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Mechatronics Engineering
19/ENG05/052
MAT 1024

1 $\int e^x \sin x \, dx$

$u = \sin x \quad dv = e^x$

$\frac{du}{dx} = \cos x \quad \int dv = \int e^x$

$du = \cos x \, dx \quad v = e^x$

$\int u \, dv = uv - \int v \, du$

$\int e^x \sin x \, dx = e^x \sin x - \int e^x \cos x \, dx$

$\int e^x \cos x \, dx$

$u = \cos x \quad dv = e^x$

$\frac{du}{dx} = -\sin x \quad \int dv = \int e^x$

$du = -\sin x \, dx \quad v = e^x$

$\int u \, dv = uv - \int v \, du$

$= e^x \cos x - \int e^x \sin x \, dx$

$\int e^x \sin x \, dx = e^x \sin x + e^x \cos x - \int e^x \sin x \, dx$

$2\int e^x \sin x \, dx = e^x (\sin x + \cos x)$

$\int e^x \sin x \, dx = \frac{e^x}{2} (\sin x + \cos x) + C$

2 $\int 2x^2 \ln x \, dx$

$u = \ln x$

$dv = 2x^2$ $\qquad \int dv = \int 2x^2$

$\frac{du}{dx} = \frac{1}{x}$ $\qquad v = \int \frac{2x^3}{3}$

$du = \frac{dx}{x}$

$\int u \, dv = uv - \int v \, du$

$= \ln x \cdot \frac{2x^3}{3} - \int \frac{2x^3}{3} \frac{dx}{x}$

$= \frac{2x^3}{3} \ln x - \int \frac{2x^2}{3} dx$

$= \frac{2x^3}{3} \ln x - \int \frac{2x^2}{3} dx \; \frac{2x^3}{9} + C$

$= \frac{2x^3}{3}\left(\ln x - \frac{1}{3}\right) + C$

3 $\int x^2 \sin x \, dx$

$u = x^2$ $\qquad dv = \sin x$

$\frac{du}{dx} = 2x$ $\qquad \int dv = \int \sin x$

$du = 2x\,dx$ $\qquad v = -\cos x$

$\int u\,dv = uv - \int v\,du$

$= -x^2 \cos x + \int 2x \cos x$

$\int 2x \cos x$

$\int u\,dv = uv - \int v\,du$

$= 2x \sin x$

$u = 2x$ $\qquad dv = \cos x$

$\frac{du}{dx} = 2$ $\qquad \int dv = \int \cos x$

$du = 2\,dx$ $\qquad v = \sin x$

$\int u\,dv = uv - \int v\,du$

$2x \sin x - \int 2 \sin x \cdot dx$

$2x - x^2 \cos x + 2x \sin x - \int 2 \sin x \, dx$

$-x^2 \cos x + 2x \sin x + 2 \cos x + C$

4 $\int x \cos x \, dx$

$u = x \qquad dv = \cos x$

$du/dx = 1 \qquad \int dv = \int \cos x$

$du = dx \qquad v = \sin x$

$\int u \, dv = uv - \int v \, du$

$= x \sin x - \int \sin x \, dx$

$= x \sin x + \cos x + C$