Role of process of interdisciplinary integration in courses to students of technical higher education institutions

E. O. Sharipov[1*], *M. R.* Radjabov[1], *M.* Rustamov[2], and *J.* Murodullaev[3]

[1]Karshi Engineering and Economic Institute, Karshi, Uzbekistan
[2]Karshi International University, Karshi, Uzbekistan
[3]Tashkent institute of irrigation and agricultural mechanism engineers opposite national research university institute of irrigation and agrotechnologies

Abstract. This article presents examples of creating a projection of a point in space onto the plane in the discipline of "Higher Mathematics" and "Engineering and Computer Graphics" and creating a projection of a point in space onto a plane.

1 Introduction

It should be noted that during the visit of our President to the research institute in "Olimlar" street in Tashkent on January 31, 2020, he paid sincere attention to the science of mathematics. At the meeting, the need to increase interest in mathematics among young people, the need to properly organize the work of selecting talented children and enrolling them in specialized schools and later higher education institutions, creating popular textbooks and training manuals for students on this subject written in simple and understandable language, instilling mathematical consciousness, if necessary, from kindergarten, the task of formation was set.

"Mathematics is the basis of all exact sciences. A child who knows this subject well will grow up sane, broad-minded, and work successfully in any field," - said the President [1].

According to the curriculum, students of technical higher education institutions study "Higher mathematics" and "Engineering and computer graphics". We believe that it is very important to directly bring the process of interdisciplinary integration in the educational training of professors-teachers in creating the projection of a point in space on a plane in these subjects.

The application of the process of interdisciplinary integration in the training of professor-teachers serves to increase the student's knowledge and the formation of the necessary qualifications and skills from these subjects [2].

This article shows some examples and problem-solving of the interdisciplinary integration process using the equations of spatial uniformity. The fact that the student solves similar examples and problems outside the classroom will strengthen his knowledge of these subjects.

*Corresponding author: ergash1969@yandex.ru

2 Methods

I present the information to higher technical educational institutions students about equations of equality in space and the distance from a point to a straight line in higher mathematics [3].
Let's look at the *0xyz* space and the plane Q given in it. The vector perpendicular to plane Q is called the normal vector of the plane. Given one point $M_1(x_1; y_1; z_1)$ and the normal vector $\overrightarrow{N} = \{A; B; C\}$ of the plane, we derive its equation (see figure 1st).
Imagine we consider a vector Q$M(x; y; z)$ to be an arbitrary point in the plane. $\overrightarrow{M_1M} = (x - x_1) \cdot \vec{i} + (y - y_1) \cdot \vec{j} + (z - z_1) \cdot \vec{k}$ vector (let's look at it) [4].

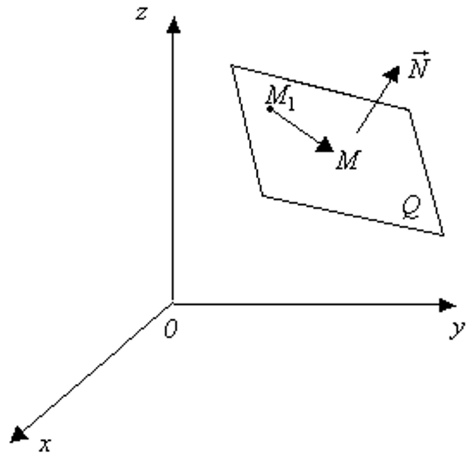

Fig.1.

