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EXISTENCE RESULTS FOR SECOND ORDER PARTIAL NEUTRAL FUNCTIONAL DIFFERENTIAL EQUATIONS

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Abstract. In this paper we establish existence of mild, strong and classical solutions for a class of second order partial neutral functional differential equations with infinite delay.
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1 Introduction

The purpose of this paper is to study existence of mild, strong and classical solutions for a class of second order partial neutral functional differential equations with infinite delay described in the abstract form

$$\frac{d}{dt}[x'(t) - g(t, x_t, x'(t))] = Ax(t) + f(t, x_t, x'(t)), \qquad t \in I = [0, a], \quad (1)$$

$$x_0 = \varphi \in \mathcal{B}, \qquad x'(0) = z \in X, \quad (2)$$

where A is the infinitesimal generator of a strongly continuous cosine function of bounded linear operators $(C(t))_{t\in\mathbb{R}}$ on a Banach space X; the history $x_t : (-\infty, 0] \to X$ belongs to some phase space $\mathcal{B}$ defined axiomatically, and f, g are appropriate functions.

Neutral differential equations arise in many areas of applied mathematics. For this reason this type of equations has received much attention in recent years. The literature relative to first and second order ordinary neutral functional differential equations is very extensive and respect to this matter we cite to Hale & Lunel [14]; Lakshmikantham, Wen & Zhang [23] and Kolmanovskii & Myshkis [22] and the references in these books. Furthermore, first order partial neutral functional differential equations are studied in different works.(See for example [1, 2, 3, 8, 17, 18, 19, 31]).

On the other hand, some second order abstract systems similar to (1)-(2) have been studied recently in [4, 5, 6, 24, 27]. However, the results established in these works are based on strong compactness assumptions on the cosine function generated by A which is valid, if and only if, the underling space X is finite dimensional, see Travis [29, pp.557]. In this work we avoid these assumptions, which allows us to include partial equations in the theory.