Mellin Integral Replacement and its Applications

J. Mamayusupov
Assistant, Department of Higher Mathematics, Fergana Polytechnic Institute, Fergana, Uzbekistan

A. Sattarov
Assistant, Department of Higher Mathematics, Fergana Polytechnic Institute, Fergana, Uzbekistan

ABSTRACT

Oscillation processes in nature are described by differential equations. Further studies show that many biological processes can be reduced to fractional differential equations. Therefore, the study of such equations and the problems posed to them has important theoretical and practical significance. This article deals with Mellin's integral substitution and its applications.

Keywords: differential equations, Euler integral, Abel integral equation, Bisadze-Likov equation, Mellin's integral substitution.

Introduction

Raising the young generation of our country to be physically healthy, intellectually developed, independent-thinking, with a firm life position, loyal to the Motherland, deepening democratic reforms and increasing their social activity in the process of civil society development are the five priorities for the development of the Republic of Uzbekistan in 2017-2021 are defined as important tasks in the "Strategy of Action" [1-4]. In the decision of the President of the Republic of Uzbekistan Sh.M. Mirziyoyev, section 4.4 of the "Strategy of Actions" on the five priority directions of the development of the Republic of Uzbekistan in 2017-2021 is aimed at the development of the field of education and science [5-9]. To continue the path of further improvement of the continuous education system, to increase opportunities for quality education services, training of highly qualified personnel in accordance with the modern needs of the labor market; in connection with the strengthening of their material and technical base by carrying out work on the construction, reconstruction, capital repair of educational institutions, equipping them with modern educational and laboratory equipment, computer equipment and teaching-methodical manuals taking measures aimed at a specific goal; expanding the network of preschool educational institutions for children, fundamentally improving the conditions in preschool educational institutions for all-round intellectual, aesthetic and physical development of children, increasing the inclusion of children in preschool education and ensuring its convenience, pedagogy and raising the level of qualifications of specialists; to fundamentally improve the quality of general secondary education, in-depth study of other important and highly demanded subjects such as foreign languages, computer science, mathematics, physics, chemistry, biology; construction of new children's sports facilities, children's music and art schools, reconstruction of existing ones in order to attract children to engage in sports in a mass way, to connect them with the world of music and art; improvement of training and employment of students of vocational colleges in specialties that meet the needs of the market economy and employers; on the basis of the introduction of international standards for the assessment of the quality of education and training, to increase the quality and efficiency of the activities of higher educational institutions, to gradually increase the admission quotas to higher educational institutions [10-19].

Euler integral of the first type (beta function)

The beta function is defined by this equation.

$$B(a,b)=\int_0^1 x^{\alpha-1}(1-x)^{b-1}dx \quad (1.1.1)$$

The integral on the right side of this equation is called Euler's integral of the first kind.

It is not difficult to show that $a>0$ and $b>0$ when (1.1.1) is integrally convergent, if a and b is an outlier if any of the parameters is equal to or less than zero.

(1.1.1) in the integral $x=1-t$ by replacing

$$B(a,b)=\int_0^1 t^{b-1}(1-t)^{a-1}dt=B(b,a)$$

we form the equation. So the beta function is its a and b is a symmetric function concerning its arguments [20-34].

Now we integrate the integral (1.1.1) piecewise. Integration operations by pieces

$$u=(1-x)^{b-1},\ \ du=-(b-1)(1-x)^{b-2}\,dx,$$

$$dv=x^{a-1}dx,\ \ v=\frac{1}{a}x^{a}$$

as done and this

$$x^{a}=x^{a-1}-x^{a-1}(1-x)$$

considering the situation $b>1$ we get the following:

$$B(a,b)=\left[\frac{(1-x)^{b-1}x^{a}}{a}\right]+\int_0^1\frac{x^{a}}{a}(b-1)(1-x)^{b-2}\,dx=$$

