WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 4, Issue 3, Mar., 2023

WHEN SOLVING SOME EQUATIONS USING TRIGONOMETRIC SUBSTITUTIONS

Maxmudova O.
Qo'qon Davlat Pedagogika Institute

Kalit so'zlar: Irrasional tenglama, trigonometriya, radikal, haqiqiy son, tenglama, ildiz.

Ba'zi hollarda irratsional tenglamalarni yechish noma'lumlarni almashtirish yordamida trigonometrik tenglamalarni yechishga keltiriladi. Bunda quyidagi noma'lumlarni almashtirish usullari qulaydir.

1.Agar tenglama tarkibiga $\sqrt{a^2-x^2}$ radikal kirsa $x=a\sin t$ yoki $x=a\cos t$ almashtirish bajariladi.

2. Agar tenglama tarkibiga $\sqrt{a^2+x^2}$ radikal kirsa $x=atgt$ almashtirish bajariladi.

3. Agar tenglama tarkibiga $\sqrt{x^2-a^2}$ radikal kirsa $x=\frac{a}{\sin t}$ almashtirish bajariladi.

1-misol. Ushbu

$$\sqrt{x^2+1}-x=\frac{5}{2\sqrt{x^2+1}} \qquad (1)$$

tenglamani yeching.

Yechish. (1) tenglamaning aniqlanish sohasi hamma haqiqiy sonlardir. $x=tgt$ almashtirish bajarib (bunda $-\frac{\pi}{2}<t<\frac{\pi}{2}$) (1) tenglamani quyidagi ko'rinishda yozamiz.

$$\frac{1}{\cos t}-tgt=\frac{5}{2}\cos t \qquad (2)$$

$\cos t\neq 0$ bo'lgani uchun (2) tenglama

$$2-\sin t=5(1-\sin^2 t) \qquad (3)$$

tenglamaga teng kuchli. (3) tenglamani yechib

$$\sin t=1 \quad \text{va} \quad \sin t=-\frac{3}{5} \qquad (4)$$

ni hosil qilamiz. Bu yechimlardan $-\frac{\pi}{2}<t<\frac{\pi}{2}$ oraliqqa faqat $t=\arcsin\left(-\frac{3}{5}\right)$ tushadi.

Bundan

$$x=tg\arcsin\left(-\frac{3}{5}\right)=\frac{\sin\left(\arcsin\left(-\frac{3}{5}\right)\right)}{\cos\left(\arcsin\left(-\frac{3}{5}\right)\right)}=\frac{-\frac{3}{5}}{\sqrt{1-\frac{9}{25}}}=-\frac{3}{4}.$$

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 4, Issue 3, Mar., 2023

Javob: $-\frac{3}{4}$.

6-misol. Ushbu

$$x+\frac{x}{\sqrt{x^2-1}}=\frac{35}{12} \qquad (5)$$

tenglamani yeching.

Yechish. (5) tenglamaning aniqlanish sohasi $|x|>1$ Aniqlanish sohasidagi hech bir manfiy son (5) tenglamaning yechimi bo'lmasligi ravshan. Natijada (5) tenglamaning hamma yechimlari $1<x<+\infty$ sohada yotadi. $x=\frac{1}{\sin t}$ almashtirish bajarib (bunda $0<t<\frac{\pi}{2}$) (5) tenglamani quyidagi ko'rinishda yozamiz.

$$\frac{1}{\sin t}+\frac{1}{\cos t}=\frac{35}{12} \qquad (6)$$

Bu tenglama qaralayotgan t uchun quyidagi tenglamaga teng kuchli.

$$12(\sin t+\cos t)=35\sin t\cos t \qquad (7)$$

$$24(\sin t+\cos t)=35[(\sin t+\cos t)^2-1] \qquad (8)$$

Tenglama $(\sin t+\cos t)=z$ almashtirishdan so'ng

$$35z^2-24z-35=0 \qquad (9)$$

ko'rinishga keladi. (9) tenglama 2 ta ildizga ega.

$$z_1=-\frac{5}{7} \quad \text{va} \quad z_2=\frac{7}{5}$$

Shuning uchun (8) tenglama quyidagi tenglamalar majmuasiga teng kuchli.

$$\cos t+\sin t=-\frac{5}{7} \quad \text{va} \quad \cos t+\sin t=\frac{7}{5}.$$

Birlashmaning birinchi tenglamasi $0<t<\frac{\pi}{2}$ oraliqda yechimga ega emas. Ikkinchi tenglamada $y=\sin t$ deb almashtirish bajarsak

$$y+\sqrt{1-y^2}=\frac{7}{5} \qquad (10)$$

tenglama hosil bo'ladi. (10) tenglama 2 ta ildizga ega

$$y_1=\frac{3}{5} \quad \text{va} \quad y_2=\frac{4}{5}$$

Shuning uchun (5) tenglama $0<t<\frac{\pi}{2}$ oraliqda 2 ta yechimga ega.

$$t_1=arc\sin\frac{3}{5} \text{ va } t_2=arc\sin\frac{4}{5}.$$

Demak, (5) tenglama 2 ta ildizga ega ekan.

