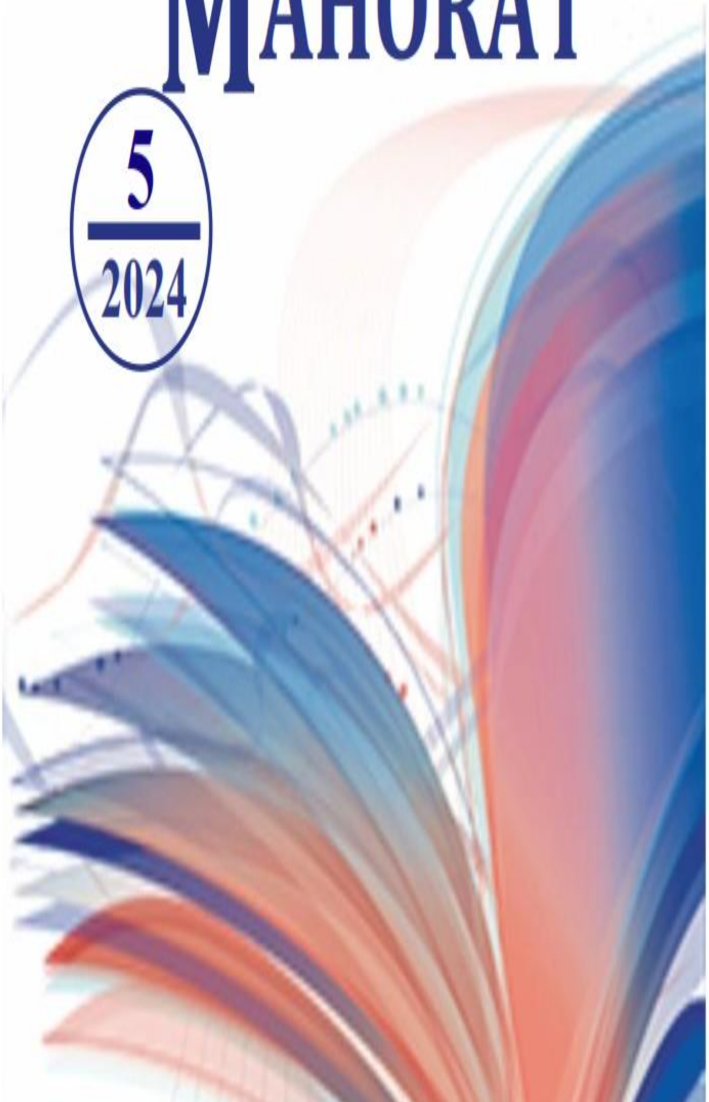
BUXORO DAVLAT UNIVERSITETI

ISSN 2181-6833

PEDAGOGIK MAHORAT

5
2024



ISSN 2181-6833
9 772181 683301

ISSN 2181-6883

PEDAGOGIK MAHORAT

Ilmiy-nazariy va metodik jurnal

5-son (2024-yil, may)

Jurnal 2001-yildan chiqa boshlagan

Buxoro – 2024

ANIQ VA TABIIY FANLARNI O‘QITISH

THE ISSUE OF TEACHING THE EQUATIONS OF MOTION AND HEAT EXCHANGE

Qahhorov Siddiq Qahhorovich,
Bukhara State University, D.p.s., Professor
Bekmurodova Manzura Bahodirovna,
Bukhara State University,
mbekmurodova@45gmail.com

In this study, the causes and methods of teaching knowledge about heat transfer and heat transfer processes were studied. In the study, the types of heat transfer, methods of lighting the elements of heat exchange were systematically studied. The issue of explaining the general and different aspects of heat transfer types in educational technologies was also discussed. Besides, students were studied how to solve the problems that arise when expressing the equations of motion in different coordinate systems using interactive methods. Connections between the coordinate system, the radius vector, the velocity vector and the acceleration vector can be cited as concepts that are important in mastering all topics in theoretical mechanics.

Keywords: *educational technologies, Venn diagram, coordinate system, radius vector, velocity vector, equation of motion, "metreshka method".*

ПРОБЛЕМА ОБУЧЕНИЯ УРАВНЕНИЯМ ДВИЖЕНИЯ И ТЕПЛООБМЕНА

В данном исследовании изучались причины и методы преподавания знаний о теплообмене и процессах теплообмена. В ходе исследования систематически изучались виды теплопередачи, способы освещения элементов теплообмена. Также обсуждался вопрос объяснения общих и различных аспектов видов теплопередачи в образовательных технологиях. Кроме того, студенты обучались интерактивным методам решения задач, возникающих при выражении уравнений движения в разных системах координат. Связи между системой координат, радиус-вектором, вектором скорости и вектором ускорения можно назвать понятиями, важными для освоения всех разделов теоретической механики.

