**Computational Technique for Semilinear Time-Fractional Diffusion Equation**

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**Abstract**

In this work, we consider a semilinear time-fractional diffusion equation where the time-fractional term includes the combination of tempered fractional derivative and -Caputo fractional derivative with a parameter . The Elzaki transform of the tempered -Caputo fractional derivative is derived here and further the semi-analytical solution is obtained using the Elzaki decomposition method. The model problem is linearized using Newton’s quasilinearization method and then the quasilinearized problem is discretized by the difference scheme namely tempered method. Stability and convergence analysis are discussed using the energy method. In support of the theoretical results, numerical example is incorporated.

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**Keywords:** k -Caputo fractional derivative, Tempered fractional derivative, Elzaki decomposition method, Stability, Error analysis.