

**Report on the scientific and scientific-organizational activities of the department  
"Differential Equations" for 2022**

The Department of Differential Equations has 12 employees. Of which 10 scientists, 6 doctors of science and 4 doctors of philosophy. In accordance with the work plan for 2022, the department is conducting 10 research works on one topic.

**TOPIC: Some Problems in the Theory of Partial Differential Operators”.**

**Work 1.** Existence of a local solution of a mixed problem with a nonlinear boundary condition for nonlinear hyperbolic equations with variable growth and their finite time distribution. **Executer: d.ph.m.s., prof. A.B.Aliev.**

Published works:

1. **A.B. Aliev**, G.A. Aliyev, A.N. Huseynova, A Mixed Problem For A One-Dimensional Viscoelasticity Equation With Non-Stationary Conjugation Conditions, *Baku Mathematical Journal*, 2022, Vol.1, pp. 63-77.

<https://doi.org/10.32010/j.bmj.2022.07>

2. **A.B. Aliev**, G.Kh. Shafieva, Mixed Problem for Systems of Hyperbolic Equations with Nonlinear Boundary Dissipation and a Nonlinear Source of Variable Growth Order, *Differential Equations*, 2022, Vol. 58, No. 8, pp. 1030–1044. 2022 **Web of Science (Science Citation Index)**

3. **A.B. Aliev**, Y. M. Farhadova<sup>1</sup>, Mathematical Analysis of Dynamic Models of Suspension Bridges with Delayed Damping, *Mathematics and Statistics* 10(5): 1024-1037, 2022(DOI: 10.13189/ms.2022.100514) **Scopus.**

4. **A.B. Aliev**, G.Kh. Shafieva, Blow - up of solutions of wave equation with a nonlinear boundary condition and interior focusing source of variable order of growth, *Mathematical methods in the Applied sciences* (ONLINE --- <https://doi.org/10.1002/mma.8572>)

5. **Akbar B. Aliev**, Yeter M. Farhadova, EXISTENCE OF A SOLUTION TO THE NONLINEAR BRIDGE PROBLEM WITH A TIME-VARYING DELAY, *Advanced Mathematical Models & Applications*, Vol.XX, No.XX, 20XX, pp.xx–xx

**Theses**

1. **A.B. Aliev**, G.Kh. Shafieva, Initial-boundary value problem for systems of wave equations with nonlinear boundary dissipation and with a nonstandard interior nonlinear source, International Conference “Modern Problems of Mathematics and Mechanics” dedicated to the 110-th anniversary of the academician Ibrahim Ibrahimov, *Baku*, 29 June-01 July, 2022, p. 42.

2. **A.B. Aliev**, G.Kh. Shafieva, Blow-up of Solutions of a Mixed Problem for Wave Equations with a Nonlinear Transmission Condition and Interior Focusing Source of Variable Order of Growth, XII International Conference of the Georgian Mathematical Union, Batumi, August 29 – September 3, 2022 47

3. **Ə.Əliyev**, G.Şəfiyeva. Dəyişən dərəcəli qeyri-xəttiliyə malik hiperbolik tənliklər, AZƏRBAYCAN XALQININ ÜMUMMİLLİ LİDERİ HEYDƏR ƏLİYEVİN ANADAN

4. **А.Б.Алиев**, Г.И.Юсифова. Смешанная задача для систем нелинейных гиперболических уравнений с анизотропной эллиптической частью и нелинейной диссипацией. **Актуальные проблемы математики и информационных технологий**. Материалы III Всероссийской конференции (г. Махачкала, 7-9 февраля 2022 г.). – Махачкала: Издательство ДГУ, 17.

5. **А.Б.Алиев**, **Е. М. Фархадова**. Математический анализ динамических моделей подвесных мостов с запаздывающим демпфированием **Актуальные проблемы математики и информационных технологий**. Материалы III Всероссийской конференции (г. Махачкала, 7-9 февраля 2022 г.). – Махачкала: Издательство ДГУ, 2022 с.19

Works accepted for publication:

**Gulshan Kh. Shafieva**, Mixed problem for systems of one-dimensional wave equations with a nonlinear boundary condition and a nonstandard internal source, Trans. Natl. Acad. Sci. Azerb. Ser. Phys.-Tech. Math. Sci. Mathematics, 42 (4), 1-16 (2022).