This vector Q lies in the plane. Since the $\overrightarrow{N}$ vector lays in Q platitude is perpendicular to the plane, it is also perpendicular to the vector $\overrightarrow{M_1M}$ lying in this plane. For two vectors to be perpendicular, it was inevitable that they should be a scalar product $\overrightarrow{M_1M} \cdot \overrightarrow{N} = 0$.
According to the formula for finding the scalar product of two vectors given by coordinates $\overrightarrow{M_1M} \cdot \overrightarrow{N} = A(x - x_1) + B(y - y_1) + C(z - z_1) = 0$ or (1), we have equality $Ax + By + Cz + D = 0$.
Similarly, the equation of the plane passing through the points $A(x_1; y_1; z_1)$, $B(x_2; y_2; z_2)$ and $C(x_3; y_3; z_3)$ is of the form: $\begin{vmatrix} x - x_1 & y - y_1 & z - z_1 \\ x_2 - x_1 & y_2 - y_1 & z_2 - z_1 \\ x_3 - x_1 & y_3 - y_1 & z_3 - z_1 \end{vmatrix} = 0$.
Let be the given point $M_1(x_1; y_1; z_1)$ and the straight line l with equation $\frac{x - x_0}{p} = \frac{y - y_0}{q} = \frac{z - z_0}{r}$. A straight line l passes through a point $M_0(x_0; y_0; z_0)$ and

has a direction vector $\vec{s} = \{p;q;r\}$. Let be the distance from the point $M_1(x_1;y_1;z_1)$ to the straight line d [5].

It is equal to the length of the height of the parallelogram built on the sought-after distance d and vectors $\overrightarrow{M_0M_1}$ and $\vec{S}$ (see figure 2).

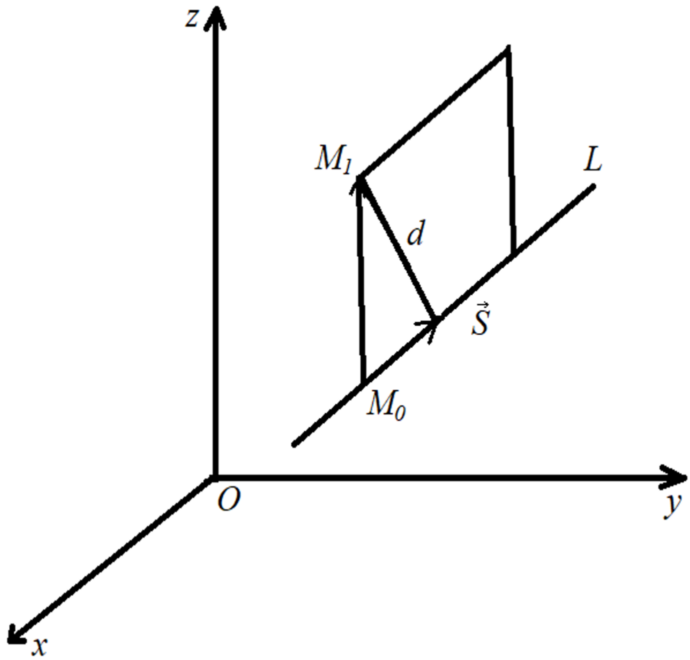

Fig.2.

The faceof the parallelogramis $|\overrightarrow{M_0M_1} \times \vec{s}|$. From this follows $d = \frac{|\overrightarrow{M_0M_1} \times \vec{s}|}{|\vec{s}|}$ (2).

1. Problem. Find the coordinates of the point $S(x_0;y_0;z_0)$, which is the projection of the point $K(x_0';y_0';z_0')$ on the plane $Ax + By + Cz + D = 0$.

Solving. The base of the perpendicular $K(x_0';y_0';z_0')$ drawn from the point $S(x_0;y_0;z_0)$ to this plane is the projection of the point on the plane $Ax + By + Cz + D = 0$. To do this, we take the normal vector of the given plane, the direction vector $\vec{n} = \{A;B;C\}$ of a straight line l passing through the point $S(x_0;y_0;z_0)$. Then the canonical equation $\frac{x-x_0}{A} = \frac{y-y_0}{B} = \frac{z-z_0}{C}$ (3) of the straight line passing through the point $S(x_0;y_0;z_0)$ will appear (see figure 3rd).

