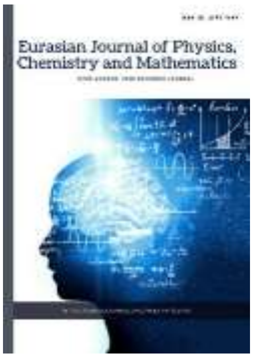

Calculating the Surface Area of a Rolling Surface Using an Exact Integral

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ABSTRACT
Calculate The Area Of Rotary Surfaces Using A Definite Integral The Emphasis Is On How The Functionality Is Displayed. Because, Function May Give Obviously, Parametric And In Another System From Decart Coordinate System.

Keywords:

Calculate The Area Of Rotary Surfaces Using A Definite Integral The Emphasis Is On How The Functionality Is Displayed. Because, Function May Give Obviously, Parametric And In Another System From Decart Coordinate System.
For The Convenience Of Computing, We Use Different Formulas For Each One. $f(x)$ Function Is Detected And Continuous In $[a,b]$ Cut, It Has Limited $f'(x)$ Derivative In $x\in(a,b)$ Interval [1-4].
1. The Side Surface Of The Rotary Surface Formed By The Rotation Of The $f(x)$ Function On The Axis *Ox* In $[a,b]$ Cut Is Obtained By The Following Formula

$$S=2\pi\int_a^b f(x)\sqrt{1+\left[f'(x)\right]^2}dx \qquad (1)$$

2. If The Curve Is Given Like $\begin{cases} x=\varphi(t) \\ y=\psi(t) \end{cases}$ $\alpha\le t\le\beta$, In This Case, According To The (1) Formula, It Looks Like The Following Below

$$S=2\pi\int_\alpha^\beta \psi(t)\sqrt{\left[\varphi'(t)\right]^2+\left[\psi'(t)\right]^2}dt \qquad (2)$$

3. If The Curve Is Given In Polar Coordinate System With $\rho=\rho(\varphi)$, $\alpha\le t\le\beta$ Formula, According To The (1) Formula, The Area Of The Rotary Surface Formed By The Rotation Of The $\rho=\rho(\varphi)$ Curve On The Axis Polar Is Obtained By The Following Formula

$$S=2\pi\int_\alpha^\beta \rho(\varphi)\sin\varphi\sqrt{\rho^2+\left[\rho'\right]^2}d\varphi \qquad (3)$$

Look At The Examples Below For Calculating The Area Of Rotary Surfaces Using The Definite Integral [5-8].
1-Problem. Find The Surface Of Sphere That The Radius Is Equal *R* And Center Is In Head Of Coordinate.
Answer. For Calculating That Problem We Use (1) Formula Above. We Know That, The Circle Equation Is $x^2+y^2=R^2$. For Using The Equality (1), We Need The Equation Of Function And We Find It From Circle Equation.

$$f(x)=\sqrt{R^2-x^2}, \quad f'(x)=\frac{-x}{\sqrt{R^2-x^2}}.$$

We Find These Findings In The Above (1) Formula And Have The Following Result

$$S=2\pi\int_{-R}^{R}\sqrt{R^2-x^2}\cdot\sqrt{1+\frac{x^2}{R^2-x^2}}dx=2\pi\int_{-R}^{R}Rdx=4\pi R^2$$

.

2-Problem. Calculate The Are Of Rotary Surfaces Formed By The Rotation On The Axis *Ox* And Given As A Parametric Form $\begin{cases} x=e^t\sin t \\ y=e^t\cos t \end{cases}$ In $\left[0;\frac{\pi}{2}\right]$ Cut.

Answer. For Calculating That Problem We Use (2) Formula Above. We Will Find Their Specific Derivatives And Put Them In (2) Formula [7-10].

$$S=2\pi\int_0^{\frac{\pi}{2}}e^t\cos t\sqrt{\left(e^t\sin t+e^t\cos t\right)^2+\left(e^t\cos t-e^t\sin t\right)^2}dt$$

,

$$S=2\sqrt{2}\pi\int_0^{\frac{\pi}{2}}e^{2t}\cos tdt.$$

We Integrate This Integral Expression Into A Gradual Integration And Have The Following Result

$$S=2\sqrt{2}\pi\int_0^{\frac{\pi}{2}}e^{2t}\cos tdt=2\sqrt{2}\pi\frac{e^{\pi}-2}{5}.$$

So That, The Area Of The Rotary Surface Is Equal $2\sqrt{2}\pi\frac{e^{\pi}-2}{5}$.

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