Ключевые слова: *образовательные технологии, диаграмма Венна, система координат, радиус-вектор, вектор скорости, уравнение движения, метод «метрешка».*

HARAKAT VA ISSIQLIK ALMASHGAN TENGLAMALARINI O'QITISH MASALASI

Ushbu maqolada issiqlik uzatish va issiqlik uzatish jarayonlari haqidagi bilimlarni o'rgatishning sabablari va usullari ko'rib chiqildi. Tadqiqot davomida issiqlik uzatish turlari va issiqlik uzatish elementlarini yoritish usullari tizimli ravishda o'rganildi. Ta'lim texnologiyalarida issiqlik uzatish turlarining umumiy va farqli jihatlarini tushuntirish masalasi ham muhokama qilindi. Bundan tashqari, talabalarga turli koordinata sistemalarida harakat tenglamalarini ifodalashda yuzaga keladigan masalalarni yechishning interfaol usullar o'rganilgan. Koordinatalar sistemasi, radius vektori, tezlik vektori va tezlanish vektori o'rtasidagi bog'lanishlarni nazariy mexanikaning barcha bo'limlarini o'zlashtirish uchun muhim bo'lgan tushunchalar deyish mumkin.

Kalit so'zlar: *ta'lim texnologiyalari, Venn diagrammasi, koordinatalar tizimi, radius vektori, tezlik vektori, harakat tenglamasi, "metreshka" metodi.*

It is not a secret to anyone that today a desired science is rapidly developing. If we look closely at the voluntary sector, it is possible to notice new changes. This, in turn, creates the need to ensure that our young people receive education in accordance with the rapid changes in development. It is necessary for our youth to understand that great knowledge lies at the foundation of achievements, especially in concrete and natural sciences, and educators should help in this regard. If we look at the achievements in physics from this point of view, it is based on strong fundamental knowledge. We can show the theoretical courses of physics as a course that is difficult to master. It is no exaggeration to say that only if the theoretical courses are well mastered, the essence of physics will be fully understood and the achievements of the science will be reached..

From this point of view, it is necessary to pay special attention to the issue of full mastery of theoretical courses. The formation of students' understanding of the elements of thermodynamics leads to certain difficulties. Because in the thermodynamic process several parameters change at the same time (P, V, T, E). However, an in-depth study of this section will provide a basis for understanding the full nature of other branches of physics. That is why it is important to fully form the elements of thermodynamics in students. One of the fastest growing areas today is the use of non-conventional energy sources. In order to participate in practical work in this area, it is important for the student to have additional knowledge about thermal processes.

Connections between the coordinate system, the radius vector, the velocity vector and the acceleration vector can be cited as concepts that are important in mastering all topics in theoretical mechanics. Because all the knowledge that needs to be mastered goes back to the above concepts. In order to create deep knowledge in theoretical mechanics, it is necessary to create complete knowledge about the coordinate system, expressing the trajectory, speed and acceleration of a material point in different coordinate systems. Students face certain difficulties in mastering these concepts. As a reason for this, we can cite the fact that students used only the Cartesian coordinate system until this topic. But there are cases where it is inconvenient to express its equation of motion in the Cartesian coordinate system. In addition, it is necessary to refer to the knowledge related to mathematics and vectors when expressing the connections between coordinates, radius vector, velocity vector and acceleration vector. In such cases, it is appropriate to use methods that match the topic during the lesson to increase the mastery rate.

As we know, heat exchange occurs in nature in 3 different ways: heat exchange due to heat conduction, convective heat exchange, heat exchange by radiation.

According to the French scientist Fourier's law, the vector of heat flux density in terms of thermal conductivity is proportional to the temperature gradient:

$$q = -\lambda \frac{\Delta T}{\Delta r} \qquad (1)$$

In this case, the thermal conductivity of the λ -body, $\left[\frac{\text{Vt}}{\text{m} \cdot \text{K}}\right]$; The r-heat dissipation length [m] represents the thermal conductivity of the λ -coefficient substance, and the negative sign in the equation indicates that the directions of the temperature gradient vectors are opposite to the heat flux, i.e., the direction of maximum temperature drop.

