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# APPROXIMATION OF SOLUTION TO SECOND ORDER IMPULSIVE DIFFERENTIAL EQUATION WITH FINITE DELAY

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**Abstract.** This paper deals with the approximation of the solution to second order impulsive differential equation with finite delay in a separable Hilbert space. Using the theory of a strongly continuous cosine family of bounded linear operator, a new set of sufficient conditions for the approximation of the solutions to the given equation is derived. With the help of projection operator, a finite dimensional approximation of the given system is constructed such that these approximate solutions form a Cauchy sequence with respect to an appropriate norm, and the limit of this sequence is a solution of the original problem. Moreover, the convergence of Faedo-Galerkin approximation of solution is obtained. Finally, an application to the abstract results is discussed.

**Keywords.** Banach fixed point theorem, Cosine family, Faedo-Galerkin approximations, Finite delay, Impulsive differential equation.

**AMS (MOS) subject classification:** 34K07, 34K30, 34K37, 34K50, 34G20.

# 1 Introduction

In recent years, the theory of impulsive differential equation has been emerging as an important area of investigation. These differential equations arise naturally in the description of phenomena that are subjected to sudden changes in their states, such as population dynamics, biological systems, optimal control, chemotherapeutic treatment in medicine, mechanical systems with impact, financial systems etc. In these models, the processes are characterized by the fact that they undergo abrupt changes of state at certain moments of time between intervals of continuous evolution. The presence of