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 4, Issue 3, Mar., 2023

$x_1 = \frac{5}{3}$ va $x_2 = \frac{5}{4}$.

Javob: $x_1 = \frac{5}{3}$, $x_2 = \frac{5}{4}$.

7-misol. Ushbu

$$8x(2x^2 - 1)(8x^4 - 8x^2 + 1) = 1 \qquad (11)$$

tenglama $[0;1]$ kesmada nechta ildizga ega.

Yechish. Izlanayotgan ildizlar $0 \le x \le 1$ shartni qanoatlantirishi uchun $x = \cos t$ almashtirish bajaramiz.

$$8\cos t(2\cos^2 t - 1)((8\cos^4 t - 8\cos^2 t + 1) = 1 \qquad (12)$$

Demak, masalani quyidagicha formulirovka qilsak bo'ladi. (12) tenglama $0 \le t \le \frac{\pi}{2}$ oraliqda nechta ildizga ega?

$$2\cos^2 t - 1 = \cos 2t,\ 8\cos^4 t - 8\cos^2 t + 1 = \cos 4t$$

ekanligini e'tiborga olib (12) tenglamani

$$8\cos t \cos 2t \cos 4t = 1 \qquad (13)$$

ko'rinishda yozamiz. $t = 0$ (13) tenglamaning ildizi bo'lganligi uchun u $t \in \left(0; \frac{\pi}{2}\right)$ oraliqda quyidagi tenglamaga teng kuchli.

$$8\sin t \cos t \cos 2t \cos 4t = \sin 4t$$

yoki

$$\sin 8t = \sin t$$

Va nihoyat

$$\sin \frac{7t}{2} \cos \frac{9t}{2} = 0 \qquad (14)$$

(14) tenglamaning yechimi

$$t = \frac{2}{7}\pi n,\ n \in z, \quad t = \frac{2}{9}\left(\frac{\pi}{2} + \pi m\right),\ m \in z.$$

Bu sonlardan $0 < t \le \frac{\pi}{2}$ shartni faqat uchta $t_1 = \frac{2}{7}\pi$, $t_2 = \frac{\pi}{9}$, $t_3 = \frac{\pi}{3}$ sonlari qanoatlantiradi. Demak, berilgan (11) tenglama $[0;1]$ kesmada 3 ta ildizga ega.

Javob: 3 ta ildiz

Foydalanilgan adabiyotlar

1.Олехник С.Н.и др.Уравнения и неравенства. Нестандартные решения. 10-11 классы. Учебно-метод. пособие. Москва. 2001.
2.О.А.Иванов. "Практикум по элементарной математике" Алгебро-аналитические методы. Мцнмо 2001.

1. THE IMPORTANCE OF THE USE OF PROJECT TECHNOLOGY IN THE DEVELOPMENT OF PROFESSIONAL COMPETENCIES OF STUDENTS IN THE PROCESS OF INDEPENDENT LEARNING
MM Sobirkhonovna EURASIAN EDUCATION, SCIENCE AND INNOVATION, 29
5. Sobirkhonovna, M. M. (2020, December). Professional Training Of Future Speakers In The Period Of Independent Study. In Archive of Conferences (Vol. 10, No. 1, pp. 75-76).
6. Sobirkhonovna, M. M. (2020). An Innovative Mechanisms to Increase the Effectiveness of Independent Education of Future Defectologists. International Journal on Integrated Education, 3(11), 210-211.
7.Mahmudova, M. S. (2020). The Role Of Independent Education In The Formation Of Professional Competencies Of Prospective Speech Therapists. Scientific Bulletin of Namangan State University, 2(10), 358-363.
8. Maxmudova, M., & Vaziraxon, A. (2022, November). Tayanch–Harakati A'zolari Falajlangan Bolalar Lug'atini Rivojlantirish Yo'llari. In Conference Zone (pp. 259-263).
9.Maxmudova, M., & Azizabonu, B. (2022, November). Ruhiy Rivojlanishi Sustlashgan Bolalar Lug'atining Psixik Rivojlanish Bilan Bog'liqligi. In Conference Zone (pp. 238-242).
10.Maxmudova, M. (2022). Technologies for the development of professional competencies of students of Higher Education. INTERNATIONAL JOURNAL OF SOCIAL SCIENCE & INTERDISCIPLINARY RESEARCH ISSN: 2277-3630 Impact factor: 7.429, 11(11), 249-254.
11.Maxmudova, M., & Zikirova, O. (2021). Speech therapist and family collaboration in overcoming severe speech deficits.
12. Sobirkhonovna, M. M. (2020). DEVELOPMENT OF PROFESSIONAL COMPETENCIES OF FUTURE SPEECH THERAPISTS IN THE PROCESS OF STUDYING INDEPENDENTLY. European Journal of Research and Reflection in Educational Sciences, 8(8), 155-158.
13. Juraev, M. M. (2022). Prospects for the development of professional training of students of professional educational institutions using electronic educational resources in the environment of digital transformation. Academicia Globe: Inderscience Research, 3(10), 158-162.
14. Juraev, M. M. (2022). The value of open mass competitions in the process of digitalization of extracurricular activities of schoolchildren. Web of Scientist: International Scientific Research Journal, 3(10), 338-344.