$$=\frac{b-1}{a}\int_0^1 x^{a-1}(1-x)^{b-2}\,dx-\frac{b-1}{a}\int_0^1 x^{a-1}(1-x)^{b-1}\,dx=$$

$$\frac{b-1}{a}B(a,b-1)-\frac{b-1}{a}B(a,b).$$

This gives rise to this recurrence formula:

$$B(a,b)=\frac{b-1}{a+b-1}B(a,b-1). \quad (1.1.2)$$

Beta function a and b since is symmetric with respect to

$$B(a,b)=\frac{a-1}{a+b-1}B(a-1,b). \quad (1.1.3)$$

Based on formulas (1.1.2) and (1.1.3).

$$(a-1)B(a-1,b)=(b-1)B(a,b-1).$$

If $a-1=p,\ \ b-1=q$ we say, in that case

$$B(p,q+1)=\frac{q}{p}B(p+1,q).$$

If b the parameter is equal to an integer, that is $b=n$ if $B(a,n)$ as a result of successive application of the formula to the function (1.1.2).

$$B(a,n)=\frac{n-1}{a+n-1}\frac{n-2}{a+n-2}\frac{n-3}{a+n-3}\dots\frac{1}{n+1}B(a,1)$$

we will have equality. But

$$B(a,1)=\int_0^1 x^{a-1}dx=\frac{1}{a}$$

for being

$$B(a,n)=B(n,a)=\frac{1\cdot2\cdot3\cdot\ldots\cdot(n-1)}{a\cdot(a+1)\cdot(a+2)\cdot\ldots\cdot(a+n-1)}$$

.

if a if the parameter is also equal to an integer, ie $a=m\in N$ then, as a result of successive application of the formula (1.1.3), we create the following equation;

$$B(m,n)=\frac{1\cdot2\cdot3\cdot\ldots\cdot(n-1)}{(m+1)(m+2)\ldots\cdot(m+n-1)}\cdot B(m,1)=$$

$$=\frac{1\cdot2\cdot3\cdot\ldots\cdot(n-1)}{(m+1)(m+2)\ldots\cdot(m+n-1)}\cdot\frac{m-1}{m}\frac{m-2}{m-1}\dots\frac{1}{2}B(1,1),$$

from this $B(1,1)=1$ for being

$$B(m,n)=B(n,m)=\frac{(n-1)!(m-1)!}{(m+n-1)!}.$$

Now in formula (1.1.1.). $a=b$

$$B(a,a)=\int_0^1 x^{a-1}(1-x)^{a-1}dx=\int_0^1\left[\frac{1}{4}-\left(\frac{1}{2}-x\right)^2\right]^{a-1}dx$$

or

$$B(a,a)=2\int_0^{1/2}\left[\frac{1}{4}-\left(\frac{1}{2}-x\right)^2\right]^{a-1}dx.$$

In the last integral $1-2x=\sqrt{t}$ we will replace. In that case

$$B(a,a)=2^{1-2a}\int_0^1 t^{-1/2}(1-t)^{a-1}dt$$

or

$$B(a,a)=2^{1-2a}B\left(\frac{1}{2},a\right). \quad (1.1.4)$$

(1.1.1) in the integral

$x=\frac{y}{1+y}$ or $y=\frac{x}{1-x}$

If we make the substitution, the beta function is written as:

$$B(a,b)=\int_0^{+\infty}\frac{y^{a-1}}{(1+y)^{a+b}}dy. \quad (1.1.5)$$

In this formula $0<\alpha<1$ counting $b=1-a$ say

$$B(a,1-a)=\int_0^{+\infty}\frac{y^{a-1}}{1+y}dy.$$

The resulting integral is the integral associated with Euler's name in mathematical analysis, to its value $\pi/\sin(\pi\alpha)$ is equal to And so, $0<\alpha<1$ at

$$B(a,1-a)=\frac{\pi}{\sin(\pi\alpha)}. \quad (1.1.6)$$

If, $a=1-a=1/2$

$$B\left(\frac{1}{2},\frac{1}{2}\right)=\pi \quad (1.1.7)$$

is formed.

