EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 06, June, 2025
brightmindpublishing.com
ISSN (E): 3061-6972
Licensed under* CC BY 4.0 *a Creative Commons Attribution 4.0 International License.

FROM PARABOLA THEORY TO PARABOLIC ANTENNA: ELECTRICAL PRACTICE

Komiljonov Bobur Komiljon ugli,
Teacher Andijan State Technical Institute
Tel.: +99893782-50-94
E-mail: komiljonovbobur33@gmail.com
ORCID: 0009-0009-2147-0400

Khalilov Murodiljon Durbek ugli
Teacher Andijan State Technical Institute,
Tel.: +99894100-45-93
E-mail: Khalilov.M.1993@mail.ru
ORCID: 0009-0001-5130-3103

Abstract
In this article, the parabola topic, which is part of the "second-order curves" section of higher mathematics, is integrated with electrical engineering. The theoretical foundations, geometric properties, and analytical equations of parabolas are illustrated using a practical example - a parabolic antenna. In the study, a mathematical model was constructed based on the dimensions of the offset parabolic antenna, widely used in home conditions, and such parameters as focal length, directrix, depth, eccentricity were calculated. Analytical geometry and computational methods were used as the research methodology. This approach strengthens the practical aspect of higher mathematics and serves to deepen students' understanding of the topic. This approach is also an effective way of interdisciplinary integration.

Keywords: parabola, parabolic antenna, second-order curves, focus, directrix, eccentricity, offset antenna, analytic geometry.

Introduction

The rapid development of modern science and technology, especially in the fields of electrical engineering, communications, and satellite technologies, requires a

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 06, June, 2025
brightmindpublishing.com
ISSN (E): 3061-6972
Licensed under CC BY 4.0 *a Creative Commons Attribution 4.0 International License.*

deep understanding of the devices used in real practice. One such technical device is **the parabolic** antenna, which plays an important role in radio communication, satellite television transmission, and many other telecommunication systems. The main operating principle of this device is directly based on the geometric properties **of second-order curves,** in **particular, parabola.**

In this work, **Andijan State Technical Institute** in order for students of the electrical engineering direction to have deep mathematical knowledge, especially to understand the theoretical topics of higher mathematics in connection with real technical fields, a detailed analysis was carried out using the example **of a parabolic antenna** based on the topic **second-order curves** entering the section **parabola** .

In accordance with the syllabus of the Andijan State Technical Institute of Higher Mathematics, students are provided with in-depth knowledge of second-degree equations, conic sections (circle, ellipse, hyperbola, parabola), their analytical equations, and practical applications. However, these knowledge is often conveyed to students in an abstract form, and their connection with technical objects in life is not sufficiently realized.

Therefore, in this practical work, the main focus is on integrating the topic through such elements as the geometry, equations, focus, and directrix of a parabolic antenna, their functional significance, and physical meaning. It is known that a **parabolic antenna** is a device designed to redirect electromagnetic waves collected by a receiver or transmitter located at the focus, the principle of operation of which is based on the properties of a complete parabola.

Within the framework of this project, the following steps were implemented:

- The **canonical equation of** the parabola and its geometric description were studied;
- **A mathematical model** was created based on the real size of the antenna ;
- **Key parameters,** such as focal length, depth, directrix, eccentricity, were calculated ;
- The graph of the parabola was constructed and **mathematical visualization** related to the real device was performed ;
- **Physico-mathematical explanation** of how the parabola equation affects the antenna's operating principle

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 06, June, 2025
brightmindpublishing.com
ISSN (E): 3061-6972
Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

Also, during the work, taking into account that the mirror surface of the antenna is in the form of an ellipse , by calculating the parameters of the ellipse, students were given a brief practical skill about another second-order curve - ellipse .

This approach helps electrical engineering students understand not only the geometry of the parabola, but also the operating principles, design mechanisms, and real-life significance of the important technical device arising from it. This is an important step in increasing the practical value of higher mathematics, generating interest in the topic, and ensuring interdisciplinary integration.

xyCurves whose equations are in the second degree with respect to the variable coordinates are called second-order curves.

