



HILFER HOSILASI VA UNI HISOBLASH USULLARI.

Latipova Shahnoza Salim qizi

Osiyo Xalqaro Universiteti

"Umumtexnik fanlar" kafedrası o'qituvchisi

slatipova543@gmail.com

<https://doi.org/10.5281/zenodo.10652624>

ARTICLE INFO

Qabul qilindi: 05-February 2024 yil

Ma'qullandi: 10- February 2023 yil

Nashr qilindi: 13- February 2023 yil

KEY WORDS

Uzluksizlik, Caputo hosilasi, Hilfer
hosilasi, Reiman – Liuvell integrali

ABSTRACT

Hilfer ma'nosida kasr tartibli hosila qatnashgan tenglamalar o'rganilib, qaralayotgan tenglamaning elliptik qismi o'z-o'ziga qo'shma, musbat aniqlangan ixtiyoriy operatoridan iborat. O'rganilayotgan masalani yechish uchun o'zgaruvchilarni ajratish usulidan foydalaniladi..

Hilfer hosilasi

Hilfer ma'nosidagi kasr tartibli hosila Reiman – Liuvell ma'nosidagi kasr tartibli hosila va Caputo ma'nosidagi kasr tartibli hosilalarning umumiy holi hisoblanadi. Shuning uchun yuqorida Reiman – Liuvell ma'nosidagi kasr tartibli hosila va Caputo ma'nosidagi kasr tartibli hosilalar haqida ma'lumotlar keltirdim. Endi Hilfer ma'nosidagi kasr tartibli hosila va tenglamalar haqida ma'lumotlar keltiraman.

Ta'rif. Ushbu

$$D^{\alpha, \beta} f(t) = I^{\beta(n-\alpha)} \frac{d^n}{dt^n} I^{(1-\beta)(1-\alpha)} f(t) \quad (1)$$

ko'rinishdagi tenglikka Hilfer ma'nosidagi kasr tartibli hosila deyiladi. Bu yerda $n-1 < \alpha < n$, $0 \leq \beta \leq 1$ oraliqlardagi sonlar.

Agar $\beta = 0$ va $n-1 < \alpha < n$ bo'lsa (1) tenglik quyidagi ko'rinishga keladi:

$$D^{\alpha} f(t) = \frac{d^n}{dt^n} I^{(n-\alpha)} f(t) \quad (2)$$

ya'ni, bu biz bilgan Reiman – Liuvell ma'nosidagi kasr tartibli hosila hisoblanadi. $\beta = 1$ va $n-1 < \alpha < n$ bo'lganda esa

$${}^C D^{\alpha} f(t) = I^{(n-\alpha)} \frac{d^n}{dt^n} f(t) \quad (3)$$

Caputo ma'nosidagi kasr tartibli hosilaga kelar ekan. Demak, yuqorida aytganimizdek Hilfer ma'nosidagi kasr tartibli hosila Reiman – Liuvell va Caputo ma'nosidagi kasr tartibli hosilalarning umumiy holi ekan.

Hilfer hosilasi qatnashan differensial tenglamalar.

Hilfer ma'nosidagi kasr tartibli hosila qatnashgan differensial tenglamalar juda ham ko'p bo'lib ulardan ba'zilarini ko'rsatamiz.

Lemma 1. Agar $\mu > n - 1$ bo'lsa u holda quyidagi tenglik o'rinli bo'ladi:

$$D^{\alpha, \beta} t^{\mu} = \frac{\Gamma(\mu + 1)}{\Gamma(\mu + 1 - \alpha)} t^{\mu - \alpha} \quad (4)$$

Isbot. $\mu > n - 1$ bo'lsin. (2.1) tenglikdan m vaqtda farq qilsin

$$\frac{d^n}{dt^n} I^{\delta} t^{\mu} = \frac{\Gamma(\mu + 1)}{\Gamma(\mu + 1 + \delta)} (\mu + \delta) \dots (\mu + \delta - n) t^{\mu + \delta - n}. \quad (5)$$

Endi Gamma funksiyaning $\Gamma(z + 1) = z\Gamma(z)$ xossasidan foydalanamiz.

$$\Gamma(\mu + \delta + 1) = (\mu + \delta) \cdot (\mu + \delta - 1) \dots (\mu + \delta - n + 1) \Gamma(\mu + \delta - n + 1).$$

