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EXISTENCE THEORY AND STABILITY ANALYSIS TO A SYSTEM OF BOUNDARY VALUE PROBLEM

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ABSTRACT. The aims and objectives of this manuscript are devoted to investigate some adequate results for the existence of solution to a nonlinear coupled system of fractional order differential equations(FDEs). Appropriate conditions for the existence of at least one solution are developed by using a fixed point theorem of Leray Schauder type to the considered problem. Further, we also investigate the Hyers-Ulam stability results for the proposed problem. Appropriate examples are given to demonstrate the established results.

1. Introduction

Differential equations of non-integer order are the best tool for the modeling of many phenomenons in different fields of science and engineering [1, 2]. Therefore in last few years considerable motivation has been provided to the subject of differential equations of arbitrary order (see[3, 4, 5] and the references therein). The area related to the existence theory of solutions to FDEs and their systems especially coupled systems were well studied by many authors, for detail see[6, 7, 8, 9, 10]. The iterative schemes for approximating the solutions of nonlinear FDEs were also studied in many articles as see[11] and the references therein. In all these articles the concerned results were obtained via using classical fixed point theorems like Banach contraction principle, fixed point theorems of Leray- Schauder and cone type.
Another aspect of FDEs which has very recently got attentions from the researchers is concerning to the Ulam type stability analysis of the afore said equations. The mentioned stability was first point out by Ulam[12], in 1940 which was later explained by Hyers[13], in 1940 for function in Banach space. Latter on many researchers done valuable work on the same task and interesting results were formed for linear and nonlinear integral and differential equations, for detail see [14, 15, 16, 17]. Benchohra and his coauthor[18], studied the afore said stability for the implicit initial value problems of non-integer order differential equations. In the same line Zhange [19], extended the results to some boundary value problems of FDEs. Urs[20] studied the Hyers-Ulam stability to the given system of periodic boundary value problem of classical differential equations

$$\begin{cases} \dfrac{d\alpha(t)}{dt} = \Theta(t, \alpha(t)) + \Phi(t, \beta(t)), \ t \in \mathfrak{I}, \\ \dfrac{d\beta(t)}{dt} = \Theta(t, \beta(t)) + \Phi(t, \alpha(t)), \ t \in \mathfrak{I}, \\ \alpha(0) = \alpha(T), \ \beta(0) = \beta(T), \end{cases}$$

where the nonlinear functions $\Theta, \ \Phi \in C(\mathfrak{I} \times \mathbf{R}, \mathbf{R})$ and $\mathfrak{I} = [0, T]$. In[21], authors extended the Hyers-Ulam stability results to a coupled system of arbitrary order differential equations with integral boundary conditions. To the best of our knowledge, the mentioned stability is not properly studied for coupled systems of FDEs with fractional integral boundary conditions. In fact, the

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