The general equation of a second-order curve on a plane can be written as follows:

$$Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0 \quad (1)$$

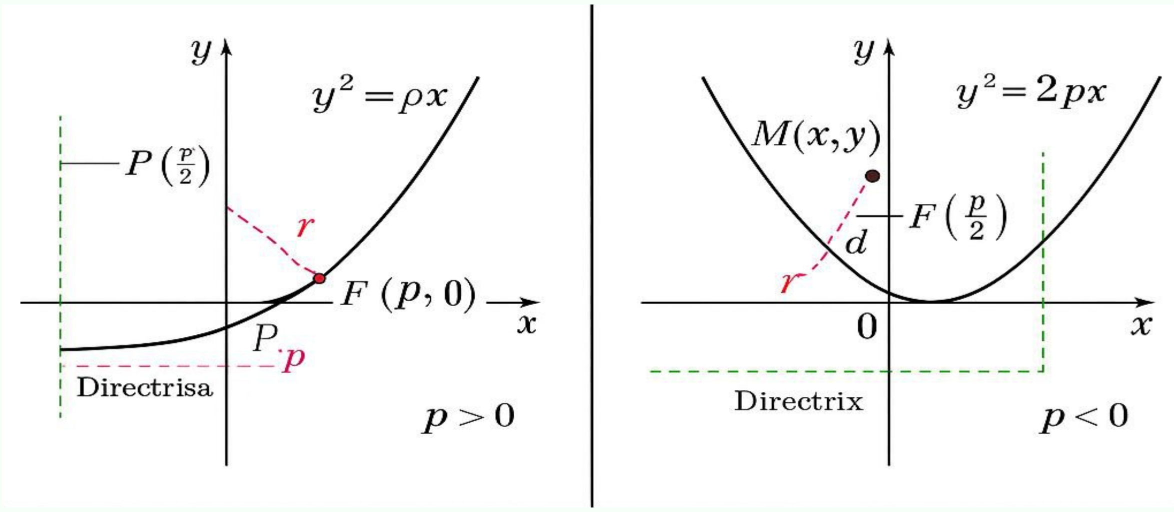
$A, B, C, D, E, F - A, B, C$Here are constant coefficients, at least one of which must be different from zero.

The special cases of second-order curves are circles, ellipses, hyperbolas, and parabolas.

$F\left(\frac{p}{2}; 0\right) x = -\frac{p}{2}$The geometric locus of points on a plane whose distances from each point of the plane to a point called the focus and a straight line called the directrix are equal to each other is called ***a parabola*** .

OXCanonical equation of a parabola, the vertex of which is at the origin, and the axis of symmetry is the axis;

$$y^2 = 2px \quad (2)$$



EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 06, June, 2025
brightmindpublishing.com
ISSN (E): 3061-6972
Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

r dIf we denote the distance from an arbitrary point of a parabola to its focus by, and the distance from that point to its directrix by, then by definition of a parabola:

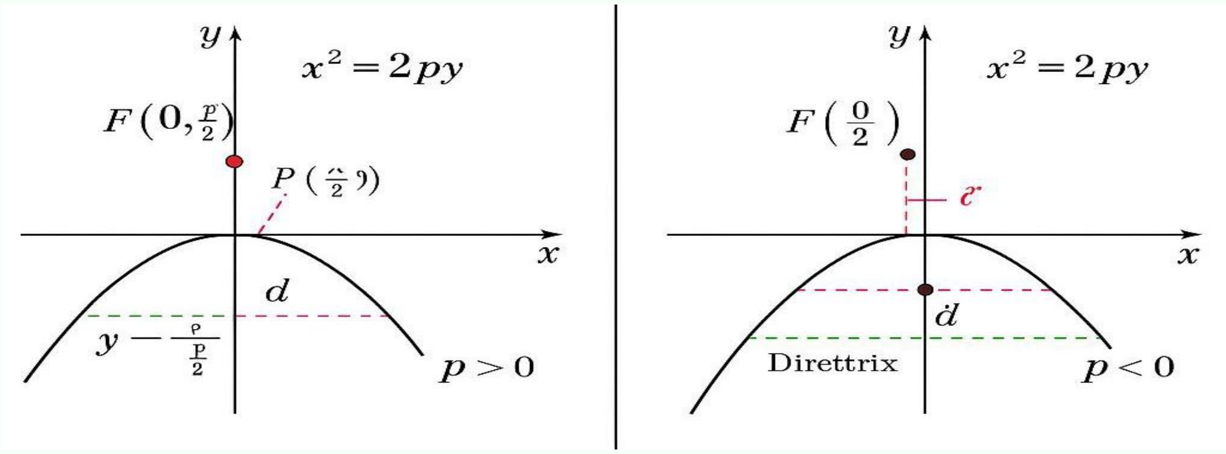
$$r = d$$

The equality holds. Then the eccentricity of the parabola;