**Work 2:** Regularity of Solutions to Parabolic Equations with Separated Coefficients.

**Executer: d.ph.m.s., prof. T.S.Gadjiev.**

1. T.Gadjiev, An initial-boundary value problem for systems of linear partial differential equations with a differential operator of Gegenbauer type- Trancations of A.Razmadze Mathematical Institute.V.175, July 3, 2021, PP-345-353. Keçən il hesabatda olmayıb dekabrda çıxıb
2. The uniformly elliptic equations of higher order with discontinuous data in unfounded domains- COIA-2022, p 1-3. WOS
3. The solvability degenerate elliptic problem with Newman boundary conditions- COIA-2022, The 8<sup>th</sup> International Conference on Contral and Optimization with Industrial Applications, 24-26 August, 2022, pp 1-3 WOS
4. The behavior of solution nonlinear elliptic equations. 6<sup>th</sup> International conference of Mathematics, 21-24 June 2022, Istanbul pp 1-16 WOS.
5. Thermal wauters of Azerbaijanian sources of Renewable alternative energy, DOI: 10.2120. 3-23-169020/V.1-Prepint. Research square.

Works accepted for publication:

1. The behavior of solution nonlinear elliptic equations with discontinuous coefficients- Nonlinear Analysis, Theory and Applications, 2022. In appear pp 1-29, IF
2. The regularity of solutions nonlinear parabolic equations with discontinuous coefficients – Computational Methods for Differential Equations, 2022, p 1-14, in appear, IF

**Work 3:** Investigation of linear and nonlinear eigenvalue problems for second and fourth order ordinary differential operators. **Executers: prof. Z.S.Aliyev, d.ph.m. H.Rzayeva.**

The results obtained are reflected in the following published works:

1. **Z.S. Aliyev**, G.T. Mamedova, Spectral properties of a beam equation with eigenvalue parameter entering via linearly to the boundary conditions, Proceedings of the Royal Society of Edinburgh Section A: Mathematics (**IF-1.25; Q1**), v. 152, no. 3, p. 780–801.

2. **Z.S. Aliyev**, Y.N. Aliyeva. Global bifurcation results for some fourth-order nonlinear eigenvalue problem with a spectral parameter in the boundary condition. 24 July, 2022. Mathematical Methods in the Applied Sciences. (**Q1**)  
<https://onlinelibrary.wiley.com/doi/10.1002/mma.8580>

3. **З.С. Алиев**, К.Ф. Абдуллаева. О РАВНОМЕРНОЙ СХОДИМОСТИ СПЕКТРАЛЬНЫХ РАЗЛОЖЕНИЙ ДЛЯ ОДНОЙ ЗАДАЧИ С КРАЕВЫМ УСЛОВИЕМ, ЗАВИСЯЩИМ ОТ СПЕКТРАЛЬНОГО ПАРАМЕТРА. Дифференциальные уравнения. Том: 58, Номер: 9, 2022, СС. 1165-1185 (**Q3**)

4. **З.С. Алиев**, М.Г. Панахов, О бифуркации из бесконечности в некоторых нелинейных задачах на собственные значения для пары операторов, Azərbaycan Xalqının Ümummilli Lideri Heydər Əliyevin anadan olmasının 99-cu ildönümünə həsr olunmuş "Riyaziyyat və mexanikanın aktual problemləri" Respublika elmi konfransının materialları, Bakı Dövlət Universiteti, 11-13 may 2022-ci il, Bakı s. 245–246.

Works accepted for publication:

1. **Z.S. Aliyev**, N.A. Ismayilova, Global bifurcation from zero in nonlinear Sturm-Liouville equation with a spectral parameter in the boundary condition, Quaestiones Mathematicae, 2022.

**Work 4:** Solution of a boundary value problem with an operator boundary condition for a second-order elliptic operator-differential equation with a complex parameter. **Executors: d.m.s., prof. B.A.Aliyev, d.ph.m.s., prof. N.M.Suleymanov.**

1. **Б.А.Алиев**. Об одной краевой задаче для эллиптического дифференциально – операторного уравнения второго порядка с комплексным параметром. Azərbaycan xalqının Ümummilli Lideri Heydər Əliyevin anadan olmasının 99-cu ildönümünə həsr olunmuş “Riyaziyyat və Mexanikanın Aktual problemləri” adlı Respublika Elmi konfransının materialları”. Tezis səh. 249-250.

2. **Б.А.Алиев**, В.З.Керимов Разрешимость одной краевой задачи с операторными граничными условиями для эллиптического дифференциально-операторного уравнений второго порядка с комплексным параметром Математическое и компьютерное моделирование естественно-научных и социальных проблем. Материалы XVI Всероссийский с международным участием научно-технической конференции молодых специалистов, аспирантов и студентов. Россия, г. Пенза, 1-4 июня 2022 г. Тезис. с.3-8

3. **B.A.Aliev**. On solvability of one boundary value problem for a second order elliptic differential-operator equation containing a complex parameter. International Conference “Modern Problems of Mathematics and Mechanics” dedicated to the 110-th anniversary of the academician Ibrahim Ibrahimov, Baku, 29 June-01 July, 2022, p. 33.

