Semi-Annual Report of Functional Analysis department for 2023

The staff of "Functional Analysis" department consists of 19 employees including 17 research associates. 8 of them doctor of sciences, professor.

1.Aslanov Hamidulla I. doct. ph.m.s.,prof.
2.Mammed Bayramoglu. doct. ph.m.s.,prof.sen.r.a.
3.Mirzoyev Sabir S. doct. ph.m.s.,prof.sen.r.a.
4.Huseynov Hidayet M. doct. ph.m.s.,prof.sen.r.a.
5.Gurbanov Veli M. doct. ph.m.s.,prof.sen.r.a.
6.Nabiyev Ibrahim M. doct. ph.m.s.,prof.sen.r.a.
7.Aliyev Araz R. doct. ph.m.s.,prof.sen.r.a.
8.Eyvazov Elsad H. doct. ph.m.s.,ass.prof. sen.r.a.
9.Aslanova Nigar M. doct. ph.m.s.,ass.prof. sen.r.a.
10.Mukhtarov Fekhreddin Sh. c.ph.m.s.,lead.r.a.
11.Jabrailova Afet N. c.ph.m.s.,lead.r.a.
12.Latifova Aygun R. phd in math.,chief.r.a.
13.Guliyev Namiq I. c.ph.m.s.,r.a.
14.Vahabov Nazim G. chief.r.a.
15.Alimardanova Kamilla A. c.ph.m.s.,chief. r.a.
16.Osmanli Jalala A. phd in math.,chief. r.a.
17.Safarova Aynur N. phd in math.,chief. r.a.
18.Iskenderli Guller Z.sen.lab.ass.
19.Bayramova Aygun F.sen.lab.ass.

I. Scientific part.

In the first half-year of 2023, in the department, according to the afformed plan 16 scientific works are carried out on "Spectral analysis of differential operators".

Theme "Spectral analysis of differential operators".

1).work: " Higher order trace formulas for second order operator- differential equations on a finite segment ." Ex. doct.ph.m.s., prof. H.I.Aslanov.

Let H- be a Hilbert space We consider the operator L determined by the differential expression $l(y) = -y'' + Q(x)y$ and the boundary conditions

$$y(0) = 0, \quad y'(1) + y(1) = 0, a > 0$$

in the space $H_1 = L_2([0,1];H)$

Here the operator – function Q(x) is a self- adjoint operator for any $x \in [0,1]$ in the space H and satisfies some additional conditions. At first the determine eigen values and eigenvectors of the considered problem for Q(x)=0 . It is shown that in this case the of the problem is the set $\{\mu_m\}_{n=1}^{\infty} \mu_1 < \mu_2 < \cdots < \mu_n < \cdots$ consisting of positive roots of the equation $\sqrt{\lambda} \cos \sqrt{\lambda} + \sin \sqrt{\lambda}$=0. Corresponding eigenvector functions of the eigenvalues μ_m are in the form

$$\varphi_{mn}^{(0)}(x) = \alpha_m \sin \sqrt{\mu_n}\, x\varphi_n,\ n=0,1,2,....$$

Here $\alpha_m = \dfrac{\sqrt{2}}{\sqrt{1+\cos\sqrt{\mu_n}}}$. Obtaining regularized trace formulas of the problem

under consideration is planned to the end of the report year.

2). work: "Spectral analysis of discontinuous coefficient Shtrum Liouville operator on a finite segment ." Ex: doct.ph.m.s.,prof. sen.re.a. H.M.Huseynov.
Integral representations for the solutions satisfying initial conditions were obtained. The properties of its Kernel, the asymptotic of eigen and normalizing number were studied.

3) . work: " Convergence of spectral expansion by eigenfunctions   of the Dirac operator ."
 Ex:doct.ph.m.s., prof. sen.re.a. V.M.Kurbanov.

Article

1. В.М.Курбанов, Х.Р.Годжаева. О бесселевости систем корневых функций дифференциального оператора второго порядка. // Pedaqoji Universitetin Xəbərləri, 2023, №2, стр.8-15.