$$\varepsilon = \frac{r}{d} = 1$$

OYCanonical equation of a parabola, the vertex of which is at the origin, and the axis of symmetry is the axis;

$$x^2 = 2py \quad (3)$$



1. Typically Used Parabolic Antenna (Home)
Most users use parabolic satellite dishes. Most common:
Model: 60 cm or 90 cm Offset Parabolic dish
Dimensions:
horizontal diameter (width): 90 cm;
vertical height: 80 cm (not a full circle due to offset);
depth (depending on depth/focal distance): approximately 13-15 cm.
2. Mathematical model: Equation of a parabola. If the shape of the antenna is a fully parabolic reflector, we can model it as follows:

$$y = \frac{1}{4f}x^2$$

Here:
f –focal length;
x –horizontal coordinate (by diameter);
y –vertical coordinate (depth).

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 06, June, 2025
brightmindpublishing.com
ISSN (E): 3061-6972
Licensed under **CC BY 4.0** *a Creative Commons Attribution 4.0 International License.*

$D = 90\ smd = 13.5\ sm3$. Calculation of focal length. If the antenna's diameter and depth are, the focus is calculated as follows:

$$f = \frac{D^2}{16d} = \frac{90^2}{16 \cdot 13.5} = \frac{8100}{216} = 37.5\ sm$$

f4. Directrix and other elements. Direction: on the opposite side at a distance from the focus of the parabola:

$$y = -f = -37.5\ s$$

(0,37.5)Focus.

5. Equation of a parabola:

$$y = \frac{1}{4 \cdot 37.5} x^2$$

This line gives the cross-section of a parabolic antenna.

6. Graph (Simplified). Let's take the points:

Table 1

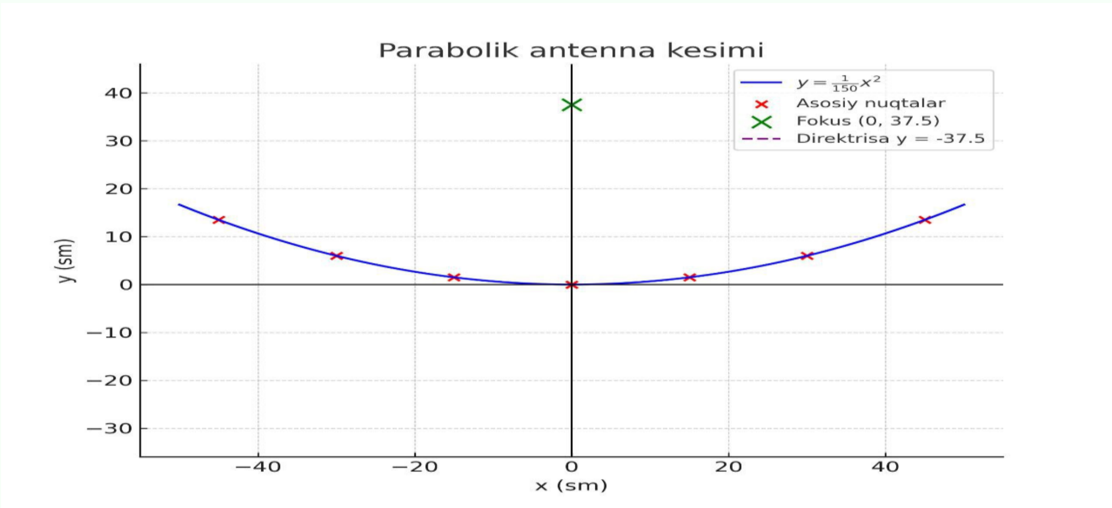
$x\ (sm)$	0	± 15	± 30	± 45
$y = \frac{1}{150} x^2$	0	1.5.	6.	13.5

Blue line-parabola:

$$y = \frac{1}{150} x^2;$$

Red dots - main coordinates;

(0,37.5)Green dot-foku:.



EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 06, June, 2025
brightmindpublishing.com
ISSN (E): 3061-6972
Licensed under CC BY 4.0 *a Creative Commons Attribution 4.0 International License.*

Figure 1

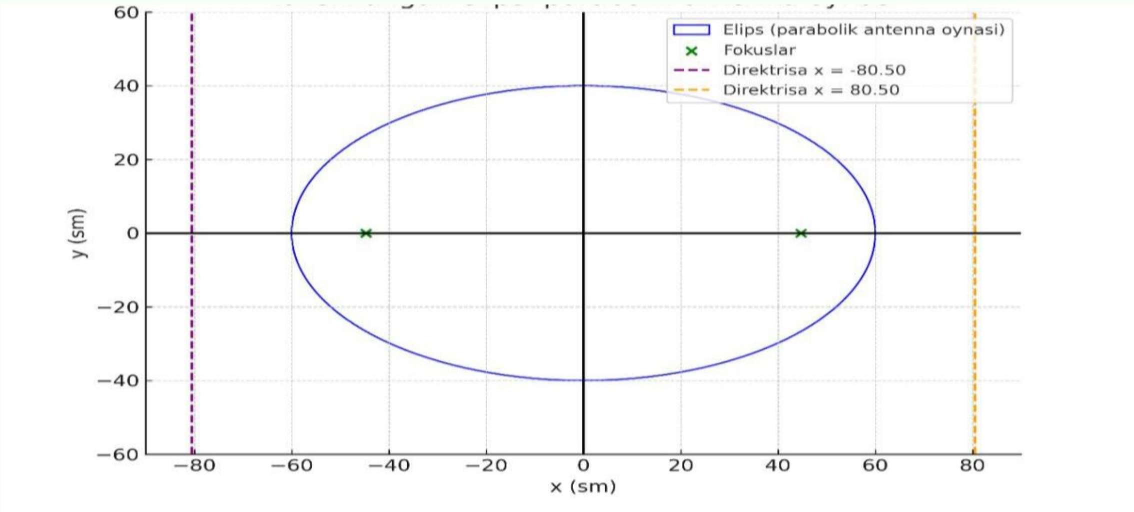
7. Additional parameters. Window surface: approximately elliptical, surface area:

$$A = \pi \cdot \frac{a}{2} \cdot \frac{b}{2} = \pi \cdot 45 \cdot 40 = 5654\ sm^2$$

$a = 60\ sm$major semi-axis;

$b = 40\ sm$minor semi-axis;

$c^2 = a^2 - b^2$Focus distance:,



$$c^2 = a^2 - b^2,$$
$$c^2 = 60^2 - 40^2,$$
$$c = 44.7\ sm;$$

$\varepsilon = \frac{c}{a}$Eccentricity:

$$\varepsilon = \frac{c}{a} = \frac{44.7}{60} = 0.745;$$

$x = \pm\frac{a}{e}$Directrix equation:

$$x = \pm\frac{a}{e} = \pm\frac{60}{0.745} = \pm 80.5.$$

References

1. Джалилова, Т. А., Комолова, Г. Ш. К., & Халилов, М. Д. У. (2022). О РАСПРОСТРАНЕНИИ СФЕРИЧЕСКОЙ ВОЛНЫ В НЕЛИНЕЙНО-СЖИМАЕМОЙ И УПРУГОПЛАСТИЧЕСКОЙ СРЕДАХ. Oriental renaissance: Innovative, educational, natural and social sciences, 2(3), 87-92.

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 06, June, 2025
brightmindpublishing.com
ISSN (E): 3061-6972
Licensed under **CC BY 4.0** *a Creative Commons Attribution 4.0 International License.*