The thermal conductivity of substances varies and, in turn, their thermal conductivity λ takes values over a wide range (from $6 \cdot 10^{-3}\, Vt\ /\ m \cdot K$ to $410\, Vt\ /\ m \cdot K$). The amount of heat that passes through a unit of surface in a unit of time is:

$$\Delta q = -\lambda \frac{\Delta T}{\Delta n} \Delta S \Delta t \qquad (2)$$

In convective heat exchange, the motion of a heat-conducting substance (liquid, gas) is both natural and artificial. The phenomenon of natural convection occurs only due to the heat exchange of the liquid (gas) mass with the heat source, which changes its volume near the hot surface and moves upwards. The temperature of the liquid (gas) molecules near the heating surface is high, and as they move away from the heat source, their temperature decreases.

The value of the heat transfer coefficient a gradually decreases in the laminar zone of the convective heat exchange process, then increases from the boundary of the transition zone to the turbulent zone, and then stabilizes.

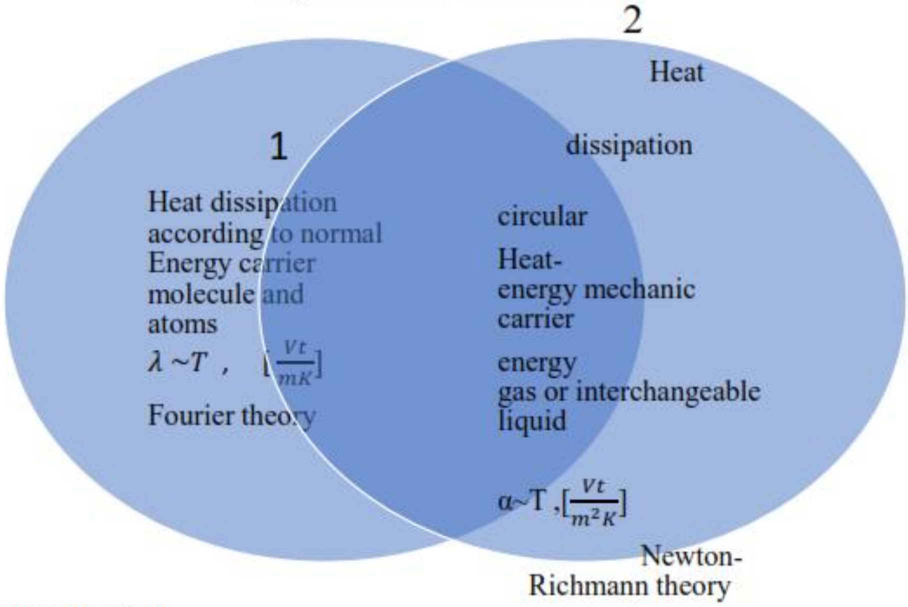
When light energy interacts with and absorbs heat, the internal energy of that medium increases [5]. Light energy has a certain wavelength and frequency and travels at the speed of light in a vacuum. A photon is taken as a particle that carries light energy. A photon has a certain mass as it moves, and at rest its mass is zero.

If we give the characteristics of the types of heat exchange in tabular form, the student will gain in-depth knowledge.

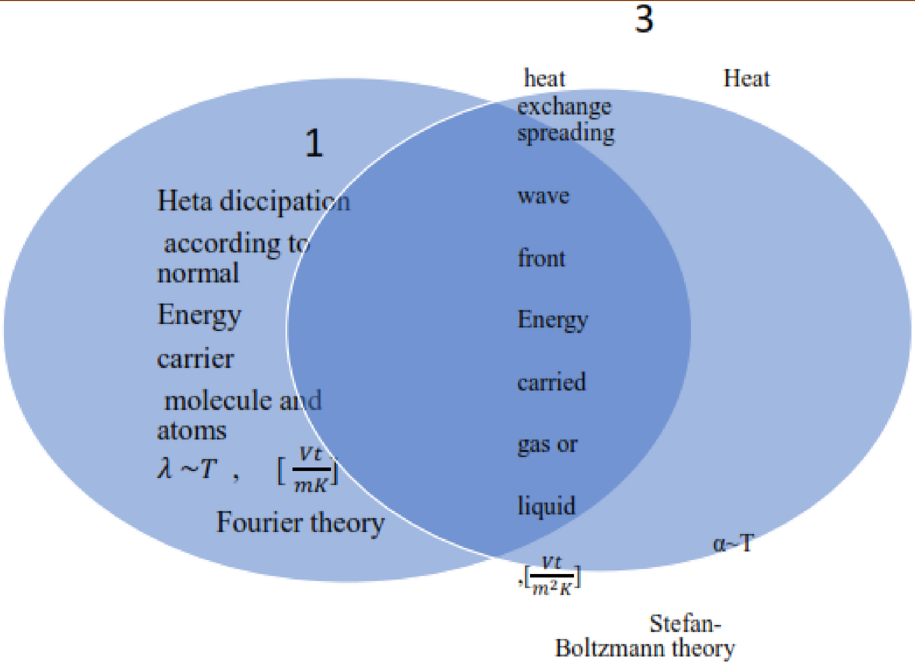
Table 1. Types of heat transfer and their characteristics.