Endi yuqoridagi tenglikni (2.3.5) ga qo'llaymiz u holda biz quyidagiga ega bo'lamiz

$$\frac{d^n}{dt^n} I^{\delta} t^{\mu} = \frac{\Gamma(\mu + 1)}{\Gamma(\mu + \delta - n + 1)} t^{\mu + \delta - n} \quad (6)$$

Boshqa tomondan

$$I^{\beta(n-\alpha)} t^{\mu + \delta - n} = \frac{\Gamma(\mu + \delta + 1 - n)}{\Gamma(\mu + \delta - n + 1 + \beta(n - \alpha))} t^{\mu + \delta - n + \beta(n - \alpha)}, \quad (7)$$

va

$$\delta + \beta(n - \alpha) = (1 - \beta)(n - \alpha) + \beta(n - \alpha) = n - \alpha,$$

Bundan biz quyidagiga erishamiz

$$D^{\alpha, \beta} t^{\mu} = \frac{\Gamma(\mu + 1)}{\Gamma(\mu + 1 - \alpha)} t^{\mu - \alpha}$$

tasdiq isbotlandi.

Ta'rif. (Kasr tartibli hosilaning limit nuqtasi haqida). $-\infty < a < +\infty$ uchun kasr tartibli hosilaning darajalari $0 < \alpha < 1$ va $0 \leq \beta \leq 1$ bo'lganda $f(x)$ a nuqtadagi limiti deb quyidagi tenglikka aytiladi

$$D^{\alpha, \beta} f(a) = \pm \lim_{x \rightarrow a^{\pm}} D_{a^{\pm}}^{\alpha, \beta} f(x). \quad (8)$$

Tasdiq 1. $f : [a, A] \rightarrow \mathbb{R}$ bo'lsa $a < A < \infty$ oraliqda bo'lsin. Agar $(I_{a+}^{\beta} f)(a)$

$0 \leq \beta \leq 1 - \alpha$ bo'lsa

$$(D_{a+}^{\alpha, \mu} f)(x) = (D_{a+}^{\alpha, \lambda} f)(x) \quad (9)$$

qachonki $0 \leq \mu < \lambda < \frac{1 - \alpha - \beta}{1 - \alpha}$, va

$$(D_{a+}^{\alpha,\mu} f)(x) = \left(D_{a+}^{\alpha,(1-\alpha-\beta)/(1-\alpha)} f \right)(x) + \frac{\left(I_{a+}^{\beta} f \right)(a)}{\Gamma(1-\alpha-\beta)(x-a)^{\alpha+\beta}} \quad (10)$$

Barcha $\mu < \lambda = \frac{1-\alpha-\beta}{1-\alpha}$ lar uchun o'rinli bo'ladi.

Isbot.

$$\left(DI_{a+}^{1-\alpha} f \right)(x) = \frac{f(a)}{\Gamma(1-\alpha)(x-a)^{\alpha}} + \left(I_{a+}^{1-\alpha} Df \right)(x) \quad (11)$$

$g(x)$ ni vaqtinchalik quyidagicha belgilaymiz $g(x) = \left(I_{a+}^{(1-\lambda)(1-\alpha)} f \right)(x)$ va integral operatorning quyidagi xossasidan foydalanamiz $I^{\alpha} I^{\beta} = I^{\alpha+\beta}$.

$$\begin{aligned} (D_{a+}^{\alpha,\lambda} f)(x) &= \left(I_{a+}^{\lambda(1-\alpha)} DI_{a+}^{(1-\lambda)(1-\alpha)} f \right)(x) \\ &= \left(I_{a+}^{\mu(1-\alpha)} I_{a+}^{(\lambda-\mu)(1-\alpha)} Dg \right)(x) \\ &= I_{a+}^{\mu(1-\alpha)} \left((DI_{a+}^{(\lambda-\mu)(1-\alpha)} g)(x) - \frac{(x-a)^{(\lambda-\mu)(1-\alpha)-1}}{\Gamma((\lambda-\mu)(1-\alpha))} g(a) \right) \\ &= (D_{a+}^{\alpha,\mu} f)(x) - \frac{(x-a)^{\lambda(1-\alpha)-1}}{\Gamma(\lambda(1-\alpha))} g(a). \end{aligned} \quad (12)$$

Kasr tartibli integraldan foydalanamiz

$$I_{a+}^{\alpha} (x-a)^{\beta} = \frac{\Gamma(\beta+1)}{\Gamma(\alpha+\beta+1)} (x-a)^{\alpha+\beta} \quad (13)$$

$\lambda < \frac{1-\alpha-\beta}{1-\alpha}$ uchun (9) tenglik o'rinli chunki $g(a) = 0$ bo'ladi, va $\lambda = \frac{1-\alpha-\beta}{1-\alpha}$

bo'lganda esa (10) tenglik o'rinli.

