EKSTREMUMLARNING YUQORI TARTIBLI HOSILA YORDAMIDA TEKSHIRILISHI. IKKINCHI TARTIBLI HOSILA YORDAMIDA EKSTREMUMGA TEKSHIRISH.

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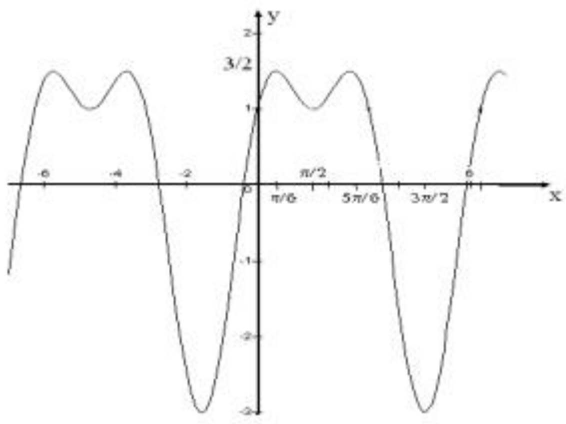
ANNOTATSIYA.

Ushbu maqolada funksiyani yuqori tartibli hosila yordamida tekshirish yo'llari grafiklari chizib yangi usullar ko'rsatilgan.

Kalit so'zlar: Teyler formulasi, minimum, maksimum, chegara.

Teorema. Faraz qilaylik $f(x)$ funksiya x_0 nuqtada birinchi va ikkinchi tartibli hosilalarga ega va $f'(x_0)=0$ bo'lsin. U holda agar $f''(x_0)<0$ bo'lsa, u holda x_0 nuqta $f(x)$ funksiyaning maksimum nuqtasi, agar $f''(x_0)>0$ bo'lsa, minimum nuqtasi bo'ladi.



Isbot. $f(x)$ funksiya x_0 nuqtada birinchi va ikkinchi tartibli hosilalarga ega va $f'(x_0)=0$, $f''(x_0)<0$ bo'lsin. Demak, $x_0$kritik nuqtada $f'(x)$ kamayuvchi, ya'ni "xÎ$x_0-d;x_0$) lar uchun $f'(x)>f'(x_0)=0$ va bo'ladi. Bu esa x_0 nuqtadan o'tishda hosila o'z ishorasini «+» dan «-» ga o'zgartirishini, demak, x_0 maksimum nuqta ekanligini bildiradi.

4-chizma

$f''(x_0)>0$ bo'lgan holda x_0 ning minimum nuqta bo'lishi shunga o'xshash isbotlanadi.

Isbotlangan teoremaga asoslanib, ikkinchi tartibli hosila yordamida funksiyani ekstremumga tekshirishning quyidagi qoidasini keltiramiz.

1-qoida. $f(x)$ funksiyaning ga tekshirish uchun

1) $f'(x)=0$ tenglamaning barcha yechimlarini topamiz;

2) har bir statsionar nuqtada (ya'ni hosilani nolga aylantiradigan nuqtada) $f''(x_0)$ ni hisoblaymiz. Agar $f''(x_0)<0$ bo'lsa, x_0 maksimum nuqtasi, $f''(x_0)>0$ bo'lsa, x_0 minimum nuqtasi bo'ladi.

3) nuqtalar qiymatini $y=f(x)$ qo'yib, $f(x)$ ning qiymatlarini topamiz.

Umuman aytganda, bu qoidaning qoʻllanish doirasi torroq masalan, u chekli birinchi tartibli hosila mavjud boʻlmagan nuqtalarga qoʻllanila olmasligi oʻz-oʻzidan ravshan. Ikkinchi tartibli hosila nolga aylangan yoki mavjud boʻlmagan nuqtada ham qoida aniq natija bermaydi.

Misol. Ikkinchi tartibli hosila yordamida *y=2sinx+cos2x* funksiya ekstremumlarini aniqlang.