Abel's integral equation

This integral equation of the form is called an Abelian integral equation.

$$\frac{1}{\Gamma(\alpha)}\int_a^x\frac{\varphi(t)dt}{(x-t)^{1-\alpha}}=f(x),\quad 0<\alpha<1 \quad (1.2.1)$$

Equation (1.2.1) is solved in the following way. In this equation x the t with, t the s by substituting and then both sides of Eq $(x-t)^{-\alpha}$ multiply by the expression and t according to a from x we integrate up to [35-41]:

$$\int_a^x\frac{dt}{(x-t)^\alpha}\int_a^t\frac{\varphi(s)ds}{(t-s)^{1-\alpha}}=\Gamma(\alpha)\int_a^x\frac{f(t)dt}{(x-t)^\alpha}.$$

Substituting the order of integration according to the Dirichlet formula,

$$\int_a^x\varphi(s)ds\int_s^x\frac{dt}{(x-t)^\alpha(t-s)^{1-\alpha}}=\Gamma(\alpha)\int_a^x\frac{f(t)dt}{(x-t)^\alpha} \quad (1.2.2)$$

we form the equation. In the inner integral on the left side of Eq $t=s+\tau(x-s)$ if we replace

$$\int_s^x(x-t)^{-\alpha}(t-s)^{\alpha-1}dt=$$

$$=\int_0^1\tau^{\alpha-1}(1-\tau)^{-\alpha}d\tau=B(\alpha,1-\alpha)=\Gamma(\alpha)\Gamma(1-\alpha)$$

equality follows. Then, according to (1.2.2).

$$\int_a^x\varphi(s)ds=\frac{1}{\Gamma(1-\alpha)}\int_a^x\frac{f(t)dt}{(x-t)^\alpha}. \quad (1.2.3)$$

By differentiating both sides of this equation, we obtain the solution of Abel's integral equation:

$$\varphi(x)=\frac{1}{\Gamma(1-\alpha)}\frac{d}{dx}\int_a^x\frac{f(t)dt}{(x-t)^\alpha}. \quad (1.2.4)$$

Thus, if there is a solution to the equation (1.2.1), it is expressed in the form (1.2.4). It follows from the process of deriving the formula that if a solution exists, it is unique [42-46].

It can be shown in this way that this

$$\frac{1}{\Gamma(\alpha)}\int_x^b \frac{\varphi(t)\,dt}{(t-x)^{1-\alpha}} = f(x), \quad 0<\alpha<1$$

(1.2.5)

the solution of the integral equation

$$\varphi(x) = -\frac{1}{\Gamma(1-\alpha)}\frac{d}{dx}\int_x^b \frac{f(t)\,dt}{(t-x)^{\alpha}}$$

(1.2.6)

determined by the formula.

Integrals of fractional order

As you know from the mathematical analysis course, n - the following formula is appropriate for multiple integrals:

$$\int_a^{x_0} dx_1 \int_a^{x_1} dx_2 \ldots \int_a^{x_{n-1}} \varphi(t)dt = \frac{1}{(n-1)!}\int_a^{x_0}(x_0-t)^{n-1}\varphi(t)dt, \; n \in N.$$

(1.2.7)

$(n-1)! = \Gamma(n)$ taking into account that, the right side of the equation (1.2.7). n can also be determined for fractional values of

According to equality (1.2.7), we determine integrals of fractional order in the following order.

Description. $\varphi(x) \in L_1(a,b)$ *(* $a<b<+\infty$ *) be. This*

$$D_{ax}^{-\alpha}\varphi(x) = \frac{1}{\Gamma(\alpha)}\int_a^x (x-t)^{\alpha-1}\varphi(t)dt, \quad \alpha>0,$$

(1.2.8)

$$D_{xb}^{-\alpha}\varphi(x) = \frac{1}{\Gamma(\alpha)}\int_x^b (t-x)^{\alpha-1}\varphi(t)dt, \quad \alpha>0$$

(1.2.9)

expressions in the form $\varphi(x)$ of the function α are called integrals of (decimal) order (in the sense of Riemann-Liouville).