Article (submitted to print)

2. V.M. Kurbanov, E.J. Ibadov. On the properties of the systems of root vector functions of Dirac-type operator with summable potential. // Operators and Matrix

Theses

1. V.M.Kurbanov, A.I.Ismailova. Riesz property criterion for the system of root function of second order differential operator. // Ümummilli lider Heydər Əliyevin

100 illiyinə həsr olunmuş "Riyaziyyat və Mexanikanın Müasir Problemləri" adlı Beynəlxalq konfrans, Bakı, 26-28 aprel 2023, pp. 233-234.

2. V.M.Kurbanov, Y.Q.Abbasova. Bessel property for the system of root vector-functions of the second order differential operator with summable coefficients // Ümummilli lider Heydər Əliyevin 100 illiyinə həsr olunmuş "Riyaziyyat və Mexanikanın Müasir Problemləri" adlı Beynəlxalq konfrans, Bakı, 26-28 aprel 2023, pp. 231-232.

4) . work: " Studying solvability conditions of boundary value problems for second operator-differential equations "
Ex: doct.ph.m.s.,prof. sen.re.a. S.S.Mirzoyev.

A boundary value problem is considered for the following operator- differential equation on a finite segment.

$$-U''(t) + A^2 U(t) + A_1(t)U'(t) + A_2(t)U(t) = f(t),$$
$$U(0) = 0, \quad U'(1) = 0$$

In the half-year, the existence of the solution of the problem corresponding to the principal part of the equation was considered

5) work: " Renewal problems for a bundle of quadratic Strum-Liouville operators."Ex: doct.ph.m.s., prof. sen.re.a. I.M.Nabiyev.

Theses

1. I.M. Nabiev, L.I. Mammadova, G.S. Mammedzadeh. On the uniqueness of the recovery of the non-selfadjoınt differential operator from spectral data / 2nd International Conference on Innovative Academic Studies ICIAS 2023 January 28 - 31, 2023 in Konya, Turkey. Abstract Book, p. 228.

https://drive.google.com/file/d/1QwAfEdWjFFaTrhVnnFRCHHvEuwwmcaZ1/view?usp=sharing

2. I.M. Nabiev, L.I. Mammadova, G.S. Mammedzadeh. Some properties of eigenvalues and eigenfunctions of the diffusion operator with a spectral

parameter in the boundary condition / 1st International Conference on Scientific and Innovative Studies ICSIS 2023 April 18 - 20, 2023 Konya, Turkey. Abstract Book, p. 120.

https://drive.google.com/file/d/1r03TxhkBCAXPEjJQrU6xTEOFQEq0fwUk/view?usp=sharing

Theses (submitted to print)

3. İ.M. Nəbiyev, L.İ. Məmmədova, A.V. Abbaslı. Sərhəd şərtində spektral parametr olan Dirak operatorunun bərpası haqqında / Ümummilli Lider H. Əliyevin anadan olmasının 100-cü ildönümünə həsr edilmiş Beyn. elmi-prak. konf. mater., Bakı, 13 aprel 2023, Biznes Univ. nəşr., s.

6) . work: " The existence and uniqueness conditions for smooth solutions for two classes of third order operator differential equation ."
Ex: doct.ph.m.s., prof. sen.re.a. A.R.Aliyev.

Article

1.Aliev A.R., Muradova N.L. On conditions of regular solvability for two classes of third-order operator-differential equations in a fourth-order Sobolev-type space. *Turkish Journal of Mathematics*, 2023, vol. 47, no. 2, pp. 608-619. (WoS-SCIE; Scopus)

Theses

1.Aliev A.R., Rzayev E.S. On solvability of boundary-value problem for fourth-order elliptic equation with operator coefficients. Proceedings of the International Conference on Modern Problems of Mathematics and Mechanics dedicated to the 100-th anniversary of the National Leader Heydar Aliyev, 26-28 April 2023, Baku, Azerbaijan, p.p. 58-60.

7) work: Some spectral problems for a fourth order operator coefficient differential equation."