Misol 1. $D_t^{\alpha,\beta}$ - Hilfer ma'nosida kasr tartibli hosilali, $I_{0+}^{1-\beta}$ - R-L kasr tartibli integrali. Bu yerda $0 < \alpha < 1$ va $0 \leq \beta \leq 1$ oraliqlarda bo'lsin. $f(t) \in C((0, \infty); H)$ va $\varphi \in H$.

$$\begin{cases} D_t^{\alpha,\beta} T(t) + \lambda T(t) = f, \\ \lim_{t \rightarrow +0} I_{0+}^{1-\beta} T(t) = \varphi. \end{cases}, \quad t > 0, \quad (14)$$

bu yerda $\varphi, f \in H$. Koshi masalasi berilgan bo'lsin. Tenglamaning yechimi quyidagi ko'rinishda bo'ladi:

$$T(t) = \varphi t^{\beta-1} E_{\alpha,\beta}(-\lambda t^\alpha) + \int_0^t (t-\tau)^{\alpha-1} E_{\alpha,\alpha}(-\lambda(t-\tau)^\alpha) f(\tau) d\tau. \quad (15)$$

Bizda manba funsiyasi $f(t)$ vaqtga bog'liq bo'lmasin. U holda (2.3.14) masala quyidagi masalaga aylanadi:

$$\begin{cases} D_t^{\alpha,\beta} T(t) + \lambda T(t) = f, \\ \lim_{t \rightarrow +0} I_{0+}^{1-\beta} T(t) = \varphi. \end{cases} \quad t > 0, \quad (16)$$

(16) u holda masalani yechishda bizga Mittag - Liffler funksiya integrali yordam berdi. Ya'ni quyidagicha:

$$\int_0^t (t-\tau)^{\alpha-1} E_{\alpha,\alpha}(-\lambda(t-\tau)^\alpha) d\tau = t^\alpha E_{\alpha,\alpha+1}(-\lambda t^\alpha). \quad (17)$$

(15) yechimdan foydalansak

$$\begin{aligned} T(t) &= \varphi t^{\beta-1} E_{\alpha,\beta}(-\lambda t^\alpha) + \int_0^t (t-\tau)^{\alpha-1} E_{\alpha,\alpha}(-\lambda(t-\tau)^\alpha) f(\tau) d\tau \\ &= \varphi t^{\beta-1} E_{\alpha,\beta}(-\lambda t^\alpha) + f \int_0^t (t-\tau)^{\alpha-1} E_{\alpha,\alpha}(-\lambda(t-\tau)^\alpha) d\tau = \\ &= \varphi t^{\beta-1} E_{\alpha,\beta}(-\lambda t^\alpha) + f t^\alpha E_{\alpha,\alpha+1}(-\lambda t^\alpha). \\ T(t) &= \varphi t^{\beta-1} E_{\alpha,\beta}(-\lambda t^\alpha) + f t^\alpha E_{\alpha,\alpha+1}(-\lambda t^\alpha). \end{aligned} \quad (18)$$

Demak, (16) masalaning yechimi (18) ko'rinishida bo'lar ekan.

Foydalanilgan adabiyotlar ro'yhati:

1. qizi Latipova, S. S. (2023). KASR TARTIBLI HOSILA TUSHUNCHASI. SCHOLAR, 1(31), 263-269.
2. qizi Latipova, S. S. (2023). HEAT PHYSICAL MEANING AND ORIGIN OF DIFFUSION EQUATIONS. International Multidisciplinary Journal for Research & Development, 10(12).
3. daughter Latipova, S. S. (2023). HEAT PHYSICAL MEANING AND ORIGIN OF DIFFUSION EQUATIONS. World of Scientific news in Science, 1(2), 163-176.
4. qizi Latipova, S. S. (2024). KASR TARTIBLI ODDIY DIFFERENSIAL TENGLAMALAR. GOLDEN BRAIN, 2(1), 383-390.
5. qizi Latipova, S. S. (2023). MITTAG-LIFFLER FUNKSIYASI VA UNI HISOBLASH USULLARI. Educational Research in Universal Sciences, 2(9), 238-244.
6. qizi Latipova, S. S. (2023). RIMAN-LUIVILL KASR TARTIBLI INTEGRALI VA HOSILASIGA OID AYRIM MASALALARNING ISHLANISHI. Educational Research in Universal Sciences, 2(12), 216-220.
7. qizi Latipova, S. S. (2023). BETA FUNKSIYA XOSSALARI VA BU FUNKSIYA YORDAMIDA

TURLI MASALALARNI YECHISH. GOLDEN BRAIN, 1(34), 66-76.

8. Latipova, S. S. (2023). SOLVING THE INVERSE PROBLEM OF FINDING THE SOURCE FUNCTION IN FRACTIONAL ORDER EQUATIONS. Modern Scientific Research International Scientific Journal, 1(10), 13-23.

9. qizi Latipova, S. S. (2023). SOLVING THE INVERSE PROBLEM OF FINDING THE SOURCE FUNCTION IN FRACTIONAL ORDER EQUATIONS. International Multidisciplinary Journal for Research & Development, 10(12).

10. qizi Latipova, S. S. (2024). CAPUTO MA'NOSIDAGI KASR TARTIBLI TENGLAMALARDA MANBA FUNKSIYANI ANIQLASH BO 'YICHA TO 'G 'RI MASALALAR. GOLDEN BRAIN, 2(1), 375-382.

11. Shahnoza, L. (2023, March). KASR TARTIBLI TENGLAMALARDA MANBA VA BOSHLANG'ICH FUNKSIYANI ANIQLASH BO'YICHA TESKARI MASALALAR. In " Conference on Universal Science Research 2023" (Vol. 1, No. 3, pp. 8-10).

12. Latipova, S. S. qizi . (2024). GAMMA FUNKSIYA. GOLDEN BRAIN, 2(1), 391-399.

13. Bobokulova, M. (2024). IN MEDICINE FROM ECHOPHRAPHY USE. Development and innovations in science, 3(1), 94-103.

14. Bobokulova, M. (2024). INTERPRETATION OF QUANTUM THEORY AND ITS ROLE IN NATURE. Models and methods in modern science, 3(1), 94-109.

15. Bobokulova, M. (2024, January). RADIO WAVE SURGERY. In Международная конференция академических наук (Vol. 3, No. 1, pp. 56-66).

16. Bobokulova, M. (2024). UNCERTAINTY IN THE HEISENBERG UNCERTAINTY PRINCIPLE. Академические исследования в современной науке, 3(2), 80-96.

17. Bobokulova, M. (2024). BLOOD ROTATION OF THE SYSTEM PHYSICIST BASICS. Инновационные исследования в науке, 3(1), 64-74.

18. Sharipova, M. (2024). IN THE FORM OF AN UNBOUNDED PARALLELEPIPED IN THE FIELD NONLOCAL BORDERLINE CONDITIONAL LINEAR THE REVERSE IS THE CASE. Science and innovation in the education system, 3(1), 105-116.

19. Sharipova, M. (2024). FUNCTIONAL SPACES. IN SHORT REFLECTION PRINCIPLE. Current approaches and new research in modern sciences, 3(1), 131-142.

20. Sharipova, M. (2024). A IS CORRECT OF THE INTEGRAL TO THE ECONOMY APPLICATIONS. Solution of social problems in management and economy, 3(1), 116-125.

21. Sharipova, M. (2024). ASYMMETRY AND KURTOSIS COEFFICIENTS. Theoretical aspects in the formation of pedagogical sciences, 3(1), 216-225.

22. Sharipova, M. (2024). TWO MULTIPLE OF THE INTEGRAL APPLICATIONS. Инновационные исследования в науке, 3(1), 135-140.

23. Sharipova, M. P. L. (2023). CAPUTA MA'NOSIDA KASR TARTIBLI HOSILALAR VA UNI HISOBLASH USULLARI. Educational Research in Universal Sciences, 2(9), 360-365.