$D_{ax}^{-\alpha}\varphi(x)$ and $D_{xb}^{-\alpha}\varphi(x)$ functions (a,b) are defined at almost all points in the range, $L_1(a,b)$ that belong to the class.

Based on this definition, Abel's integral equations (1.2.1) and (1.2.5)

$$D_{ax}^{-\alpha}\varphi(x) = f(x), \qquad D_{bx}^{-\alpha}\varphi(x) = f(x)$$

(1.2.10)

can be written as

If $0<\alpha_1,\ \alpha_2<+\infty$ almost everyone $x \in (a,b)$ for

$$D_{ax}^{-\alpha_2}D_{ax}^{-\alpha_1} f(x) = D_{ax}^{-\alpha_1}D_{ax}^{-\alpha_2} f(x) = D_{ax}^{-(\alpha_1+\alpha_2)} f(x)$$

(1.2.11)

equality is appropriate. Indeed,

$$D_{ax}^{-\alpha_2}D_{ax}^{-\alpha_1} f(x) = \frac{1}{\Gamma(\alpha_1)}D_{ax}^{-\alpha_2}\int_a^x (x-s)^{\alpha_1-1} f(s)ds =$$

$$= \frac{1}{\Gamma(\alpha_1)\Gamma(\alpha_2)}\int_a^x\left[\int_a^t (t-s)^{\alpha_1-1} f(s)ds\right](x-t)^{\alpha_2-1}dt =$$

$$= \frac{1}{\Gamma(\alpha_1)\Gamma(\alpha_2)}\int_a^x f(s)ds\int_s^x (x-t)^{\alpha_2-1}(t-s)^{\alpha_1-1}dt.$$

In the last inner integral $t = s+(x-s)\tau$. As a result of substitution, we get the following equation:

$$\int_s^x (x-t)^{\alpha_2-1}(t-s)^{\alpha_1-1}ds = (x-s)^{\alpha_1+\alpha_2-1}\int_0^1 \tau^{\alpha_1-1}(1-\tau)^{\alpha_2-1}d\tau =$$

$$= \frac{\Gamma(\alpha_1)\Gamma(\alpha_2)}{\Gamma(\alpha_1+\alpha_2)}(x-s)^{\alpha_1+\alpha_2-1}.$$

This shows that equality (1.2.11) is correct.

By definition,

$$D_{ax}^{0} f(x) = f(x) \quad (1.2.12)$$

we think that

Conclusion

This article shows the solution of the Bisadze-Lykov equation by the Mellin integral substitution in a simpler way, gives an example of the application of the Mellin integral substitution, and works aimed at proving the existence and uniqueness of the solution to the given problems. In addition, the concept of relative humidity of desiccation plays an important role in many areas of science. In 1965, the term relative humidity permeability was introduced to the science by the famous scientist, expert in thermal physics AB Likov, through the methods of the thermodynamic process in which the moisture flow density of a polycapillary structural body is restored.

It is known that physicists were among the first to be interested in moisture permeability equations. A.B. Bisadze learned in his book published in 1959,

$$y^m \frac{\partial^2 U}{\partial x^2} - \frac{\partial^2 U}{\partial y^2} + a(x,y)\frac{\partial U}{\partial x} + a(x,y)\frac{\partial U}{\partial y} + C(x,y)U = 0$$

$|a| \le 1$. take the Cauchy problem as an example $y^2 U_{xx} - U_{yy} + aU_x = 0$. Therefore, relative humidity is called the Bisadze-Likov equation. This equation is K.U. Karapetyan $|a| \le \frac{1}{11}$, $a = \frac{1}{2}$ studied in C. Minyu studied this issue in heat.