Yechish. Funksiya davriy boʻlganligi sababli [0;2p] kesma bilan cheklanishimiz mumkin. Funksiyaning birinchi va ikkinchi tartibli hosilalarini topamiz:

y'=2cosx-2sin2x=2cosx(1-2sinx); *y''=-2sinx-4cos2x.*

Ushbu *2cosx(1-2sinx)*=0 tenglamadan funksiyaning [0;2p] kesmaga tegishli boʻlgan kritik nuqtalarini topamiz: $x_1=p/6$; $x_2=p/2$; $x_3=5p/6$; $x_4=3p/2$. Endi har bir kritik nuqtada ikkinchi tartibli hosila ishorasini aniqlaymiz va tegishli xulosa chiqaramiz:

y''(p/6)=-3<0, demak x_1=p/6 nuqtada *y(p/6)*=3/2 maksimum mavjud.
y''(p/2)=2>0, demak x_2=p/2 nuqtada y(p/2)=1 minimum mavjud.
y''(5p/6)=-3<0, demak x_3=5p/6 nuqtada *y(5p/6)*=3/2 maksimum mavjud.
y''(3p/2)=6>0, demak $x_4=3p/2$ nuqtada *y(3p/2)*=-3 minimum mavjud.

Bu funksiyaning (-2p;2p) intervaldagi grafigi 4-chizmada keltirilgan.

Biz o'tgan mavzularda funksiyaning ekstremumi mavjud bo'lishining 2-yetarlilik shartini bayon qilganda ekstremum topishni ikkinchi tartibli hosila yordamida topishni keltirib o'tgan edik. Endi ekstremumlarni **Teylor formulasi** yardamida tekshirishni ko'rib o'tamiz.

$f(x)f(x)$ funksiya $x=x_0 x=x_0$ nuqta atrofida uzluksiz n-tartibli hosilaga ega va $x=x_0 x=x_0$ nuqtada $(n-1)(n-1)$ tartibgacha bo'lgan xosilalarning hammasi nolga teng deb, faraz qilamiz:

$f'(x_0)=f''(x_0)=\cdots=\ f^{(n-1)}(x_0)=0 \quad f^{(n)}(x_0)\neq 0$
$f'(x_0)=f''(x_0)=\cdots=\ f^{(n-1)}(x_0)=0 \quad f^{(n)}(x_0)\neq 0$ ni hisobga olib, $f(x)f(x)$ funksiya uchun Teylor formulasini yozamiz:

$$f(x)=f(x_0)+\frac{f^{(n)}(\xi)}{n!}(x-x_0)^n$$

Bunda soni $x_0\ va\ x x_0\ va\ x$ lar orasidagi son.

$f^{(n)}(x)f^{(n)}(x)$ funksiya x_0x_0 nuqtaning atrofida uzluksiz va $f^{(n)}(x_0)\neq 0$ $f^{(n)}(x_0)\neq 0$ bo'lgani uchun, uzluksiz funksiyalar ishoralarning saqlanish xossasiga ko'ra, x_0x_0 nuqta atrofi topiladiki, bu atrofning har qaysi x nuqtasida $f^{(n)}(x)\neq 0 f^{(n)}(x)\neq 0$

Bunda, agar $f^{(n)}(x) > 0 f^{(n)}(x) > 0$ agar $f^{(n)}(x_0) < 0 f^{(n)}(x_0) < 0$ bo'lsa, u holda $x_0 x_0$ nuqta atrofining hamma x nuqtalarida $f^{(n)}(x) < 0 f^{(n)}(x) < 0$ uzluksiz funksiya ishorasining saqlanishining bu xossasi bundan keying tekshirishimizda yordam berishi mumkun.

$f(x) = f(x_0) + \frac{f^{(n)}(\xi)}{n!}(x - x_0)^n f(x) = f(x_0) + \frac{f^{(n)}(\xi)}{n!}(x - x_0)^n$ (1)formulani quyidagicha yozamiz.

$f(x) = f(x_0) + \frac{f^{(n)}(\xi)}{n!} f(x) = f(x_0) + \frac{f^{(n)}(\xi)}{n!}$ (2)

Xar hil xususiy hollarni ko'ramiz:

Birinchi xol. $n \rightarrow n \rightarrow$ juft son.

