EXISTENCE AND STABILITY RESULTS FOR NEUTRAL FUNCTIONAL DIFFERENTIAL EQUATIONS OF FRACTIONAL ORDER WITH DELAY

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Abstract. In this paper, we establish sufficient conditions for the existence of solutions for a class of Initial Value Problem (I.V.P) for implicit neutral functional differential equations of fractional order with finite delay using Caputo fractional derivative, also, the stability of this class of problem. The arguments are based upon the Banach contraction principle, Banach's fixed point theorem. Two examples are included to show the applicability of our results.

Keywords. Neutral fractional differential equation, Caputo's fractional derivative, implicit fractional differential equations, fractional integral, existence, stability, fixed point.

AMS (MOS) subject classification: 26A33, 34A08, 34K37.

1   Introduction

Fractional calculus is a generalization of ordinary differentiation and integration to arbitrary order (non-integer). See, for example, the books [2, 3, 4, 7, 24, 25, 30] and the papers [9, 11] and the references therein.

In recent years, fractional differential equations arise naturally in various fields such as rheology, fractals, chaotic dynamics, modeling and control theory, signal processing, bioengineering and biomedical applications, etc; Fractional derivatives provide an excellent instrument for the description of memory and hereditary properties of various materials and processes. We refer the reader, for example, to the books [8, 20, 22, 31] and references therein.

"Under what conditions does there exist an additive mapping near an approximately additive mapping?" This is the stability problem of functional equation (of group homomorphisms) which was raised by Ulam in 1940 in a talk given at Wisconsin University [32, 33]. In 1941, Hyers [14] gave the