**Works accepted for publication:**

1. **B.A.Aliev**, V.Z.Kerimov and Ya.Yakubov Solvability of a boundary value problem for a second order elliptic differential operator equation with complex parameter Proceedings of the Institute of Mathematics and Mechanics. ISSN 2409-4986 (Print) ISSN2409-4994 (Online).

2. **B.A.Aliev**, S.Z Khaligova Solvability of a boundary value problem with bounded operator boundary conditions for second order elliptic differential operator equations with a complex parameter Trans.Natl Acad. Sci.Azerb.Ser. Phys.-Tech. Sci. Mathematics, 42 (4), 1-19 (2022).

**Work 5:** Direct and inverse problems of spectral analysis for the one-dimensional Schrödinger equation with an additive potential. **Executor: d.ph.m.s., prof. Agil Kh.Khanmamedov.**

The results obtained are published in the following 4 papers:

1. **A.Kh.Khanmamedov.** The Jost solutions to the Schrodinger equation with an additional complex potential// Trans. Natl. Acad. Sci. Azerb. Ser. Phys.-Tech. Math. Sci. Mathematics, 42 (1), 1-5 (2022).

2. **A.Kh.Khanmamedov.** One remark on the transformation operator for perturbed Hill operators// Azerbaijan Journal of Mathematics V. 12, No 1, 2022, January, pp.160-166.

3. **A.Kh.Khanmamedov.** The Riemann function of the Cauchy problem for a second-order hyperbolic equation with a periodic coefficient// Advanced Mathematical Models & Applications, 2022, v.7, №1, pp. 44-47.

4. **A.Kh.Khanmamedov.** To the inverse spectral problem for a perturbed oscillator on the semiaxis// Proceedings of the Institute of Mathematics and Mechanics of NAS of Azerbaijan, 2022, V. 48, №1, 12-21.

5. **А.Ханмаммедов.** Одно замечание к обратной задаче рассеяния для возмущенного уравнения Хилла, Матем. заметки, 2022, том 112, выпуск 2, 263–268.

**Work 6:** Gradient estimates for elliptic-parabolic operators in generalized weighted Morrey spaces. **Executor: d.ph.m. , ass.prof. Sh.A.Muradova.**

1. **Ш.А.Мурадова**, Э.М. Мустафаев. Об одной задаче рассеяния с сингулярным потенциалом типа меры. АКТУАЛЬНЫЕ ПРОБЛЕМЫ МАТЕМАТИКИ И ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ Материалы III Всероссийской конференции с международным участием, г. Махачкала, 7-9 февраля 2022 г., сс.135-138

2. **Sh. A. Muradova.** Boundedness of anisotropic singular operator in anisotropic generalized Morrey spaces. **International Conference “Modern Problems of Mathematics and Mechanics” dedicated to the 110-th anniversary of the academician Ibrahim Ibrahimov, Baku, 29 June-01 July, 2022**, p. 154

3. E.M. Mustafayev, **Sh.A. Muradova.** On a dispersion problem with a singular potential of measure type. **International Conference “Modern Problems of Mathematics and Mechanics” dedicated to the 110-th anniversary of the academician Ibrahim Ibrahimov, Baku, 29 June-01 July, 2022**, p. 158.

4. **Sh.A. Muradova**, E.M. Mustafayev. The Dispersion Problem with a Measure Type Singular Potential. **XII International Conference of the Georgian Mathematical Union, Batumi, August 29 – September 3, 2022**, p. 167.

**Work 7:** Study of a Multidimensional Mixed System of Problems for a Class of Nonlinear Third Order Differential Equations. **Executor: d.ph.m. ass.prof. A.G.Aliyeva.**

The results obtained are published in the following works:

1. S.Aliyev, **A.Aliyeva**; Some a priori estimates for solutions of a multidimensional mixed problem for a class of nonlinear differential equations of the third order, *The European Journal of Technical and Natural Sciences*, № 1-2, p.12-16.

2. S.Aliyev, **A.Aliyeva**. The investigation of multidimensional mixed problem for one class of third Order semilinear pseudohyperbolic equations, 5<sup>th</sup> International online conference on Mathematical Advances and Applications, May, 11-14, 2022, Yıldız Technical University, İstanbul, Türkiye.

**Work 8:** On various formulations of the Dirichlet problem for the Laplace equation in non-standard function spaces. **Executor: d.ph.m., N.R.Ahmedzade.**

Published works:

1. Bilalov, B.T., **Ahmedzadeh, N.R.** & Garayev, T.Z. Some Remarks on Solvability of Dirichlet Problem for Laplace Equation in Non-standard Function Spaces. *Mediterr. J. Math.* **19**, 133 (2022). <https://doi.org/10.1007/s00009-022-02045-y> (WOS, IF-**1.305**)

2. Z.A. Kasumov & **N.R. Ahmedzade**. О некоторых свойствах потенциала Рисса в пространствах гранд Лебега и гранд-Соболева. Труды Московского математического общества", Том 83, вып. 1, 2022 г., 77-85 (SCOPUS)

1. **N.R. Ahmedzade**, Z.A. Kasumov, On some properties of the Riesz potential in the grand Lebesgue and grand Sobolev spaces. XII International Conference of the Georgian Mathematical Union, Batumi, August 29 – September 3, 2022, p. 43

4. Z.A. Kasumov & **N.R. Ahmedzade**, On some properties of the Riesz potential in the grand Lebesgue and grand Sobolev spaces. *Modern problems of Mathematics and Mechanics*, June 29 – 1 July, 2022, Baku, Azerbaijan, pp. 122-123.