2. Djalilova, T. (2022). О РАСПРОСТРАНЕНИИ СФЕРИЧЕСКОЙ ВОЛНЫ В НЕЛИНЕЙНО-СЖИМАЕМОЙ И УПРУГОПЛАСТИЧЕСКОЙ СРЕДАХ. Scienceweb academic papers collection.
3. Djalilova, T. (2022). Solution of the energy equation of a two-phase medium taking into account heat transfer between phases. Scienceweb academic papers collection.
4. Ergashov, S. (2022). Differensial tenglamalarni mehanika va fizikaning bazi masalalarini yechishga tadbiqlari. Scienceweb academic papers collection.
5. Акбарова, С. Х., & Халилов, М. Д. (2019). О краевой задаче для смешанно-параболического уравнения. In Andijan State University named after ZM Babur Institute of Mathematics of Uzbekistan Academy of Science National University of Uzbekistan named after Mirzo Ulugbek Scientific Conference (pp. 88-89).
6. Акбарова, С. Х., Акбарова, М. Х., & Халилов, М. Д. (2019). О разрешимости нелокальной краевой задачи для смешанно–параболического уравнения. International scientific journal «global science and innovations, 130-131.
7. Ergashev Sultonmurod, K. B. (2021). DIFFERENSIAL TENGLAMALARNI MEHANIKA VA FIZIKANING BAZI MASALALARINI YECHISHGA TADBIQLARI. НАМАНГАН МУҲАНДИСЛИКТЕХНОЛОГИЯ ИНСТИТУТИ ИЛМИЙ-ТЕХНИКА ЖУРНАЛИ, 430-433.
8. Abdujalilovna, D. T. (2022). On Cratering In A Flat Barrier Upon Impact Of A Spherical Particle. Journal of Pharmaceutical Negative Results, 2068-2071.
9. Abdujalilovna, D. T., Sayibjon, K., Shukirillayevna, K. G., & Durbekovich, K. M. (2023). Flow Around A Thin Profile With A Two-Phase Medium With Solid Particles. Journal of Pharmaceutical Negative Results, 3592-3596.
10. Turgunoy, D., Komolova, G., & Murodiljon, K. О распространении сферической волны в нелинейно-сжимаемой и упругопластической средах. Innovative, educational, natural and social sciences, 2(3), 2181-1784.
11. Abdujalilovna, D. T., Murodiljon, K., Axrorbek, O., & Bexzod, T. (2023). SOME STUDIES OF THE FLOW OF A TWO-PHASE MEDIUM WITH SOLID PARTICLES AROUND BODIES WITH A SIGNIFICANT CONCENTRATION OF PARTICLES. MODELS AND METHODS FOR

Licensed under* CC BY 4.0 *a Creative Commons Attribution 4.0 International License.

INCREASING THE EFFICIENCY OF INNOVATIVE RESEARCH, 3(29), 43-47.
12. Abdujalilovna, D. T., & Durbek, K. M. (2023). Extreme Problems and Their Study in a Mathematics Course. American Journal of Public Diplomacy and International Studies (2993-2157), 1(10), 113-118.
13. Abdujalilovna, D. T., Murodiljon, K., Axrorbek, O., & Bexzod, T. (2023). IMPACT OF SOLID PARTICLES OF A TWO-PHASE FLOW ON A WEDGE (DIRECT PROBLEM). SUSTAINABILITY OF EDUCATION, SOCIO-ECONOMIC SCIENCE THEORY, 2(13), 299-303.
14. Murodiljon, K., Gulhayo, K., & Bobur, K. (2022). Solve some chemical reactions using equations. European Journal of Business Startups and Open Society, 2(1), 45-48.
15. Komolova, G., Xalilov, M., & Komiljonov, B. Tenglamalar yordamida ba'zi kimyoviy reaksiyalarni yechish. Yevropa biznes startaplari va ochiq jamiyat jurnali.-2022.-2-jild.-Yo'q, 1(8), 45-48.
16. Дурбекович, М. Х., & Жавлонбек, И. Р. (2023, January). ОБ ОСОБЫХ ТОЧКАХ РЕШЕНИЙ МНОГОМЕРНОЙ СИСТЕМЫ В КОМПЛЕКСНОЙ ОБЛАСТИ. In " CANADA" INTERNATİONAL CONFERENCE ON DEVELOPMENTS İN EDUCATİON, SCİENCESAND HUMANİTİES (Vol. 9, No. 1).
17. Xalilov, M. D., & Komiljonov, B. K. (2022). Komolova GS GARMONIK SKALİAR VIBRASYONLARNING KOMPLEKSI VA VEKTOR FOYDALANISHI. Miasto Przyszłości, 341-344.
18. Комолова, Г., & Халилов, М. Stages of drawing up a mathematical model of the economic issue. Journal of ethics anddiversity in international communication. Испания-2022, 60, 45-48.
19. Murodiljon, K., & Donyorbek, T. (2021). Experience In Using The Relationship Between Mathematics And Physics In Shaping The Concept Of Limit. TA'LIM VA RIVOJLANISH TAHLILI ONLAYN ILMIY JURNALI, 1(6), 212-215.
20. Gulhayo, K. G. K., Murodil, X., & Bobur, K. Ba'zi kimyoviy reaksiyalarni tenglamalar yordamida yechish. EVROPA JURNALI, 45-48.

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 06, June, 2025
brightmindpublishing.com
ISSN (E): 3061-6972
Licensed under CC BY 4.0 a Creative Commons Attribution 4.0 International License.