Properties and magnitudes in heat transfer	Thermal conductivity at the expense of heat exchange	Convective heat exchange	By means of light heat exchange
Energy exchange	Heat-mechanical	Heat-mechanical	Light-heat energy
Heat dissipation trajectory	By default	Circular	Wave front
Energy carrier (agent)	Molecules and atoms	Gas or liquid	Electromagnetic waves, photon quantum
Temperature dependence of heat flux	Correctly proportional	Correctly proportional	quadratic parabolic connection
Proportionality coefficient	λ	α	C_0
Participating physical quantities	T, q,Q,V,μ,	T, q,Q,V,μ,	T, q,Q,V,μ,λ, ρ
Units of proportionality coefficient	$\left[\frac{Vt}{m \cdot K}\right]$	$\left[\frac{Vt}{m^2 \cdot K}\right]$	$[Vt / m^2 \cdot K]$
Authors of the theory of heat transfer	Fourier	Newton , Rixman	Stefan-Bolstman

Diagrams are created based on the table



1.Thermal conductivity
2. Convective heat exchange



1. Thermal conductivity
3. Exchange through light

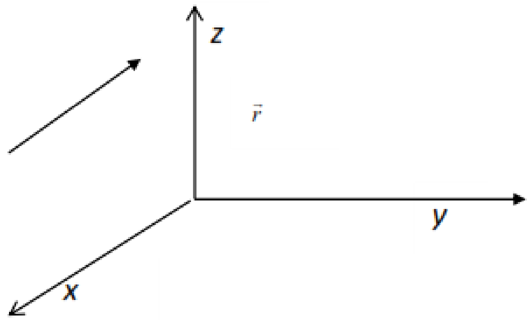
Any movement in nature is relative. It is necessary to choose a coordinate system to represent the movement of the body. Otherwise, whether the point is moving or the observer remains abstract. Therefore, the appropriate coordinate system is selected for movements with different trajectories.

The following coordinate systems are addressed in the theoretical mechanics course: Cartesian coordinate system, cylindrical coordinate system, spherical coordinate system, and polar coordinate system. The coordinates in all coordinate systems can be represented by Cartesian coordinates, that is, the coordinate systems are related to each other. The simplest and most convenient system known to us is the Cartesian coordinate system.

The laws of motion of a material point in the Cartesian coordinate system are as follows

$$x = x(t), \quad y = y(t), \quad z = z(t) \tag{3}$$

The vector directed from the coordinate origin to the material point is called a radius vector. The radius vector expressed by coordinates is written in the following form.



Show the radius vector in the picture

$$\vec{r} = x\vec{i} + y\vec{j} + z\vec{k} \quad (4)$$

Also, the complete differentials of this radius-vector with respect to time give the velocity and acceleration vectors of the point

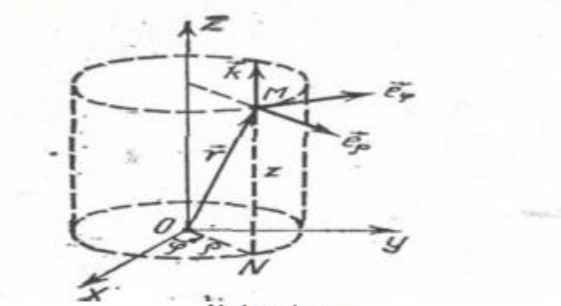
$$\vec{v} = \dot{\vec{r}} = \dot{x}\vec{i} + \dot{y}\vec{j} + \dot{z}\vec{k} \quad (5)$$

$$\vec{a} = \dot{\vec{v}} = \ddot{\vec{r}} = \ddot{x}\vec{i} + \ddot{y}\vec{j} + \ddot{z}\vec{k} \quad (6)$$