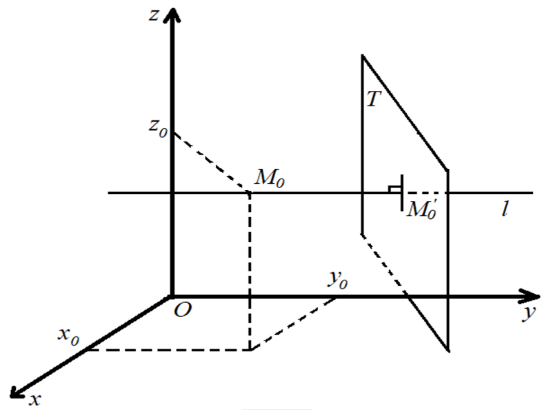

Fig. 3.

Now we proceed as follows: $\dfrac{x-x_0}{A}=\dfrac{y-y_0}{B}=\dfrac{z-z_0}{C}=t \Rightarrow \begin{cases} x=At+x_0 \\ y=Bt+y_0 \\ z=Ct+z_0 \end{cases} (4)$ - we find the value of the parameter t by putting these values into the equation of the given plane. By setting this $A(At+x_0)+B(Bt+y_0)+C(Ct+z_0)+D=0 \Rightarrow$ $t=-\dfrac{Ax_0+By_0+Cz_0+D}{A^2+B^2+C^2}=t_0$ (5) to the coordinates of the point $K(x_0';y_0';z_0')$ lying both on the given plane (4), and $\begin{cases} x_0'=At_0+x_0 \\ y_0'=Bt_0+y_0 \\ z_0'=Ct_0+z_0 \end{cases} (6)$ on the straight line l are determined [6].

Orthogonal projection of a point in space on a given plane in engineering and computer graphics for technical higher education institutions students. If we project the plane onto the plane of projections, it completely covers it, resulting in abstraction. Therefore, points, straight lines, and flat shapes (triangle, circle, ellipse) are used to describe the plane in a drawing (epure). The traces of the epure also represent the plane. The lines of intersection of the plane with the projection planes are called traces of the plane. A plane has at least two and at most three tracks. It is convenient to describe the plane by traces [7-8].

If the projection beam is perpendicular to the projection plane, it is called orthogonal projection.

2. Problem. The coordinates of points A (115;95;85), B (95;25;5), C (10;5;50), and S (60;85;10) are given. Find the orthogonal projection of point C on the plane of triangle ABC.

Solving. To find the orthogonal projection of point S on the plane of the triangle ABC, it is necessary to transfer the perpendicular from the point to the plane. The point of intersection of the perpendicular with the plane is the sought point. For a straight line to be perpendicular to a plane, two intersecting lines lying in the plane must be perpendicular to the straight line. We use a horizontal and frontal plane as intersecting straight lines. The horizontal plane is a straight line lying in the plane and parallel to the plane of horizontal projections H. A frontal plane is a straight line lying on the plane and parallel to the plane of frontal projections V.

We carry out the perpendicular transfer from the point S to the plane of the triangle

ABC in the drawing (epure) as follows (see Fig. 1).

We construct the plane's horizontal h (h', h") and the front f (f', f"). From the horizontal projection S' of point S to the horizontal projection h' of the horizontal, we transfer perpendicularly from the frontal projection S" of point S to the frontal projection f" of the frontal. To find the point of intersection of the perpendicular with the plane, we pass the TV projection plane through the perpendicular. Constructing the intersection line MN (M'N', M"N") of the given plane with the projection plane, we find the point of intersection of the perpendicular with this line. Point K is the point we are looking for. In addition, the cross-section SK is equal to the distance from point S to the plane of the triangle ABC. We determine the coordinates of point K by measuring [9-10].

The algorithm for solving the problem is as follows:

1. We construct a projection according to the coordinates of the given points. We connect projections of the same name of points A, B, and C.

2. We build the horizontal and frontal sides of the plane.h''||Ox, f'||Ox.

3. From the horizontal projection S' of the point S' to the horizontal projection h' of the horizontal, we transfer perpendicularly from the frontal projection S" of the point S to the frontal projection f" of the frontal.S' ⊥h' (C'1'), S" ⊥f" (B''2").

