

**ON APPROXIMATE SOLUTIONS OF FRACTIONAL ORDER  
SMOKING EPIDEMIC MODEL USING SUMUDU  
DECOMPOSITION METHOD**

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**Abstract:** In this paper, an approximate analytical solution of a fractional-order smoking epidemic model is obtained by employing the Sumudu Decomposition Method (SDM). To validate the effectiveness and reliability of the proposed method, the obtained SDM solutions are compared with numerical solutions computed via the classical Runge–Kutta method. A detailed error and convergence analysis is presented to assess the accuracy of the method. The results demonstrate that the SDM provides highly accurate approximations, particularly for small and moderate time intervals. Graphical simulations are included to illustrate the dynamical behavior of the model for different parameter values. The study confirms that the SDM is a simple, efficient, and reliable technique for solving nonlinear fractional-order epidemic models and can be effectively applied to analyze short-term dynamics in smoking-related population systems.

**Keywords and Phrases:** Caputo fractional derivative, Sumudu Decomposition Method, Sumudu Transform, Adomian Polynomials.

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## **1. Introduction**

In this paper, a mathematical model of smoking epidemic is considered in Caputo fractional derivative sense. Smoking is one of the major reasons for lung