I.M. Gelfandom 1959 mentioned the need to solve the problem, if on the one hand parabolic and on the other hand hyperbolic equations are given. He cites the example of gas escaping from the wave equation of motion outside the diffusion equation.

Today, many scientific works on solving Bisadze-Lykov equations are cited in mathematical literature. For the study of relative humidity equations, M.A. Nakhushev, T.Sh. Kalmenov, C.K. Kumikovoy, A.A. Kilbasa, O.A. Repina, M. Saigo for mixed equations S.I. Gayduka, A.V. Repina, A.P. Saldatova, V.N. Abrashina, O.A. Repina, A.A. Kilbasa, A.N. Zarubina, A.A. Kerefova's articles can be cited as an example.

This graduation work is devoted to the study of the sliding problems given in the theory of boundary value problems and the methods of solving them, as well as the theoretical applications of these equations, which are known to be effectively used in physics, mechanics, astronomy and other various fields.

References

1. Kosimov, K., & Mamayusupov, J. (2019). Transitions melline integral of fractional integrodifferential operators. *Scientific Bulletin of Namangan State University*, *1*(1), 12-15.
2. Abdurazakov, A., Mirzamahmudova, N., & Maxmudova, N. (2021). "Iqtisod" yo'nalishi mutaxassislarini tayyorlashda matematika fanini o'qitish uslubiyoti. *Scientific progress*, *2*(7), 728-736.
3. Qo'ziyev, S. S., & Mamayusupov, J. S. (2021). Umumiy o'rta ta'lim maktablari uchun elektron darslik yaratishning pedagogik shartlari. *Oriental renaissance: Innovative, educational, natural and social sciences*, *1*(10), 447-453.
4. Файзуллаев, Ж. И. (2020). Методика обучения ортогональных проекций геометрического тела в координатных плоскостях на основе развития математической компетентности. *Вестник Ошского государственного университета*, (1-4), 285-289.
5. Файзуллаев, Д. И. (2022). Развитие профессиональной компетентности студентов технических высших учебных заведений на основе деятельностного подхода. *Central asian journal of mathematical theory and computer sciences*, *3*(10), 102-107.
6. Файзуллаев, Ж. И. (2022). Техника олий таълим муассасалари талабаларининг математик компетенциясини ривожлантириш математик таълим сифатини оширишнинг асоси сифатида. *Pedagogs jurnali*, *9*(2), 248-256.
7. Abdujabbor, A., & Nabiyevich, F. A. (2022). Econometric Assessment of the Perspective of Business Entities. *Eurasian Journal of Physics, Chemistry and Mathematics*, *8*, 25-29.
8. Абдураззаков, А., Фозилов, А. Н., & Ташпулатов, А. (2021). Некоторые вопросы оптимизации рынка труда. *The Scientific Heritage*, (76-2), 29-32.
9. Расулов, Р., Сатторов, А., & Махкамова, Д. (2022). Вычисленние Квадрат Нормы Функционала Погрошности Улучшенных Квадратурных Формул В Пространстве. *Central asian journal of mathematical theory and computer sciences*, *3*(4), 114-122.
10. Rashidjon, R., & Sattorov, A. (2021). Optimal Quadrature Formulas with Derivatives in the Space. *Middle European Scientific Bulletin*, *18*, 233-241.

