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Oscillation and Nonoscillation for Caputo–Hadamard Impulsive Fractional Differential Equations

Mouffak Benchohra [1,2*], Samira Hamani [3], and Juan Nieto [4]

[1] *Laboratory of Mathematics, Djillali Liabes University of Sidi Bel-Abbès, P.O. Box 89, Sidi Bel-Abbès 22000, Algeria;*
[2] *Department of Mathematics, College of Science, King Saud University, P.O. Box 2455, Riyadh 11451, Saudi Arabia;*
[3] *Laboratory of Applied and Pure Mathematics, University of Mostaganem, B.P. 227, 27000, Mostaganem, Algérie;*
[4] *Department of Statistics, Mathematical Analysis and Optimization, Institute of Mathematics, University of Santiago de Compostela, Santiago de Compostela, Spain*

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Abstract: In this paper, the concept of the upper and lower solutions method combined with the fixed point theorem is used to investigate the existence of oscillatory and nonoscillatory solutions for a class of initial value problems for Caputo–Hadamard impulsive fractional differential equations.

Keywords: *impulsive fractional differential equations; Caputo–Hadamard fractional derivative; fixed point; upper solution; lower solution, oscillation, nonoscillation.*

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1 Introduction

Fractional differential equations and integrals are valuable tools in the modeling of many phenomena in various fields of science and engineering. Indeed, there are numerous applications in viscoelasticity, electrochemistry, control, porous media, electromagnetism, etc. In the monographs [1, 3, 4, 11, 12, 15], we can find the mathematical background and various applications of fractional calculus. Recently, many researchers studied different fractional problems involving the Riemaan-Liouville, Caputo and Hadamard derivatives; see, for example, the papers [2, 17]. Sufficient conditions for the oscillation of solutions of differential equations are given in [9, 14, 16].

* Corresponding author: `mailto:benchohra@univ-sba.dz`