21. Xalilov, M. D., Komiljonov, B. K., & Komolova, G. S. (2022). COMPLEX AND VECTOR EXPRESSION OF HARMONIC SCALIAR VIBRATIONS. Miasto Przyszłości, 24, 341-344.
22. Murodiljon, K., Gulhayo, K., & Bobur, K. (2022). Solve some chemical reactions using equations. European Journal of Business Startups and Open Society, 2(1), 45-48.
23. Комолова, Г. ХМ (2022.). Комолова Гулхаё, Халилов Муродил, Комилжоноа Бобур,“Solve some chemical reactions using equations”. EUROPEAN JOURNAL OF BUSINESS STARTUPS AND OPEN SOCIETY, 2(1), 45-48.
24. Xalilov, M. D., Komiljonov, B. K., & Komolova, G. S. Garmonik skalyar tebranishlarning kompleks va vektor ifodalanishi. Miasto Przyszłości. ISSN-L.
25. Tillayev Donyorbek, X. M. (2021). Fazoda urinma akslantirish va uning formalizmga bog ‘liqligi. UzACADEMIA ILMIY-USLUBIY JURNALI, 86-92.
26. Komiljonov Boburjon, X. M. (2021). O’quvchilarda funksiya tushunchasini shakllantirish. Matematikani iqtisodiy-texnik masalalarga tadbiqlari va oqitish muammolari,(стр. 297-303). Узбекистан.
27. Xalilov Murodiljon, K. B. (2021). Irratsional tenglama va tengsizliklarni yechish jarayonida o’quvchilarning ijodiy qobiliyatlarini rivojlantirish. Matematikani iqtisodiy-texnik masalalarga tadbiqlari va o’qitish muammolari (стр. 312-322). Toshkent: Respublika ilmiy-amaliy anjumani.
28. Халилов, M. (2022). Differensial tenglamaga olib keluvchi ba’zi masalalar. Scienceweb academic papers collection.
29. Muradiljon, K., & Mashxuraxon, S. (2023). Application of the Theory of Linear Differential Equations to the Study of Some Oscillations. Web of Synergy: International Interdisciplinary Research Journal, 2(1), 60-65.
30. Abdujalilovna, D. T., & Durbek, K. M. (2023). Extreme Problems and Their Study in a Mathematics Course. American Journal of Public Diplomacy and International Studies (2993-2157), 1(10), 113-118.,
31. Джалилова, Т. А., Комолова, Г. Ш. К., & Халилов, М. Д. У. (2022). О РАСПРОСТРАНЕНИИ СФЕРИЧЕСКОЙ ВОЛНЫ В НЕЛИНЕЙНО-СЖИМАЕМОЙ И УПРУГОПЛАСТИЧЕСКОЙ СРЕДАХ. Oriental renaissance: Innovative, educational, natural and social sciences, 2(3), 87-92.

Volume 01, Issue 06, June, 2025
brightmindpublishing.com
ISSN (E): 3061-6972

Licensed under* CC BY 4.0 *a Creative Commons Attribution 4.0 International License.

32. Muradiljon, K., & Mashxuraxon, S. (2023). Application of the Theory of Linear Differential Equations to the Study of Some Oscillations.
33. Abdujalilovna, D. T., Murodiljon, K., Axrorbek, O., & Bexzod, T. (2023). SOME STUDIES OF THE FLOW OF A TWO-PHASE MEDIUM WITH SOLID PARTICLES AROUND BODIES WITH A SIGNIFICANT CONCENTRATION OF PARTICLES. MODELS AND METHODS FOR INCREASING THE EFFICIENCY OF INNOVATIVE RESEARCH, 3(29), 43-47.
34. Abdujalilovna, D. T., Murodiljon, K., Axrorbek, O., & Bexzod, T. (2023). IMPACT OF SOLID PARTICLES OF A TWO-PHASE FLOW ON A WEDGE (DIRECT PROBLEM). SUSTAINABILITY OF EDUCATION, SOCIO-ECONOMIC SCIENCE THEORY, 2(13), 299-303.
35. Акбарова, С. Х., & Халилов, М. Д. (2019). О краевой задаче для смешанно-параболического уравнения. In Andijan State University named after ZM Babur Institute of Mathematics of Uzbekistan Academy of Science National University of Uzbekistan named after Mirzo Ulugbek Scientific Conference (pp. 88-89).
36. Акбарова, С. Х., Акбарова, М. Х., & Халилов, М. Д. (2019). О разрешимости нелокальной краевой задачи для смешанно–параболического уравнения. International scientific journal «global science and innovations, 130-131.