24. Sharipova, M. P. (2023). MAXSUS SOHALARDA KARLEMAN MATRITSASI. Educational Research in Universal Sciences, 2(10), 137-141.

25. Madina Polatovna Sharipova. (2023). APPROXIMATION OF FUNCTIONS WITH COEFFICIENTS. American Journal of Public Diplomacy and International Studies (2993-2157), 1(9), 135-138.

26. Akhmedova, Z. (2023). CREATION AND PLACEMENT OF INTERACTIVE ELEMENTS. Solution of social problems in management and economy, 2(13), 120-128.

27. Axmedova, Z. I. (2024). LEARNING MANAGEMENT SYSTEM IMKONIYATLARI. GOLDEN BRAIN, 2(1), 509-516.
28. Ikromovna, A. Z. (2023). Programming Environments for Creating Mobile Applications on the Android Operating System. American Journal of Public Diplomacy and International Studies (2993-2157), 1(10), 305-309.
29. Akhmedova, Z. (2023). EDUCATIONAL MANAGEMENT SYSTEMS, ELECTRONIC EDUCATION: TASKS AND OPPORTUNITIES. Theoretical aspects in the formation of pedagogical sciences, 2(21), 171-177.
30. Ikromovna, A. Z. (2023). SQL (STRUCTURED QUERY LANGUAGE) CAPABILITIES OF THE STATISTICAL DATABASE LANGUAGE. Multidisciplinary Journal of Science and Technology, 3(5), 274-280.
31. Sharopova, M. (2024). CREATION OF A DATABASE FOR THE SYSTEM PLATFORM OF NON-GOVERNMENT EDUCATIONAL CENTERS. Current approaches and new research in modern sciences, 3(1), 185-191.
32. Sharopova, M. (2024). DSA ERI STANDARD. ELECTRONIC DIGITAL SIGNATURE OF GOST R 34.10-94. Theoretical aspects in the formation of pedagogical sciences, 3(1), 169-178.
33. Sharopova, M. (2024). COLLECTORS.(OBJECT CONTAINERS). Development of pedagogical technologies in modern sciences, 3(1), 93-101.
34. Sharopova, M. (2024). JAVA PROGRAMMING IN THE LANGUAGE FLOWING INPUT AND RELEASE. Solution of social problems in management and economy, 3(1), 84-93.
35. Ikromovna, A. Z. (2023). SQL (STRUCTURED QUERY LANGUAGE) STATISTICAL PACKAGES OF CAPABILITIES. Best Journal of Innovation in Science, Research and Development, 2(12), 781-787.
36. Akhmedova, Z. (2023). SQL SPECIFICATIONS FOR DATA ANALYSIS. Science and innovation in the education system, 2(13), 113-120.
37. Akhmedova, Z. (2023). DISADVANTAGES OF ELECTRONIC LEARNING. Current approaches and new research in modern sciences, 2(12), 99-109.
38. Behruz Ulug'bek o'g, Q. li.(2023). Mobil ilovalar yaratish va ularni bajarish jarayoni. International journal of scientific researchers, 2(2).
39. Karimov, F. (2022). ANIQ INTEGRALNI TAQRIBIY HISOBLASH. ЦЕНТР НАУЧНЫХ ПУБЛИКАЦИЙ (buxdu.uz), 14(14).
40. Quvvatov, B. (2024). GLOBAL IN VIRTUAL LEARNING MOBILE APP CREATION INFORMATION SYSTEMS AND TECHNOLOGIES. Science and innovation in the education system, 3(1), 95-104.
41. Quvvatov, B. (2024). SQL DATABASES AND BIG DATA ANALYTICS: NAVIGATING THE DATA MANAGEMENT LANDSCAPE. Development of pedagogical technologies in modern sciences, 3(1), 117-124.
42. Quvvatov, B. (2024). CONSTRUCTION OF SPECIAL MODELS THROUGH DIFFERENTIAL EQUATIONS AND PRACTICAL SOLUTIONS. Solution of social problems in management and economy, 3(1), 108-115.
43. Quvvatov, B. (2024). FINDING SOLUTIONS OF SPECIAL MODELS BY INTEGRATING INTEGRAL EQUATIONS AND MODELS. Current approaches and new research in modern sciences, 3(1), 122-130.
44. Quvvatov, B. (2024). WEB FRONT-END AND BACK-END TECHNOLOGIES IN