a) $f^{(n)}(x_0) < 0 f^{(n)}(x_0) < 0$ bo'lsin, u holda $x_0 x_0$ nuqtaning kichik atrofiga tegishli barcha x nuqtalarda $f^{(n)}(x) < 0 f^{(n)}(x) < 0$ demak, $f^{(n)}(\xi) < 0$ $f^{(n)}(\xi) < 0$ chunki qiymat $x_0\ va\ x x_0\ va\ x$

orasida yotadi. Ammo n-juft son, shu sababli $x \neq x_0 x \neq x_0$ da $(x - x_0)^n > 0$ $(x - x_0)^n > 0$ shunga ko'ra $x \neq x_0\ da\ \frac{f^{(n)}()}{n!}(x - x_0)^n < 0$ $x \neq x_0\ da\ \frac{f^{(n)}()}{n!}(x - x_0)^n < 0$ demak (2)dan $x_0 x_0$ nuqtaning atrofiga tegishli hamma x lar uchun $f^{(x)} - f(x_0) < 0 f^{(x)} - f(x_0) < 0$ yoki $f f(x_0) > f(x)$ $x_0) > f(x)$ ekani kelib chiqadi. Bu esa $x = x_0 x = x_0$ da funksiya funksiya maksimumga ega ekanini bildiradi.

b) $f^{(n)}(x_0) > 0 f^{(n)}(x_0) > 0$ bo'lsin. U holda $x_0 x_0$ nuqtaning kichik atrofida $f^{(n)}(x) > 0 f^{(n)}(x) > 0$ tengsizlik o'rinli bo'ladi, demak, $f^{(n)}(\xi) > 0$ $f^{(n)}(\xi) > 0$ tengsizlik ham o'rinli bo'ladi, chunki son $x\ va\ x_0 x\ va\ x_0$ lar orasida yotadi. Demak, $x \neq x_0 x \neq x_0$ da $\frac{f^{(n)}(\xi)}{n!}(x - x_0)^n > 0$ $\frac{f^{(n)}(\xi)}{n!}(x - x_0)^n > 0$ shu sababli (2)dan $x_0 x_0$ nuqta atrofiga tegishli hamma x lar uchun $f(x) - f(x_0) > 0 f(x) - f(x_0) > 0$ yoki $f(x_0) < f(x)$ $f(x_0) < f(x)$ ekani kelib chiqadi. Bu esa $x \neq x_0 x \neq x_0$ da funksiya **minimum**ga ega ekanini bildiradi.

Ikkinchi hol. N$\rightarrow noq\ son \rightarrow noq\ son$

Bu holda n$\rightarrow toq\ son \rightarrow toq\ son$ va $(x-x_0)^n(x-x_0)^n$ miqdor $x<x_0$ $x<x_0$ va $x>x_0x>x_0$ da har hil ishorali bo`ladi.

a)$f^{(n)}(x_0)f^{(n)}(x_0)$<0 bo`lsin, u holda x_0x_0 nuqtaning shunday atrofi topiladiki, unda $f^{(n)}(x)<0f^{(n)}(x)<0$ va demak $f^{(\xi)}<0f^{(\xi)}<0$ Shu sababli $x<x_0x<x_0$ lar uchun

$$\frac{f^{(n)}(\xi)}{n!}(x-x_0)^n>0$$

$ga, x>x_0ga, x>x_0$ lar uchun esa

$\frac{f^{(n)}(\xi)}{n!}(x-x_0)^n<0\frac{f^{(n)}(\xi)}{n!}(x-x_0)^n<0$ ga ega bo'lamiz.

Demak(2) dan x<x_0x_0 lar uchun $f(x)-f(x_0)>0f(x)-f(x_0)>0$ yoki $f(x)>fx_0)f(x)>fx_0)$

$x>x_0x>x_0$ lar uchun esa $f(x)-f(x_0)f(x)-f(x_0)$ ekani kelib chiqadi.

Bu esa $x=x_0x=x_0$ da minimum ham,maksimum ham mavjud emasligini,funksiya esa kamayuvchi ekanini bildiradi.

Olingan natijalani umumlashtirib quyidagi xulosalarga kelish mumkin.

Agar $x=x_0x=x_0$ da $f`(x_0)=f"(x_0)=\cdots=f^{(n-1)}(x_0)=0$ $f`(x_0)=f"(x_0)=\cdots=f^{(n-1)}(x_0)=0$

va $f^{(n)}(x_0)\neq 0f^{(n)}(x_0)\neq 0$ ga ega bo`lsak, u holda:

a) n-juft son bo`lganda ekstremum mavjud:agar $f^{(n)}(x_0)<0f^{(n)}(x_0)<0$ bo`lsa, f(x) maxsimumga ega.

b) n-toq son bo`lganda ekstremum mavjud emas; $f^{(n)}(x_0)<0f^{(n)}(x_0)<0$ bo`lsa, f(x) kamayuvchi, $f^{(n)}(x_0)>0bo`lsa\ f^{(n)}(x_0)>0bo`lsa$, f(x) o`suvchi.