15. Jo‘rayev, M. (2022). Professional ta’lim jarayonida fanlararo uzvilik va uzliksizlikni ta’minlash o ‘quvchilari kasbiy tayyorgarligining muhim omili sifatida. Zamonaviy dunyoda amaliy fanlar: Muammolar va yechimlar, 1(29), 43-46.
16. Juraev, M. M. (2021). OA Qo ‘ysinov Description of the methodological basis for ensuring interdisciplinary continuity of the subject “Computer Science and Information Technology” in vocational education. JournalNX-A Multidisciplinary Peer Reviewed, 7(10).
17. Mansurjonovich, J. M. (2021). Experience Of Cambridge Curricula In Ensuring The Continuity Of Curricula In The Field Of “Computer Science And Information Technology” In The System Of Professional Education. The American Journal of Interdisciplinary Innovations Research, 3(11), 26-32.
18. Juraev, M. M. (2021). PEDAGOGICAL CONDITIONS FOR THE DEVELOPMENT OF VOCATIONAL EDUCATION THROUGH INTERDISCIPLINARY INTEGRATION INTO THE VOCATIONAL EDUCATION SYSTEM. In НАУКА, ОБРАЗОВАНИЕ, ОБЩЕСТВО: АКТУАЛЬНЫЕ ВОПРОСЫ, ДОСТИЖЕНИЯ И ИННОВАЦИИ (pp. 110-112).
19. Juraev, M. M. ZY Xudoyberdiyev Theoretical analysis of the continuity model of computer science and information technology in the System of professional education. European Scholar Journal (ESJ)//ISSN (E), 2660-5562.
20. Juraev, M. M. (2022). Theoretical and practical principles of improving the content of the pedagogical activity of ICT teachers of professional educational institutions in the conditions of information of education.
21. Mansurjonovich, J. M. (2022). CURRENT STATUS OF THE SCIENCE OF INFORMATICS AND INFORMATION TECHNOLOGIES IN THE PROFESSIONAL EDUCATION SYSTEM, EXISTING PROBLEMS AND SOLUTIONS, PRINCIPLES AND CONTENT OF THE SCIENCE ORGANIZATION. Galaxy International Interdisciplinary Research Journal, 10(12), 327-331.
22. Mansurjonovich, J. M. (2022). Professional Educational Institutions Theoretical and Practical Basis of Development of the Content of Pedagogical Activity of Teachers of" Information and Information Technologies". Texas Journal of Engineering and Technology, 15, 49-53.
23. Mansurjonovich, J. M. (2022). METHODOLOGICAL FOUNDATIONS FOR IMPROVING THE CONTENT OF TRAINING FUTURE ICT TEACHERS IN THE CONDITIONS OF DIGITAL TRANSFORMATION OF EDUCATION. АКТУАЛЬНЫЕ ВОПРОСЫ СОВРЕМЕННОЙ НАУКИ И ОБРАЗОВАНИЯ,
24. Makhmudov Khurshid Shukhratovich. IMPORTANCE OF DIDACTIC GAMES IN SPEECH DEVELOPMENT OF MENTALLY RETARDED CHILDREN. Asian Journal

of Multidimensional Research. ISSN: 2278-4853 Vol. 11, Issue 11, November 2022 SJIF 2022 = 8.179 A peer reviewed journal. Pages 20-23
25. Shuxratovich, Maxmudov Xurshid. "SOCIO-PSYCHOLOGICAL OF CHILDREN WITH SPEECH IMPAIRMENT ADAPTATION FEATURES." INTERNATIONAL JOURNAL OF SOCIAL SCIENCE & INTERDISCIPLINARY RESEARCH ISSN: 2277-3630 Impact factor: 7.429 11.11 (2022): 243-248.
26. Sobirxonovna, M. M. (2023). The genealogy of thoughts of the manifestations of ancient antiquity in the study of the speech deficit of dıslaliya. Confrencea, 11(11), 17-20.
27 .Sobirxonovna, M. M. (2023). GENEALOGY OF SCHOLARS AFTER THE 15TH CENTURY İN THE STUDY OF SPEECH DEFİCİT. Confrencea, 11(11), 21-25.
28. Mansurjonovich, J. M. (2023). Designing an electronic didactic environment to ensure interdisciplinary integration in the teaching of" Informatics and information technologies" during professional education. Confrencea, 11(11), 78-82.
29. Maxmudova, M. S. Logopediya. BibTeX EndNote RefMan