- PROGRAMMING. Theoretical aspects in the formation of pedagogical sciences, 3(1), 208-215.
45. Behruz Ulug'bek o'g, Q. (2023). USE OF ARTIFICIAL NERVOUS SYSTEMS IN MODELING. Multidisciplinary Journal of Science and Technology, 3(5), 269-273.
46. Просмотр «CALCULATION OF THE THERMODYNAMIC CYCLE OF A VAPOR COMPRESSION HEAT PUMP INSTALLATION WITH A SUBCOOLER FOR HEATING AND HOT WATER SUPPLY.»
47. qizi Sharopova, M. M. (2023). RSA VA EL-GAMAL OCHIQ KALITLI SHIFRLASH ALGORITMI ASOSIDA ELEKTRON RAQMLI IMZOLARI. RSA OCHIQ KALITLI SHIFRLASH ALGORITMI ASOSIDAGI ELEKTRON RAQAMLI IMZO. Educational Research in Universal Sciences, 2(10), 316-319.
48. Sharopova, M. M. qizi . (2023). JAVA TILI YORDAMIDA OB'EKTGA YUNALTIRILGAN DASTURLASH ASOSLARI BILAN TANISHISH. GOLDEN BRAIN, 1(34), 111-119.
49. Sharopova, M. (2023). CHOOSE: COMPOSITION OR INHERITANCE. Science and innovation in the education system, 2(13), 96-102.
50. Sharopova, M. (2023). JAVA PROGRAMMING IN THE LANGUAGE HERITAGE TO DO SYNTAX. Current approaches and new research in modern sciences, 2(12), 82-87.
51. Sharopova, M. (2023). ARRAY AND ARRAYS INSTALLATION. Development of pedagogical technologies in modern sciences, 2(12), 102-107.
52. Муродов, О. Т. (2023). РАЗРАБОТКА АВТОМАТИЗИРОВАННОЙ СИСТЕМЫ УПРАВЛЕНИЯ ТЕМПЕРАТУРЫ И ВЛАЖНОСТИ В ПРОИЗВОДСТВЕННЫХ КОМНАТ. GOLDEN BRAIN, 1(26), 91-95.
53. Murodov, O. T. R. (2023). ZAMONAVIY TA'LIMDA AXBOROT TEXNOLOGIYALARI VA ULARNI QO 'LLASH USUL VA VOSITALARI. Educational Research in Universal Sciences, 2(10), 481-486.
54. Murodov, O. T. (2023). INFORMATIKA FANINI O'QITISHDA YANGI INNOVATION USULLARDAN FOYDALANISH METODIKASI. GOLDEN BRAIN, 1(34), 130-139.
55. Tursunov, B. J., & Allanazarov, G. O. (2019). Perspektivnye tehnologii proizvodstva po uluchsheniyu kachestva benzina. Theory and practice of contemporary science, 3(45), 305-308.
56. Турсунов, Б. Ж., & Алланазаров, Г. О. (2019). Перспективные технологии производства по улучшению качества бензина. Теория и практика современной науки, (3 (45)), 305-308.
57. Tursunov, B. Z. (2023). Analysis of Concepts About the Effect of an Explosion in Solid Wednesday. American Journal of Public Diplomacy and International Studies (2993-2157), 1(10), 296-304.
58. Tursunov, B. Z. (2023). Methods of Control of Explosion Energy Distribution in Rocks. Intersections of Faith and Culture: American Journal of Religious and Cultural Studies (2993-2599), 1(10), 108-117.
59. Tursunov, B. Z. (2023). WASTE-FREE TECHNOLOGY FOR ENRICHMENT OF PURIFIC COPPER-ZINC ORE. American Journal of Public Diplomacy and International Studies (2993-2157), 1(9), 288-293.
60. Tursunov, B. Z. (2023). ANALYSIS OF MODERN METHODS FOR OIL SLUDGE PROCESSING. American Journal of Public Diplomacy and International Studies (2993-2157), 1(9), 280-287.