Misol. Ushbu funksiyani ekstremumga tekshiring:

$$f(x)=x^4-4x^3+6x^2-4x+1$$

Yechish:

1) Birinchi hosilani topamiz:

$$f`(x)=4x^3-12x^2+12x-4$$

2) Kritik nuqtalarni aniqlaymiz:

$$4x^3-12x^2+12x-4=0$$

$$x^3-3x^2+3x-1=0$$

Bundan $(x-1)^3=0(x-1)^3=0$ x=1 kritik nuqta

3) Kritik nuqtada funksiyaning yuqori tartibli hosilalarini tekshiramiz:

$f''(x) = 12x^3 - 24x + 12 f''(1) = 0$

$f'''(x) = 24x - 24f'''(1) = 0$

$f^{V}(x) = 24 > 0 f^{V}(x) = 24 > 0$ (barcha x lar uchun)

Demak x=1 da f(x) funksiya minimumga ega.

Foydalanilgan adabiyotlar ro'yhati:

1. Latipova, S. (2024). YUQORI SINF GEOMETRIYA MAVZUSINI O'QITISHDA YANGI PEDAGOGIK TEXNOLOGIYALAR VA METODLAR. SINKVEYN METODI, VENN DIAGRAMMASI METODLARI HAQIDA. Theoretical aspects in the formation of pedagogical sciences, 3(3), 165-173.
2. Latipova, S. (2024, February). SAVOL-JAVOB METODI, BURCHAKLAR METODI, DEBAT (BAHS) METODLARI YORDAMIDA GEOMETRIYANI O'RGANISH. In Международная конференция академических наук (Vol. 3, No. 2, pp. 25-33).
3. Latipova, S., & Sharipova, M. (2024). KESIK PIRAMIDA MAVZUSIDA FOYDALANILADIGAN YANGI PEDAGOGIK TEXNOLOGIYALAR. 6X6X6 METODI, BBB (BILARDIM, BILMOQCHIMAN, BILIB OLDIM) METODLARI HAQIDA. Current approaches and new research in modern sciences, 3(2), 40-48.
4. Latipova, S. (2024). 10-11 SINFLARDA STEREOMETRIYA OQITISHNING ILMIY VA NAZARIY ASOSLARI. Академические исследования в современной науке, 3(6), 27-35.
5. Latipova, S. (2024). HILFER HOSILASI VA UNI HISOBLASH USULLARI. Центральноазиатский журнал образования и инноваций, 3(2), 122-130.
6. Latipova, S. (2024). HILFER MA'NOSIDA KASR TARTIBLI TENGLAMALAR UCHUN KOSHI MASALASI. Development and innovations in science, 3(2), 58-70.
7. Latipova, S. (2024). KESIK PIRAMIDA TUSHUNCHASI. KESIK PIRAMIDANING YON SIRTINI TOPISH FORMULALARI. Models and methods in modern science, 3(2), 58-71.
8. 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).
9. 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.
10. 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.

11. Sharipova, M., & Latipova, S. (2024). TAKRORIY GRUPPALASHLAR. Development of pedagogical technologies in modern sciences, 3(3), 134-142.
12. Sharipova, M. (2024). TAQQOSLAMA TUSHUNCHASI VA UNING XOSSALARI. Current approaches and new research in modern sciences, 3(2), 68-78.
13. Sharipova, M. (2024). IKKI O'ZGARUVCHILI TENGSIZLIKLAR SISTEMASINI TAQQOSLAMALAR USULI BILAN YECHISH. Development and innovations in science, 3(2), 97-105.
14. Sharipova, M. (2024). BIRINCHI DARAJALI TAQQOSLAMALARNI YECHISH USULLARI. Solution of social problems in management and economy, 3(2), 60-69.
15. Latipova, S., & Sharipova, M. (2024). KESIK PIRAMIDA MAVZUSIDA FOYDALANILADIGAN YANGI PEDAGOGIK TEXNOLOGIYALAR. 6X6X6 METODI, BBB (BILARDIM, BILMOQCHIMAN, BILIB OLDIM) METODLARI HAQIDA. Current approaches and new research in modern sciences, 3(2), 40-48.
16. 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.
17. Sharipova, M. (2024). FUNCTIONAL SPACES. IN SHORT REFLECTION PRINCIPLE. Current approaches and new research in modern sciences, 3(1), 131-142.
18. 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.
19. Sharipova, M. (2024). ASYMMETRY AND KURTOSIS COEFFICIENTS. Theoretical aspects in the formation of pedagogical sciences, 3(1), 216-225.
20. Sharipova, M. (2024). TWO MULTIPLE OF THE INTEGRAL APPLICATIONS. Инновационные исследования в науке, 3(1), 135-140.
21. Sharipova, M. P. L. (2023). CAPUTA MA'NOSIDA KASR TARTIBLI HOSILALAR VA UNI HISOBLASH USULLARI. Educational Research in Universal Sciences, 2(9), 360-365.
22. Sharipova, M. P. (2023). MAXSUS SOHALARDA KARLEMAN MATRITSASI. Educational Research in Universal Sciences, 2(10), 137-141.
23. Madina Polatovna Sharipova. (2023). APPROXIMATION OF FUNCTIONS WITH COEFFICIENTS. American Journal of Public Diplomacy and International Studies (2993-2157), 1(9), 135–138.