**Work 9.** Problems of the exponential decrease in the energy of a suspension bridge in the presence of linear aerodynamic forces with delay. **Executors: d.ph.m.s., prof. A.B.Aliev, Y.M.Ferhadova.**

1. A.B. Aliev, Y. M. Farhadova<sup>1</sup>, Mathematical Analysis of Dynamic Models of Suspension Bridges with Delayed Damping, *Mathematics and Statistics* 10(5): 1024-1037, 2022(DOI: 10.13189/ms.2022.100514) **Scopus**

2. **А.Б.Алиев, Е. М. Фархадова**. Математический анализ динамических моделей подвесных мостов с запаздывающим демпфированием **Актуальные проблемы**

математики и информационных технологий. Материалы III Всероссийской конференции (г. Махачкала, 7-9 февраля 2022 г.). – Махачкала: Издательство ДГУ, 2022 с.19.

3. **Y.M. Farhadova.** Existence of solution of nonlinear bridge problem with time-varying delay. **International Conference “Modern Problems of Mathematics and Mechanics” dedicated to the 110-th anniversary of the academician Ibrahim Ibrahimov, Baku, 29 June-01 July, 2022**, p. 78.

**Work 10.** Entropy optimization and stochastic differential equations. **Executor: prof. A.Shamilov.**

### **Social Activity Of Collaborators Of The “Differential Equations” Department**

Every Wednesday at 12.00 the department holds a seminar "*Modern problems in the theory of differential equations*" under the guidance of prof. A.B. Aliyev. All employees of the department, including doctoral students, dissertators and masters take part in these seminars. During this period, several scientific papers and dissertations were discussed in the department..

The employees of Department prof. Akbar Aliyev, prof. Ziyatkhan Aliyev, prof. Agil Khanmamedov, prof. Tahir Hajiyev, prof. Bahram Aliyev, assoc.prof. Shemsiyye Muradova teaches at the universities of the republic (Azerbaijan Technical University, BSU, ADPU, AZMU) for bachelors and masters.

Head of department prof. Akbar Aliyev made a plenary report on the topic: "Existence and absence of global solutions of nonlinear hyperbolic equations in function spaces of variable degree" at the International Scientific Conference "Actual Problems of Physics, Astronomy and Mathematics" at Nakhichevan State University.

Head of department prof. Akbar Aliyev made a plenary report on the topic: "Global existence and nonexistence of solutions for a system of nonlinear hyperbolic equations with damping", at the republican conference held at BSU and dedicated to the 99th anniversary of the national leader of Azerbaijan Heydar Aliyev, may 11-13, 2022.

Senior Researcher of the Department, Ph.D. N. Ahmadzade successfully completed the project "Methods of Spectral Theory and Nonharmonic Fourier Analysis in Some Issues of Classical and Quantum Mechanics" of the Foundation for the Development of Science under the President of the Republic of Azerbaijan in March of this year, of which she was a co-participant (2021/2022).

Employee of the department Sh.A. Muradova was a member of the working group of the International Conference "Modern Problems of Mathematics and Mechanics", dedicated to the 110th anniversary of the birth of Academician Ibragim Ibragimov, Baku, June 29-July 01, 2022.

On May 23, 2022, the doctoral student of the department Mehriban Karimova defended her dissertation on the topic “Investigation of the solution of folded elliptic-parabolic equations”,

presented for the degree of Doctor of Philosophy, in the dissertation council ED 1.04 1211.01-Mathematics, specializing in Differential Equations. Scientific adviser: prof. Tair Hajiyev.

On October 14, 2022, the doctoral student of the department Samira Rustamova defended her dissertation on the topic “Existence and absence of global solutions to mixed problems with homogeneous and inhomogeneous boundary conditions for a system of semilinear hyperbolic equations”, submitted for the degree of Doctor of Philosophy, in the dissertation council ED 1.04 1211.01- Mathematics, specialty Differential Equations. Scientific adviser: prof. Akbar Aliyev.

**Total – 46 works:**

**Article - 18 published, 7 prepared and submitted for publication**

**Thesis – 21**

**Head of Department**

**prof. Akbar B. Aliev**