4. We pass the T_V frontal projection plane through the perpendicular.

5. Constructing the intersection line MN (M'N', M"N") of the given plane with the projecting plane, we find the intersection point of the perpendicular K (K', K") with this line.

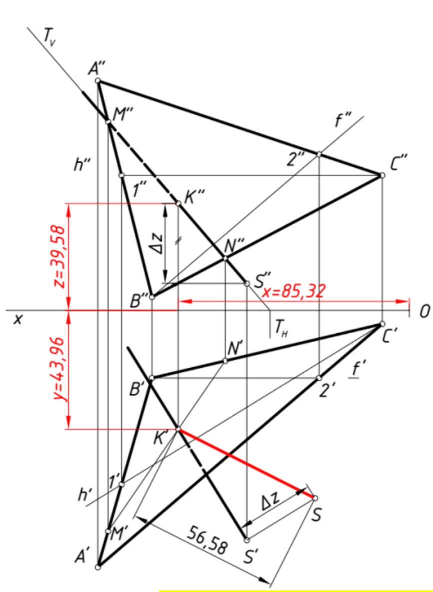

Fig 4.

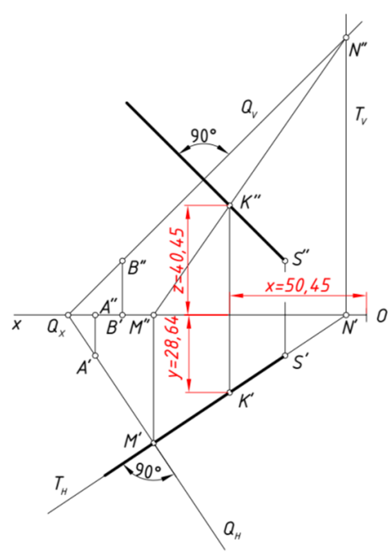

Fig. 5.

6. Measure and determine the coordinates of point K: x=85.32, y=43.96, z=39.58. Point K is the projection of point S in the given plane. We determine from the drawing that the distance from point C to the plane of the triangle ABC is equal to $|SK| = 56.58$ mm.

Problem 3. Find the orthogonal projection of the point S(30;15;20) on the plane whose traces pass through the points Q_X(110,0,0), A(100;15;0), B(90;0;20).

Solving. If the plane is given by traces, it is not necessary to transfer the horizontal (S' $\perp Q_H$) and frontal plane from a given point perpendicular to it, (S" $\perp Q_V$) we pass (see Fig 2).

Passing a horizontal projecting plane T through the perpendicular, we find the line of intersection of this plane with the given plane Q(Q_H,Q_V)MN(M'N',M''N"). We find this line's intersection point with the perpendicular K(K',K"). We determine the coordinates of point K by measuring: *x*=50.45, *y*=28.64, and *z*=40.

3 Results and Discussion

So, based on the information of engineering and computer graphics science, the orthogonal projection of the point $S(60;85;10)$ on the triangular plane ABC was found by measuring and determining the coordinates of point K. That is $K(85.32;43.96;39.58)$.

Now we determine the coordinates of the point $K(x'_0;y'_0;z'_0)$ based on the equation of the plane passing through the three points and the data of problem 1 (above presented). We put the coordinates of the points A(115;95;85), B(95;25;5), and C(10;5;50) into the equation of the plane passing through the three points: $\begin{vmatrix} x-115 & y-95 & z-85 \\ 95-115 & 25-95 & 5-85 \\ 10-115 & 5-95 & 50-85 \end{vmatrix} = 0$. We calculate this determinant and form the equation $4750x - 7700y + 5550z - 286500 = 0$. Comparing this equation with the general equation $Ax + By + Cz + D = 0$ of the plane, we determine the coefficients $A = 4750$, $B = -7700$, $C = 5550$, $D = -286500$ and according to their coordinates $S(60;85;10)$. Findings would be $x_0 = 60$, $y_0 = 85$, $z_0 = 10$. According to the formula of problem 1 above shown (5): $t_0 = -\frac{4750 \cdot 60 - 7700 \cdot 85 + 5550 \cdot 10 - 286500}{(4750)^2 + (-7700)^2 + (5550)^2} = -0.0053$ let's put it in the formula (6) $\begin{cases} x'_0 = 4750 \cdot (-0.0053) + 60 = 34.825 \\ y'_0 = -7700 \cdot (-0.0053) + 85 = 125.81 \\ z'_0 = 5550 \cdot (-0.0053) + 10 = -19.415 \end{cases}$, which determines the coordinates of the point $K(34.825;125.81;-19.415)$. The distance from point C to the plane of triangle ABC is $|SK| = \sqrt{(34.825-60)^2 + (125.81-85)^2 + (-19.415-10)^2} = 56.2537$ mm.