24. Bobokulova, M. (2024). IN MEDICINE FROM ECHOPHRAPHY USE. Development and innovations in science, 3(1), 94-103.
25. Bobokulova, M. (2024). INTERPRETATION OF QUANTUM THEORY AND ITS ROLE IN NATURE. Models and methods in modern science, 3(1), 94-109.
26. Bobokulova, M. (2024, January). RADIO WAVE SURGERY. In Международная конференция академических наук (Vol. 3, No. 1, pp. 56-66).
27. Bobokulova, M. (2024). UNCERTAINTY IN THE HEISENBERG UNCERTAINTY PRINCIPLE. Академические исследования в современной науке, 3(2), 80-96.
28. Bobokulova, M. (2024). BLOOD ROTATION OF THE SYSTEM PHYSICIST BASICS. Инновационные исследования в науке, 3(1), 64-74.
29. Bobokulova, M. (2024). THE ROLE OF NANOTECHNOLOGY IN MODERN PHYSICS. Development and innovations in science, 3(1), 145-153.
30. Boboqulova, M. X. (2023). STOMATOLOGIK MATERIALLARNING FIZIK-MEXANIK XOSSALARI. Educational Research in Universal Sciences, 2(9), 223-228.
31. Xamroyevna, B. M. (2023). ORGANIZM TO ‘QIMALARINING ZICHLIGINI ANIQLASH. GOLDEN BRAIN, 1(34), 50-58.
32. Bobokulova, M. K. (2023). IMPORTANCE OF FIBER OPTIC DEVICES IN MEDICINE. Multidisciplinary Journal of Science and Technology, 3(5), 212-216.
33. Khamroyevna, M. B. (2023). PHYSICO-CHEMICAL PROPERTIES OF BIOLOGICAL MEMBRANES, BIOPHYSICAL MECHANISMS OF MOVEMENT OF SUBSTANCES IN THE MEMBRANE. Multidisciplinary Journal of Science and Technology, 3(5), 217-221.
34. Bobokulova, M. K. (2024). TOLALI OPTIKA ASBOBLARINING TIBBIYOTDAGI AHAMIYATI. GOLDEN BRAIN, 2(1), 517–524.
35.
36. Axmedova, Z. I. (2024). LEARNING MANAGEMENT SYSTEM IMKONIYATLARI. GOLDEN BRAIN, 2(1), 509-516.
37. Akhmedova, Z. (2024). DATA BY COMBINING MAIL THROUGH TO SEND METHODS. Theoretical aspects in the formation of pedagogical sciences, 3(1), 198-207.
38. Axmedova, Z. (2024). KOMPYUTER TESTLARINING MAQSADLARI, MAZMUNI VA TUZILISHI. B THEORETICAL ASPECTS IN THE FORMATION OF PEDAGOGICAL SCIENCES (T. 3, Выпуск 3, сс. 211–222).