61. Jumaev, K., & Tursunov, B. (2022, December). Environmentally friendly technology for obtaining fuel briquettes from oil waste. In IOP Conference Series: Earth and Environmental Science (Vol. 1112, No. 1, p. 012005). IOP Publishing.
62. Madina Polatovna Sharipova. (2023). Applications of the double integral to mechanical problems. International journal of sciarchers, 2(2), 101-103.
63. Sharipova, M. P. L. (2023). FINDING THE MAXIMUM AND MINIMUM VALUE OF A FUNCTION ON A SEGMENT. American Journal of Public Diplomacy and International Studies (2993-2157), 1(9), 245-248.
64. Sharipova, M. P. (2023). FUNKSIYALARNI KOEFFITSIENTLAR ORQALI FUNKSIYALARNI YAKINLASHTIRISH HAQIDA MA'LUMOTLAR. GOLDEN BRAIN, 1(34), 102-110.
65. Sharipova, M. (2023, December). RELATIONSHIPS BETWEEN STRAIGHT LINES AND PLANES IN SPACE. In Международная конференция академических наук (Vol. 2, No. 12, pp. 60-66).
66. Sharipova, M. (2023). FRACTIONAL DERIVATIVES. Академические исследования в современной науке, 2(27), 106-113.
67. Sharipova, M. (2023). CORRECT PLACED AND CORRECT NOT PLACED ISSUES. Models and methods in modern science, 2(13), 115-121.
68. Sharipova, M. (2023). HEAT SPREAD EQUATION. Инновационные исследования в науке, 2(12), 50-56.
69. Madina Polatovna Sharipova. (2023). HIGH MATH SCORE AND INTERVAL ASSESSMENT. American Journal of Public Diplomacy and International Studies (2993-2157), 1(10), 420-424.
70. Madina Polatovna Sharipova. (2023). IN HIGHER MATHEMATICS, THE EXTREMUM OF A MULTIVARIABLE FUNCTION. American Journal of Public Diplomacy and International Studies (2993-2157), 1(10), 425-429.
71. Sharipova, M. P. (2024). ISSIQLIK TARQALISH TENGLAMASI UCHUN KOSHI MASALASI. GOLDEN BRAIN, 2(1), 525-532.
72. Sharopova, M. (2023). CLASSES AGAIN APPLY. Solution of social problems in management and economy, 2(13), 106-111.
73. qizi Sharopova, M. M. (2023). INTRODUCING "PROGRAM CONTROL OPERATORS" IN THE JAVA PROGRAMMING LANGUAGE. Multidisciplinary Journal of Science and Technology, 3(5), 222-231.
74. qizi Sharopova, M. M. (2023). Working with folders in the JAVA programming language. Multidisciplinary Journal of Science and Technology, 3(5), 232-236.
75. Behruz Ulugbek og, Q. (2023). TECHNOLOGY AND MEDICINE: A DYNAMIC PARTNERSHIP. International Multidisciplinary Journal for Research & Development, 10(11).
76. Quvvatov, B. (2024). DIFFERENTIAL TENGLAMALAR VA AMALIY ECHIMLAR ORQALI MAXSUS MODELLARNI QURISH. Menejment va iqtisodiyotda ijtimoiy muammolarni hal qilish, 3 (1), 108-115.
77. Behruz Ulug'bek o'g', Q. (2023). SUN'IY NERV TIZIMLARIDAN MODELLASHDA FOYDALANISH. Fan va texnologiyaning ko'p tarmoqli jurnali, 3 (5), 269-273.
78. Behruz Ulug'bek og', Q. (2023). TEXNOLOGIYA VA TIBBIYOT: DINAMIK HAMKORLIK. Tadqiqot va ishlanmalar bo'yicha xalqaro multidisipliner jurnali, 10 (11).

79. Zulxumor, A. (2022). IMPLEMENTATION OF INTERACTIVE COURSES IN THE EDUCATIONAL PROCESS. ILMIY TADQIQOT VA INNOVATSIYA, 1(6), 128-132.
80. Axmedova, Z. (2023). MOODLE TIZIMI VA UNING IMKONIYATLARI. Development and innovations in science, 2(11), 29-35.
81. Ikromovna, A. Z. (2023). USING THE USEFUL ASPECTS OF THE MOODLE SYSTEM AND ITS POSSIBILITIES. American Journal of Public Diplomacy and International Studies (2993-2157), 1(9), 201-205.
82. Axmedova, Z. I. (2023). LMS TIZIMIDA INTERAKTIV ELEMENTLARNI YARATISH TEXNOLOGIYASI. Educational Research in Universal Sciences, 2(11), 368-372.