Thus, the relative error $\frac{0.3263}{56.58} = 0.006 \approx 1\%$ to will be the absolute error $|56.58 - 56.2537| = 0.3263$.

4 Conclusions

In short, the process of solving problems from "Higher mathematics" and "Engineering and computer graphics" subjects for students of technical higher education institutions is presented. If the given point found on the basis of theoretical information of higher mathematics science is the projection of the point $S(60;85;10)$)on the plane of the triangle ABC, the point $K(34.825;125.81;-19.415)$ is the point that was found based on the practical information $S(60;85;10)$ of the science of engineering and computer graphics would be $K(85.32;43.96;39.58)$. It was shown the importance of giving assignments explaining the interdisciplinary relationship to students in solving problems of practical importance in the conditions of a creative approach in the preparation of competent personnel.

Formation of students' abilities such as creativity, inquisitiveness, and creative approach is the basis which guarantees that the future specialist will be able to make independent decisions and apply the acquired knowledge to the production process.

References

1. Danilova O. V. Peculiarities of Forming General Cultural Competences in Students of Institutions of Higher Technical Education by Means of Interdisciplinary Integration. In SHS Web of Conferences, Vol. 50, p. 01216. EDP Sciences. (2018).
2. Yarime, M., Trencher, G., Mino, T., Scholz, R. W., Olsson, L., Ness, B., ... & Rotmans, J. Establishing sustainability science in higher education institutions: towards an integration of academic development, institutionalization, and stakeholder collaborations. Sustainability Science, 7, 101-113. (2012).
3. Meyliev K.J., and Kholbekov S.O. Voltaire quadratic stochastic operators of a bisexual population. ACADEMICIA: An International Multidisciplinary Research Journal, 11(5), 56-64. (2021).
4. A. Mallayev, J. Sevinov, S. Xusanov, O. Boborayimov. Algorithm for the synthesis of gradient controllers in a nonlinear control system. II International Conference CAMSTech-II 2021: AIP Conference Proceedings 2467, 030003 (2022).
5. Aida-zade K. R., and Guliyev S. Z. Zonal Control Synthesis for Nonlinear Systems under Nonlinear Output Feedback. Journal of Automation and Information Sciences, 47(1). (2015).
6. Sharipov E.O., Shodiev S.Yu., Chuyanov H.U. Theorem proof algorithm. In International scientific journalof Biruni. Vol. 1. (2022).
7. Sharipov E. O., Shodiev S. Yu., and Rakhmanov B. N. On the solution of equations involving certain inverse trigonometric functions. Oriental renaissance: Innovative, Educational, Natural and Social Sciences, 1(9), 516-521. (2021).
8. Shiriaev, A. S., and Fradkov, A. L. Stabilization of invariant manifolds for nonlinear nonaffine systems. IFAC Proceedings Volumes, 31(17), 213-218. (1998).
9. Tsai S. C., and Loo M. A graphical synthesis technique for non-linear control systems. International Journal of Control, 15(4), 705-716. (1972).
10. Kamenetskiy V. A. Synthesis of a constrained stabilizing control for nonlinear control systems. Avtomatika i Telemekhanika, (1), 43-56. (1995).