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EXISTENCE RESULTS AND APPROXIMATE SOLUTIONS OF VOLTERRA FREDHOLM INTEGRO-DIFFERENTIAL EQUATIONS

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Abstract. In the present paper, we establish the existence and uniqueness for a fractional Volterra Fredholm integro-differential equation involving Caputo's fractional derivative using the Krasnoselskii and Banach fixed point theorems. Moreover, we study the convergence of the approximated solutions of the same problem by applying the modified Adomian decomposition method. An example is given to substantiate the usefulness of the obtained results.

Keywords. Krasnoselskii's fixed point theorem, Adomian decomposition method, Volterra Fredholm integro-differential equation, Caputo fractional derivative.

AMS (MOS) subject classification: 49M27, 45J05, 26A33.

1 Introduction

In the recent years, the integro fractional differential equation arises in a lot of phenomena of various areas of science such as physics, engineering, chemistry, rheology, dynamical processes in self-similar, porous structures, electrochemistry of corrosion and viscoelasticity, etc. For more details see ([7, 11, 14, 15, 18, 24]) and the references cited therein.

Some results on the existence of solutions of integro fractional differential equations have been discussed by many mathematicians using the fixed point theorem. For example we refer the reader to ([6, 8, 12, 13, 17, 27]). Moreover, many researches occur about the approximate solution of this type of equations by the Adomian decomposition method (ADM) that has been proposed by the American mathematician George Adomian [1] during the second half of the 20th century. The Adomian method is based on the use of polynomials that bear his name, this technique has the advantage of elegance and especially ease of use. The solution is given in the form of a series of which each term is easily computable using the Adomian polynomials adapted to nonlinearity ([3, 4, 20, 22]).

In [26] Wazwaz introduced the modified Adomian decomposition method (MADM) that consists on decomposing the first term of the series into two