39. Akhmedova, Z., & Rahmatova, N. (2024). LMS (LEARNING MANAGEMENT SYSTEM) LEARNING MANAGEMENT SYSTEM FEATURES. Science and innovation in the education system, 3(1), 85-94.
40. Akhmedova, Z. (2024). CREATION OF A DATABASE FOR THE SYSTEM PLATFORM OF NON-GOVERNMENT EDUCATIONAL CENTERS. Development of pedagogical technologies in modern sciences, 3(1), 106-116.
41. Akhmedova, Z. (2024). IPHONE OPERATIONAL IN THE SYSTEM MOBILE APPLICATIONS TO CREATE INTENDED PROGRAMMING ENVIRONMENTS. Current approaches and new research in modern sciences, 3(1), 111-121.
42. Axmedova, Z. I. (2023). MA'LUMOTLAR BAZASI BOSHQARISH TIZIMLARI. GOLDEN BRAIN, 1(34), 40-49.
43. Akhmedova, Z. (2023). CREATION AND PLACEMENT OF INTERACTIVE ELEMENTS. Solution of social problems in management and economy, 2(13), 120-128.
44. 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.
45. Akhmedova, Z. (2023). EDUCATIONAL MANAGEMENT SYSTEMS, ELECTRONIC EDUCATION: TASKS AND OPPORTUNITIES. Theoretical aspects in the formation of pedagogical sciences, 2(21), 171-177.
46. Ikromovna, A. Z. (2023). SQL (STRUCTURED QUERY LANGUAGE) CAPABILITIES OF THE STATISTICAL DATABASE LANGUAGE. Multidisciplinary Journal of Science and Technology, 3(5), 274-280.
47. 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.
48. Akhmedova, Z. (2023). SQL SPECIFICATIONS FOR DATA ANALYSIS. Science and innovation in the education system, 2(13), 113-120.
49. Akhmedova, Z. (2023). DISADVANTAGES OF ELECTRONIC LEARNING. Current approaches and new research in modern sciences, 2(12), 99-109.
50. Axmedova, Z. (2023). MOODLE TIZIMI VA UNING IMKONIYATLARI. Development and innovations in science, 2(11), 29-35.
51. 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.

52. Axmedova, Z. I. (2023). LMS TIZIMIDA INTERAKTIV ELEMENTLARNI YARATISH TEXNOLOGIYASI. Educational Research in Universal Sciences, 2(11), 368-372.
53. Axmedova, Z. (2024). KOMPYUTER TESTLARINING MAQSADLARI, MAZMUNI VA TUZILISHI. Theoretical aspects in the formation of pedagogical sciences, 3(3), 211-222.
54. Axmedova, Z. (2024). NODAVLAT O'QUV MARKAZLARI TIZIMI PLATFORMASI UCHUN MOBIL ILOVA YARATISH. Академические исследования в современной науке, 3(6), 162-179.
55. Axmedova, Z. (2024). NODAVLAT O'QUV MARKAZLARI TIZIMI PLATFORMASI UCHUN MA'LUMOTLAR BAZASINI YARATISH. Science and innovation in the education system, 3(3), 83-93.
56. Akhmedova, Z. (2024). STRUCTURES OF SMALL DATABASE MANAGEMENT SYSTEMS. Solution of social problems in management and economy, 3(1), 97-107.
57. Behruz Ulug'bek o'g, Q. li.(2023). Mobil ilovalar yaratish va ularni bajarish jarayoni. International journal of scientific researchers, 2(2).
58. Karimov, F. (2022). ANIQ INTEGRALNI TAQRIBIY HISOBLASH. ЦЕНТР НАУЧНЫХ ПУБЛИКАЦИЙ (buxdu. uz), 14(14).
59. 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.
60. 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.
61. 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.
62. 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.
63. Quvvatov, B. (2024). WEB FRONT-END AND BACK-END TECHNOLOGIES IN PROGRAMMING. Theoretical aspects in the formation of pedagogical sciences, 3(1), 208-215.
64. Behruz Ulug'bek o'g, Q. (2023). USE OF ARTIFICIAL NERVOUS SYSTEMS IN MODELING. Multidisciplinary Journal of Science and Technology, 3(5), 269-273.