Projections of velocity and acceleration vectors on axes can be written in the following form:

$$v_x = \dot{x}, \quad v_y = \dot{y}, \quad v_z = \dot{z}; \qquad a_x = \dot{v}_x = \ddot{x}, \quad a_y = \dot{v}_y = \ddot{y}, \quad a_z = \dot{v}_z = \ddot{z} \quad (7).$$

There are processes for which it is inconvenient to use the Cartesian coordinate system in the formulation of the equations of motion. For example: changes in liquid crystals, changes in biological fluids in a centrifuge are convenient to see in cylindrical coordinates.



Update pictures

In the cylindrical coordinate system, the position of point M is determined by the coordinates ρ, φ, z. Laws of motion of a point

$$\rho = \rho(t), \quad \varphi = \varphi(t), \quad z = z(t) \quad (8)$$

will be in appearances.

Cartesian coordinates can be written in cylindrical coordinates as follows.

$$x = \rho\cos\varphi, \quad y = \rho\sin\varphi, \quad z = z \quad (9)$$

$$\vec{r} = \rho \cdot \vec{e}_\rho + z\vec{k} = x\vec{i} + y\vec{j} + z\vec{k} \quad (10)$$

To find the connection between $\vec{e}_\rho, \vec{e}_\varphi$ the coordinates of the cylindrical coordinate system and $\vec{i}, \vec{j}$ the Cartesian coordinates we mutually equate expressions (10) in both $\vec{r}$ radius-vector systems and, taking into account (9), we get the following connections:

$$\vec{r} = \rho \cdot \vec{e}_\rho + z\vec{k} = x\vec{i} + y\vec{j} + z\vec{k} = \cos\varphi\vec{i} + \sin\varphi\vec{j} + z\vec{k} \quad (11)$$

What is this

$$\vec{e}_\rho = \vec{i}\cos\varphi + \vec{j}\sin\varphi, \quad \vec{e}_\varphi = \frac{d\vec{e}_\rho}{d\varphi} = -\vec{i}\sin\varphi + \vec{j}\cos\varphi \quad (12)$$

we will have results.

To convert from radius vector to speed, it is necessary to take derivative of radius vector with respect to time

$$\vec{v} = \dot{\vec{r}} = \dot{\rho}\vec{e}_\rho + \rho\dot{\vec{e}}_\rho + \dot{z}\vec{k} = \dot{\rho}\vec{e}_\rho + \rho\left(\frac{d(\cos\varphi\vec{i} + \sin\varphi\vec{j})}{dt}\right) + \dot{z}\vec{k} \quad (13)$$

It appears. This is where most students make a mistake. (12) is derived from the simple function. But (13) is the derivative of a complex function. In this case, using the matreshka method gives its effective result. Here φ the function also changes according to t. In this case, the following is appropriate $\vec{e}_\rho(\varphi(t))$. We use the "Matryushka" method to calculate the product. This method is as follows: $F(q(k(r(x)))'_x$ if we take the derivative of the function with respect to x $F'_q \times q'_k \times k'_r \times r'_x$ looks like. By opening each parenthesis, the derivative is obtained from the previous function with respect to the visible function. It reminds me of a Russian matryoshka. Let's number the matryoshka dolls in Figure 1 consecutively as 1, the smallest one. We apply to the derivation problem as follows: derivative of matryoshka 5 by matryoshka 4, derivative of matryoshka 4 by matryoshka 3, derivative of matryoshka 3 by matryoshka 2 and derivative of matryoshka 2 by matryoshka 1 . It is similar to the derivative of the complex function above. $\vec{e}_\rho(\varphi(t))$ it is necessary to take a derivative from a function that looks like.