11. Abdujabbor, A., Nasiba, M., & Nilufar, M. (2022). The Numerical Solution of Gas Filtration in Hydrodynamic Interconnected Two-Layer Reservoirs. *Eurasian Journal of Physics, Chemistry and Mathematics*, *6*, 18-21.
12. Абдуразаков, А., Махмудова, Н. А., & Мирзамахмудова, Н. Т. (2022). Об одном численном решении краевых задач для вырождающихся параболических уравнений имеющие приложении в теории фильтрации. *Universum: технические науки*, (5-1 (98)), 41-45.
13. Abdujabbor, A., Nasiba, M., & Nilufar, M. (2022). Semi-discretization method for solving boundary value problems for parabolic systems. *Texas Journal of Multidisciplinary Studies*, *13*, 77-80.
14. Shaev, A. K., & Makhmudova, N. A. (2021). Convergence of the method of straight lines for solving parabolic equations with applications of hydrodynamically unconnected formations. *Ministry of higher and secondary special education of the republic of Uzbekistan national university of Uzbekistan Uzbekistan academy of sciences vi romanovskiy institute of mathematics*, 280.
15. Абдуразаков, А., Махмудова, Н. А., & Мирзамахмудова, Н. Т. (2021). Численное решение краевых задач для вырождающихся уравнений параболического типа, имеющих приложения в фильтрации газа в гидродинамических невзаимосвязанных пластах. *Universum: технические науки*, (10-1 (91)), 14-17.
16. Далиев, Б. С. (2021). Оптимальный алгоритм решения линейных обобщенных интегральных уравнений Абеля. *Проблемы вычислительной и прикладной математики*, *5*(35), 120-129.
17. Акбаров, Д. Е., Абдуразоков, А., & Далиев, Б. С. (2021). О Функционально Аналитической Формулировке И Существования Решений Системы Эволюционных Операторных Уравнений С Краевыми И Начальными Условиями. *Central asian journal of mathematical theory and computer sciences*, *2*(11), 14-24.
18. Kosimova, M. Y., Yusupova, N. X., & Kosimova, S. T. (2021). Бернулли тенгламасига келтирилиб ечиладиган иккинчи тартибли оддий дифференциал тенглама учун учинчи чегаравий масала. *Oriental renaissance: Innovative, educational, natural and social sciences*, *1*(10), 406-415.
19. Yusupova, N. K., & Abduolimova, M. Q. (2022). Use fun games to teach geometry. *Central asian journal of mathematical theory and computer sciences*, *3*(7), 58-60.
20. Yusupova, N. X., & Nomoanjonova, D. B. (2022). Innovative technologies and their significance. *Central asian journal of mathematical theory and computer sciences*, *3*(7), 11-16.
21. Shakhnoza, S. (2022). Application of Topology in Variety Fields. *Eurasian Journal of Physics, Chemistry and Mathematics*, *11*, 63-71.
22. Bozarov, B. I. (2019). An optimal quadrature formula with sinx weight function in the Sobolev space. *Uzbekistan academy of sciences vi romanovskiy institute of mathematics*, *47*.
23. Akbarov, D. E., Kushmatov, O. E., Umarov, S. A., Bozarov, B. I., & Abduolimova, M. Q. (2021). Research on General Mathematical Characteristics of Boolean Functions' Models and their Logical Operations and Table Replacement in Cryptographic Transformations. *Central asian journal of mathematical theory and computer sciences*, *2*(11), 36-43.
24. Shavkatjon oʻgʻli, T. B. (2022). Proving The Inequalities Using a Definite Integral and Series. *Texas Journal of Engineering and Technology*, *13*, 64-68.
25. Nazarova, G. A. (2022). Will be on the basis of modern economic education Principles of pedagogical development of analytical thinking in economists. *Journal of Positive School Psychology*, 9579-9585.
26. Shavkatjon o'g'li, T. B. (2022). Some integral equations for a multivariable function. *Web*

of Scientist: International Scientific Research Journal, *3*(4), 160-163.