65. Behruz Ulugbek og, Q. (2023). TECHNOLOGY AND MEDICINE: A DYNAMIC PARTNERSHIP. International Multidisciplinary Journal for Research & Development, 10(11).
66. Quvvatov, B. (2024). DIFFERENTSIAL TENGLAMALAR VA AMALIY ECHIMLAR ORQALI MAXSUS MODELLARNI QURISH. Menejment va iqtisodiyotda ijtimoiy muammolarni hal qilish , 3 (1), 108-115.
67. Behruz Ulug‘bek o‘g‘, Q. (2023). SUN'IY NERV TIZIMLARIDAN MODELLASHDA FOYDALANISH. Fan va texnologiyaning ko'p tarmoqli jurnali , 3 (5), 269-273.
68. Behruz Ulug‘bek og‘, Q. (2023). TEXNOLOGIYA VA TIBBIYOT: DİNAMIK HAMKORLIK. Tadqiqot va ishlanmalar bo'yicha xalqaro multidisipliner jurnali , 10 (11).
69. Quvvatov, B. (2024). ALGEBRAIK ANIQLIGI YUQORI BOLGAN KVADRATUR FORMULALAR. GAUSS KVADRATUR FORMULALARI. Models and methods in modern science, 3(2), 114-125.
70. Quvvatov, B. (2024). ALGEBRAIK ANIQLIGI YUQORI BOLGAN KVADRATUR FORMULALAR. ORTOGONAL KOPHADLAR. Инновационные исследования в науке, 3(2), 47-59.
71. Quvvatov, B. (2024, February). ALGEBRAIK ANIQLIGI YUQORI BOLGAN KVADRATUR FORMULALAR. REKURSIV TRAPETSIYALAR QOIDASI. In Международная конференция академических наук (Vol. 3, No. 2, pp. 41-51).
72. Murodov, O. (2024). DEVELOPMENT OF AN AUTOMATED PARAMETER CONTROL SYSTEM ROOMS AND WORKSHOPS BASED ON CLOUD TECHNOLOGIES. Академические исследования в современной науке, 3(2), 16-27.Murodov, O. T. R. (2023). Zamonaviy ta’limda axborot texnologiyalari va ularni qo ‘llash usul va vositalari. Educational Research in Universal Sciences, 2(11), 481-486.
73. Муродов, О. Т. (2023). РАЗРАБОТКА АВТОМАТИЗИРОВАННОЙ СИСТЕМЫ УПРАВЛЕНИЯ ТЕМПЕРАТУРЫ И ВЛАЖНОСТИ В ПРОИЗВОДСТВЕННЫХ КОМНАТ. GOLDEN BRAIN, 1(26), 91-95.
74. Murodov, O. T. R. (2023). INFORMATIKA DARSLARINI TASHKIL ETISHDA INNOVATSION USULLARDAN FOYDALANISH. GOLDEN BRAIN, 1(32), 194-201.
75. Murodov, O. T. R. (2023). INFORMATIKA FANINI O ‘QITISHDA YANGI INNOVATSION USULLARDAN FOYDALANISH METODIKASI. GOLDEN BRAIN, 1(34), 130-139.

76. Turakulovich, M. O. (2023). DEVELOPMENT AND INSTALLATION OF AN AUTOMATIC TEMPERATURE CONTROL SYSTEM IN ROOMS. International Multidisciplinary Journal for Research & Development, 10(12).
77. MURODOV, O. T. (2023). INNOVATIVE INFORMATION TECHNOLOGIES AND NEW METHODS AND TOOLS FOR THEIR APPLICATION IN TODAY'S EDUCATION. International Multidisciplinary Journal for Research & Development, 10(12).
78. Muradov, O. (2024, January). APPLICATION OF BASIC PRINCIPLES AND RULES OF INNOVATIVE PEDAGOGICAL TECHNOLOGIES TO EDUCATIONAL PROCESSES. In Международная конференция академических наук (Vol. 3, No. 1, pp. 46-55).
79. Muradov, O. (2024). BASIC PRINCIPLES AND RULES OF INNOVATIVE PEDAGOGICAL TECHNOLOGIES IN THE EDUCATIONAL PROCESS. Models and methods in modern science, 3(1), 84-93.
80. Muradov, O. (2024). APPLIED TO THE CURRENT TRAINING PROCESS REQUIREMENTS. Инновационные исследования в науке, 3(1), 54-63.
81. Murodov, O. (2024). DEVELOPMENT OF AN AUTOMATED PARAMETER CONTROL SYSTEM ROOMS AND WORKSHOPS BASED ON CLOUD TECHNOLOGIES. Академические исследования в современной науке, 3(2), 16-27.
82. Tursunov, B. J., & Allanazarov, G. O. (2019). Perspektivnye tehnologii proizvodstva po uluchsheniyu kachestva benzina. Theory and practice of contemporary science, 3(45), 305-308.
83. Турсунов, Б. Ж., & Алланазаров, Г. О. (2019). Перспективные технологии производства по улучшению качества бензина. Теория и практика современной науки, (3 (45)), 305-308.
84. 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.
85. 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.
86. 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.

87. 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.
88. 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.