APPROVAL SHEET

The Title of Thesis Ph. D. :

"On The Numerical Solutions of Fractional and Variable Order Differential Equations"

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Abstract

The main objective of this thesis, which consists of six chapters, is to introduce and investigate some numerical treatments for solving fractional order differential equations based on the spectral methods. These equations are the diffusion equation in one and two dimensions, the telegraph equation and the multi-term fractional differential equations. The spectral collocation method that especially depends on the shifted Chebyshev polynomials of all kinds are the main tools for the numerical methods. Moreover, the Sinc function is used for investigation some numerical methods. Furthermore, the operational matrix is used for fractional and variable order multi-term differential equations. The concept of the fractional derivative is considered in the sense of Caputo fractional derivative. Numerical examples are given to demonstrate the applicability and effectiveness of the proposed methods. Finally, from the comparison between the results of the suggested methods and the results of other published methods in many papers, we can conclude that the proposed methods in this thesis are more accurate than some of the published methods.

Keywords: Fractional calculus; Caputo fractional derivative; Numerical methods; Spectral methods; Fractional diffusion equations; Fractional order telegraph equation; Shifted Chebyshev polynomials; Sinc function; Explicit finite difference approximation; Multi-term fractional order differential equations; Multi-term variable order fractional differential equations.