ABSTRACTS

of the international conference

MATHEMATICAL ANALYSIS AND ITS APPLICATIONS IN MODERN MATHEMATICAL PHYSICS

PART I

Samarkand
September 23-24, 2022

MINISTRY OF HIGHER AND SECONDARY SPECIAL
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MATHEMATICAL ANALYSIS AND ITS APPLICATIONS IN MODERN MATHEMATICAL PHYSICS

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Investigation the direct problem for integro -differential fractional diffusion equation

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Consider the problem of determining of function $u(x,t)$, from the following equations with fractional derivative in time t :

$$\partial_t^\alpha u - u_{xx} + a(x)u = \int_0^t k(t-\tau)u(x,\tau)d\tau, \quad (x,t) \in D_T, \alpha \in (0,1), \tag{1}$$

$$u|_{t=0} = \varphi(x), \quad x \in [0,l], \tag{2}$$

$$u|_{x=0} = \mu_1(t), \quad u|_{x=l} = \mu_2(t), \ \varphi(0) = \mu_1(0), \quad \varphi(l) = \mu_2(0), \ t \in [0,T], \tag{3}$$

with the Caputo time fractional derivative ∂_t^α of order $0 < \alpha < 1$, defined by

$$\partial_t^\alpha u(t) = \frac{1}{\Gamma(2-\alpha)} \int_0^t (t-\tau)^{1-\alpha} u'(\tau)d\tau,$$

where Γ is the Euler's Gamma function, $D_\tau = \{(x,t)|x \in (0,l), \ 0 < t \leq \tau, \tau \in (0,T]\}$, $T > 0$ are arbitrary fixed number, $a(x), k(t), \varphi(x), \mu_1(t), \mu_2(t)$ are given functions of $x \in [0,l]$ and $t \in [0,T]$.

Lemma. *If* $(\varphi(x), a(x)) \in C[0,l]$,$(\mu_1(t), \mu_2(t)) \in C^1([0,T])$, $k(t) \in C([0,T])$, *then there is the unique classical solution* $u(x,t)$ *to the problem (1)-(3) of the class* $C^{2,\alpha}([0,l] \times [0,T])$ *(*$C^{2,\alpha}(D_T) = \{u(x,t) \in C^2[0,l]; t \in (0,T]; u(x,t) \in AC[0,T]; x \in [0,l]\}$ *).*

In what follows we also use the usual class $C(D_T)$ of continuous in D_T functions.

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Spectral properties of a family of the Generalized Friedrichs models with the perturbation of rank one

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Let $\mathbb{Z}^3$ be the three-dimensional hypercubes lattice and $\mathbb{T}^3 = (-\pi,\pi]^3$ be the three-dimensional torus (Billion zone), the dual group of $\mathbb{Z}^3$. The operators of addition and multiplication by number of the elements of torus $\mathbb{T}^3 \equiv (-\pi,\pi]^3 \subset \mathbb{R}^3$ was defined as operations in $\mathbb{R}^3$ modulo $(2\pi\mathbb{Z}^3)$.

Let $L^2(\mathbb{T}^3)$ be the Hilbert space of square-integrable functions defined on the torus $\mathbb{T}^3$ and $\mathbb{C}^1$ be the one-dimensional complex Hilbert space.

We consider a family of the Generalized Friedrichs models acting in $L^2(\mathbb{T}^3)$ as follows:

$$H_\mu(p) = H_0(p) + \mu\Phi^*\Phi, \ \mu > 0.$$