability, Fixed Point Theory

SHORT ABSTRACT

The theory of fractional differential equations provides a powerful framework for modeling systems with memory and hereditary properties. The ψ-Hilfer fractional derivative serves as a unifying and flexible operator, generalizing several classical derivatives through suitable choices of the weight function ψ and type parameter β. This dissertation focuses on the qualitative analysis of fractional differential equations involving the ψ-Hilfer derivative, with particular emphasis on Ulam-type stability.

Five problems are studied from the perspective of stability and applications. The first two problems deal with abstract fractional differential equations, where existence and various Ulam-type stabilities are established using Banach's and Schauder's fixed point theorems. Numerical results are also presented to illustrate the behavior of solutions under different parameters.

The third problem considers neutral fractional differential equations with delay, establishing existence and stability results, along with numerical simulations to demonstrate the effect of delay. The fourth problem focuses on coupled systems, where existence and uniqueness results are obtained, along with an application to a blood alcohol concentration model.

Finally, a system of three fractional differential equations is analyzed, and existence, uniqueness, and stability results are established. An application to a financial system highlights the complex dynamics arising from fractional-order interactions.