Ex. : doct. ph.m.s.,prof.sen.r.a. M.Bayramoglu., doct. ph.m.s.,ass.prof. sen.r.a. N.M.Aslanova

Articles

1. Fatma Aydın Akgun., Mamed Bayramoglu,"A regularized trace of an even order differential operator with bounded operator coefficient in a finite interval", FILOMAT journal of mathemati s, vol.37, no 11, 2023

2. Nigar M.Aslanova, Khalig M.Aslanov, "On self-adjoint extensions of symmetric operator with exit to larger space" Twis jurnal of pure and applied mathematics vol.14, no 1, 2023, pp. 91-105

8) work: " Relation between discontinuity points of a transfer function and eigenvalues of the perturbed operator."
Ex: doct.ph.m.s., ass.prof. sen.re.a. E.H.Eyvazov.

Construction of the projection operator to the boundary subspace is very important in solving boundary value problems stated for differential operators whose coefficient are distributions. In the report year, the projection of the Dirac function used widely in solving a boundary value problem for Schrodinger equation on the space of multi-point self centered distributions, was constructed.

Theses

1.E.H.Eyvazov., L.V. Ibrahimova "On the discreteness of the spectrum of a degenerate elliptic differential operator" , Modern Problems of Mathematics and Mechanics PROCEEDINGS of the International Conference dedicated to the 100-th anniversary of the National Leader Heydar Aliyev Baku, 26-28 Aprel 2023, səh. 160-161.

Theses (submitted to print)

1.E.H.Eyvazov "Dirak funksiyasinin ikinöqtəli çoxluğa mərkəzləşmiş ümumiləşmiş funksiyalar fəzasina proyeksiyasi", BAKI BIZNES UNIVERSITETI, Ümummilli Lider Heydər Əliyevin anadan olmasının 100-cu ildönümünə həsr edilmiş "Riyaziyyatın və İnformasiya Texnologiyalarının bəzi

actual məsələləri" mövzusunda Beynəlxalq elmi- praktiki konfransın materialları, Bakı, 13 aprel, 2023-ci il.

9).work: " On spectral theory of operator bundles ". Ex: cand.ph.m.s., ass.prof. lead r.a. A.R.Jabrailova

Theses

1.R.Dzabarzadeh, A.Jabrailova. Some results of multiparameter spectral theory. «Riyaziyyat və Mexanikanın Müasir Problemləri» Ümum. Lider H.Əliyevin 100-illik yubileyinə həsr olunmuş Beynəlxalq konfransın materialları.Bakı,26-28 aprel 2023,səh.156

10)work: " Studying multi-interval boundary value problems "
Ex: cand.ph.m.s., ass prof. lead r.a. F.Sh.Mukhtarov.
In the work, a Strum-Liouville type equation determined in two non-intersecting intervals, is considered. A periodic boundary value problem is considered in the intervals (a,c) and (c,b) with the mutual point. x=c. The differential transformation method for solving this boundary value problem is used.

Article

1.F.Sh.Muhtarov, M.Yucel.O.Sh.Muhtarov. Generalized differential transformation method for solving two-interval weber equation subject to transmission conditions.Bulletin of the Karaganda University.pp.168-176. https://mathematics-vestnik.ksu.kz/

Theses

1.F.Sh.Muhtarov. "Rayleigh quotient for two-interval periodic Shturm-Lioville problems." Ümumilli Lider Heydər Əliyevin 100-illik yubileyinə həsr olunmuş Beynəlxalq konfrans, səh 288-290

11) .work: " Mixed inverse problems for Strum-Liouvill operator containing a spectral parameter in boundary conditions ."
Ex: cand.ph.m.s., lead.r.a. N.J.Guliyev.
In the report period, the properties of the Weyl- Titchmarch function of Sturm-Liouville operator containing a spectral parameter in the boundary conditions, have been studied.

Article (submitted to print)

1. Guliyev N.J. Inverse square singularities and eigenparameter-dependent boundary conditions are two sides of the same coin, Q. J. Math., to appear. https://doi.org/10.1093/qmath/haad004

12) .work: '' Scattering problems for a system of ordinary differential equations on a semi-axis.''Ex:c.ph.m.s.,chief. r.a. K. A. Alimardanova

   In the report period, direct scattering problems were studied for a system of ordinary differential equations on a semi-axis three problems have been considered. The scattering operator was determine. A theorem on the existence and uniqueness of the scattering problem was proved.