If we use this method, we will have the following.

$$\dot{\vec{e}}_\rho = \dot{\varphi}(-\vec{i}\sin\varphi + \vec{j}\cos\varphi) = \dot{\varphi}\cdot\vec{e}_\varphi,$$
$$\dot{\vec{e}}_\varphi = -\dot{\varphi}(\vec{i}\cos\varphi + \vec{j}\sin\varphi) = -\dot{\varphi}\cdot\vec{e}_\rho \qquad \dot{\vec{e}}_\rho = \dot{\varphi}\cdot\vec{e}_\varphi, \qquad \dot{\vec{e}}_\varphi = -\dot{\varphi}\cdot\vec{e}_\rho \qquad (14)$$

We can determine the velocity and acceleration vectors if we take into account the equations (14) in the time derivatives of the radius vector of the point (13).

$$\vec{v} = \dot{\rho}\vec{e}_\rho + \rho\dot{\varphi}\vec{e}_\varphi + \dot{z}\vec{k} \qquad (15)$$

we get the expression of acceleration in the form.

Derivatives of this form are formed both in spherical coordinates and in polar coordinates. Explaining to students the derivative of a complex function in the "matryoshka" method increases the mastery rate. In addition, the connection between the trajectory, speed, and acceleration of a material point in all coordinate systems is important. Because Lagrange's formalism, which is one of the most basic concepts of the course of theoretical mechanics, and the connection between the radius vector, speed and acceleration in oscillating movements are of great importance. Therefore, it is necessary to create deep knowledge in students about this connection. It is appropriate to use the "matryoshka" method.

References:

1. Saidov.Q.S., Bekmurodova.M.B. Complex movement of object // International Scientific Journal 85:5 (2020), pp. 316-322
2. Saidov.Q.S. , Bekmurodova.M.B. The problem of teaching heat transfeer and heat exchange in schools and lyceums // JournalNX-A Multidisciplinary Peer Reviawed Journal 6:9 (2020), pp. 176-183
3. Саидов К. С., Бекмуродова М. Б. К. Проблема преподавания теплопроводности и теплообмена в школаХ //Наука, техника и образование. – 2021. – №. 2-1 (77). – С. 38-41.
4. Qahhorov S., Bekmurodova M. Use of interactive methods in expressing motion equations in different coordinate systems // Science and innovation 2 (A6)(2023), pp.19-24
5. Qurbon S, Manzura B nuqtaning impuls momentini slindrik koordinatalar sistemasida isodalashning yangi pedagogik usullari //Involta Scientific Journal,1:6 (2022), s.113-119
6. S.K. Sayfulloevich , M.B.Bekmurodova. Using the methods of" matryoshka" and" consecutive contraction" to explain the theory of motion of a material point//Open Access Repository 8:04 (2022) pp.67-70.
7. Saidov.Q.S., Bekmurodova.M.B. He problem of teaching heat transfeer and heat exchange in schools and lyceums // JournalNX-A Multidisciplinary Peer Reviawed Journal 6:9 (2020), pp. 176-183
8. Bekmurodova M.B., Maddalarning tuzilishiga oid tushunchalarni yoshga xos xususiyatlarni hisobga olgan holda interfaol metodlar yordamida tushuntirish, Центр научных публикаций (buxdu. uz): Том 1 № 1 (2020)
9. Bekmurodova M.B. Issiqlik uzatilishi va issiqlik almashinuvi jarayonlarini o'qitish metodikasi, Центр научных публикаций (buxdu. uz),Том 1 № 1 (2020)
10. Kakhkharov S.K., Juraev K.O., JamilovY.Y., Xudoyberdiyev S.B. // Journal of Contemporary Issues in Business and Government (2021) 27 PP 744-751.
11. Tuksanova Z., Nazarov E. Effective use of innovative technologies in the education system // Интернаука (2020) №16-3 С 30-32
12. Fayziyeva X.A. Modern pedagogical technologies of teaching physics in secondary school. // European Journal of Research and Reflection in Educational Sciences Vol. 8 No. 12, 2020 Part III ISSN 2056-5852. C 85-90.

13. Fayziyeva X.A. Fizika fanini o’qitishda yangi pedagogik texnologiya elementlaridan foydalanish. // “O’zbekistonda milliy tadqiqotlar: Davriy anjumanlar:” [Toshkent; 2022]. C 30-31.

14. Kakhkhorov S.K, Juraev H.O Modeling of heat-physical processes in solar dryers// journal of critical reviews. vol 7, issue 17, (2020) pp 9-15

15. Каххоров С.К., Рахматов И.И., Мухаммедов Ш.М. Особенности построения образовательного процесса на основе модульных технологий обучения в узбекистане // Вестник науки и образования (2020) № 18(96) Часть 2 С 33-36.