National Conference on Latest Innovations in Engineering, Science, Management and Humanities (NCLIESMH – 2024)

26th May, 2024, Raipur, Chhattisgarh, India.

CERTIFICATE NO : NCLIESMH /2024/C0524547

A Study of Quantitative Approaches for Solving the Differential Difference Equations

V Radhakishan

Research Scholar, Ph. D. in Mathematics, Mansarovar Global University, Sehore, M.P., India.

ABSTRACT

Differential-Difference Equations (DDEqs) are mathematical models that incorporate both differential and difference operations, commonly used in systems where the current state depends on both its rate of change and discrete time intervals or delays. These equations appear frequently in control systems, biology, economics, and engineering applications. Solving them poses significant analytical challenges due to their hybrid continuous-discrete nature. Quantitative approaches for solving DDEqs offer practical methods for finding approximate or exact solutions and include both analytical and numerical techniques. Analytical methods such as Laplace Transform, method of steps, and series solutions are effective for linear DDEqs with constant coefficients and known delays. For more complex or nonlinear forms, numerical approaches like Euler's method, Runge-Kutta methods, finite difference techniques, and spectral methods are widely applied. Additionally, modern semi-analytical techniques such as the Adomian Decomposition Method (ADM), Differential Transform Method (DTM), and Homotopy Perturbation Method (HPM) are gaining popularity due to their simplicity and convergence properties. These methods help in reducing the computational complexity and improving the stability of solutions. This paper presents a comprehensive overview of the quantitative approaches for solving differential-difference equations and evaluates their effectiveness through examples, demonstrating their importance in real-world system modeling and simulations.