Oyeleye Wuradeen Opeyemi
Mechatronics Engineering
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MAT104

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

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

Soln

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

$\frac{du}{dx} = \cos x \qquad v = e^x$

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

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

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

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

$\frac{du}{dx} = -\sin x \qquad v = e^x$

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

So there fore

$\cancel{\int e^x \sin x dx = \sin x(e^x) + \int -e^x}$

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

Add $\int e^x \sin x dx$ to both sides

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

$2 \int e^x \sin x dx = e^x \sin x - \cos x e^x$

$$\int e^x \sin x dx = \frac{e^x \sin x - \cos x e^x}{2}$$

$\therefore$

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

2. $2x^2 \ln x dx$

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

$u = \ln x \qquad dv = \cancel{2}x^2$

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

$\int 2x^2 \ln x \, dx = 2\left[\ln x\left(\frac{x^3}{3}\right) - \int\left(\frac{x^3}{3}\right)\left(\frac{1}{x}\right)dx\right]$

$= 2\left[\frac{x^3 \ln x}{3} - \int \frac{x^2}{3} dx\right]$

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

$= 2\left(\frac{x^3 \ln x}{3} - \frac{x^3}{9}\right) + C$

3. $x^2 \sin x dx$

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

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

$\frac{du}{dx} = 2x \qquad v = -\cos x$

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

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

for $\int x \cos x \, dx$

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

$\frac{du}{dx} = 1 \qquad v = \sin x$

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

$\therefore$

$$\int x^2 \sin x \, dx = -x^2\cos x + 2\left(x\sin x - \int \sin x \, dx\right)$$

$$= -x^2\cos x + 2(x\sin x + \cos x) + C$$

4. $x \cos x \, dx$

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

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

$\frac{du}{dx} = 1$ $\quad\quad$ $v = \sin x$

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

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