27. Alimjonova, G. (2021). Modern competencies in the techno-culture of future technical specialists. *Current research journal of pedagogics*, *2*(06), 78-84.
28. Kupaysinova, Z. S. (2022). Attempts of Central Asian Scholars to Prove Euclid's Fifth Postulate. *Eurasian Journal of Physics, Chemistry and Mathematics*, *12*, 71-75.
29. Yakubjanovna, Q. M. (2022). Some Methodological Features of Teaching the Subject «Higher Mathematics» in Higher Educational Institutions. *Eurasian Journal of Physics, Chemistry and Mathematics*, *4*, 62-65.
30. Abdurahmonovna, N. G. (2022). Factors for the Development of Creativity and Critical Thinking in Future Economists Based on Analytical Thinking. *Journal of Ethics and Diversity in International Communication*, *2*(5), 70-74.
31. Abdurahmonovna, N. G. (2022). Will Be on the Basis of Modern Economic Education Principles of Pedagogical Development of Analytical Thinking in Economists. *European Multidisciplinary Journal of Modern Science*, *6*, 627-632.
32. Назарова, Г. А. (2022). Аналитик тафаккурни ривожлантиришнинг педагогик зарурати. *Integration of science, education and practice. Scientific-methodical journal*, *3*(3), 309-314.
33. Kosimova, M. Y. (2022). Talabalarni ta’lim sifatini oshirishda fanlararo uzviyligidan foydalanish. *Nazariy va amaliy tadqiqotlar xalqaro jurnali*, *2*(2), 57-64.
34. Qosimova, M. Y., & Yusupova, N. X. (2020). On a property of fractional integro-differentiation operators in the kernel of which the meyer function. *Scientific-technical journal*, *24*(4), 48-50.
35. Mirzakarimov, E. M., & Fayzullaev, J. S. (2020). Improving the quality and efficiency of teaching by developing students* mathematical competence using the animation method of adding vectors to the plane using the maple system. *scientific bulletin of namangan state university*, *2*(9), 336-342.
36. Mirzakarimov, E. M., & Faizullaev, J. I. (2019). Method of teaching the integration of information and educational technologies in a heterogeneous parabolic equation. *scientific bulletin of namangan state university*, *1*(5), 13-17.
37. Mirzaboevich, M. E. (2021). Using Maple Programs in Higher Mathematics. Triangle Problem Constructed on Vectors in Space. *Central asian journal of mathematical theory and computer sciences*, *2*(11), 44-50.
38. Мирзакаримов, Э. М., & Файзуллаев, Д. И. (2021). Выполнять Линейные Операции Над Векторами В Пространстве В Системе Maple. *Central asian journal of mathematical theory and computer sciences*, *2*(12), 10-16.
39. Abdurasul, D. (2022). Investigation of heat transfer rate in smooth turbulizer pipes. *Universum: технические науки*, (6-6 (99)), 59-62.
40. Мирзакаримов, Э. М. (2022). Использовать Систему Maple Для Определения Свободных Колебаний Прямоугольной Мембраны При Начальных Условиях. *Central Asian Journal Of Mathematical Theory And Computer Sciences*, *3*(1), 9-18.
41. Мамаюсупов, Ж. Ш. (2022). Интегральное преобразование Меллина для оператора интегродифференцирования дробного порядка. *Periodica Journal of Modern Philosophy, Social Sciences and Humanities*, *11*, 186-188.
42. Акбаров, Д. Е., Кушматов, О. Э., Умаров, Ш. А., & Расулов, Р. Г. (2021). Исследования Вопросов Необходимых Условий Крипто Стойкости Алгоритмов Блочного Шифрования С Симметричным Ключом. *Central asian journal of mathematical theory and computer sciences*, *2*(11), 71-79.
43. Mamayusupov, J. S. O. (2022). “Iqtisod” yo’nalishi mutaxassislarini tayyorlashda matematika fanini o’qitish uslubiyoti. *Academic research in educational sciences*, *3*(3), 720-728.

44. Jalilov, I. (2019). To the problems of innovation into the educational process. *Scientific Bulletin of Namangan State University*, *1*(3), 344-347.
45. Qosimova, S. T. (2021). Two-point second boundary value problem for a quadratic simple second-order differential equation solved by the bernoulli equation. *Innovative Technologica: Methodical Research Journal*, *2*(11), 14-19.
46. Jalilov, I. I. U. (2022). К актуальным проблемам становления педагогического мастерства преподавателя. *Nazariy va amaliy tadqiqotlar xalqaro jurnali*, *2*(9), 81-89.