Theses

1. A.N.Safarova, K.A.Alimardanova. The scattering problem for the system of six ordinary differential equations on a semi-axis with three given incident waves / "Riyaziyyat və mexanikanın müasir problemləri" adlı Ümummilli Lider Heydər Əliyevin 100 illik yubileyinə həsr olunmuş Beynəlxalq Konfransının Materialları, 26-28 aprel 2023 il, Bakı, Azərbaycan, səh. 353-354.

13) .work: '' Direct and inverse problems of spectral analyses for a class of Sturm-Liouvill operators.''
 Ex:phd in math.,chief.r.a. A.R. Latifova
Studies on the topic have been continued.

14) .work: '' Goldberg spectrum of the norm Hermite operators, its numerical range and the Lax milgram theorem '' Ex:sen.res.ass. N.G.Vahabov.
The structure of the norm- Hermitian type operator were studied and the state diagram of Taylor. Goldberg was researched.

The operators that are the analogs of unitary operators in Banach space were introduced. The Laxmilgram type theorem in Hilbert space is proved. The obtained proof method is determined from simpler and easily verifiable conditions .

15) .work: '' Inverse problem for Sturm - Lioville operator in the impedance form '' Ex: phd in math.,chief. r.a. J. A. Osmanli

The main equation of the inverse problem has been obtained and its solvability has been studies

16) .work: " A scattering problem for a system of ordinary differential equations in the case of three incident and three scattered waves on a semi-axis were considered."
Ex: phd in math., chief. r.a. A. N. Safarova

Three problems were considered on a semi-axis, the asymptotic of the solution in the infinity is recorder when the coefficients satisfy some decreasing conditions. Studying the scattering problem was reduced to the system of integral equations. The scattering matrix was determined.

Theses

1. A.N.Safarova, K.A.Alimardanova. The scattering problem for the system of six ordinary differential equations on a semi-axis with three given incident waves / "Riyaziyyat və mexanikanın müasir problemləri" adlı Ümummilli Lider Heydər Əliyevin 100 illik yubileyinə həsr olunmuş Beynəlxalq Konfransının Materialları, 26-28 aprel 2023 il, Bakı, Azərbaycan, səh. 353-354.

II. Scientific-social activity.

The head of the department**, doct. ph.m.s.,prof.sen.r.a. H.M. Aslanov** is a participant of the Science foundation, of the grant project of state oil Company.

He was an official opponent of one doctor of sciences degree and one phil. doct. dissertations.

He supervises three doctoral students. One cand. for a degree has defended phil. doct. dissertation.

Doct. ph.m.s.,prof.sen.r.a. A.R. Aliyev is an editor-in-chief of the international scientific journal "Azerbaijan Journal of High performance computing" (Azerbaijan), manager editor of the international scientific journal "Azerbaijan journal of Mathematics" and a member of the journals: «Proceedings

of the Institute Mathematics and Mechanics, National Academy of Sciences of Azerbaijan» (Azərbaycan), «Transactions of Azerbaijan Institutes of Technology» (Azərbaycan), "Electronic scientific journal, SCIENCE and TECHNOLOGIES: MATHEMATICAL MODELLING. COMPUTER SCIENCE" (Rusiya) və «Mathematics and Statistics»

Doct. ph.m.s.,prof.sen.r.a. I.M. Nabiyev has has participated in the international conference. His 2 papers were published. They were published in Web of Science and Scopus base journal.

He was a chairman of the State Certificate Commission (in mathematics) in Azerb. State Oil and Industry University.

Doct. ph.m.s.,prof.sen.r.a. H.M. Huseynov is a member of editorial board of a lot of international and republican scientific journals. He is an adviser of magisters and doctoral students.

Doct. ph.m.s.,prof.sen.r.a. S.S. Mirzoyev's two cand. for degrees have submitted their dissertation works to the Scientific Council of IMM.

Many of the department collaborators are engaged in pedagogical activity in different higher education institutions of the Republic.

PARTICIPATION IN SCIENTFIC SEMINARS

All the collaborators have participated in the institute and department seminars.

THE PUBLISHED SCIENTIFIC PAPERS

5 papers, 9 abstract of the department employees were published, 2 papers and 2 abstracts were submitted for publication. 4 of these papers were included into the Science of Scopus base.

Heard of department: **d.ph.m.s.prof. H.İ.Aslanov**