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Question

find the integral of the following

(i) $e^x \sin x\,dx$ (ii) $2x^2 \ln x\,dx$ (iii) $x^2 \sin x\,dx$ (iv) $x \cos x\,dx$

Answer

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

$$\int e^x \sin x\,dx \quad u = e^x \quad du = e^x \quad v = -\cos x \quad dv = \sin x$$

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

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

$$-e^x \cos x + x\int e^x \cos x\,dx \quad \text{let } u = e^x \; du = 1 \; dv = \cos x \; v = \sin x$$

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

$$= -e^x \cos x + x e^x \sin x + x \cos x + C //$$

(2) $2x^2 \ln x\,dx$

Solution

$$u = \ln x \quad du = \frac{1}{x}\,dx \quad v = \frac{2x^3}{3} \quad dv = 2x^2$$

$$\ln x \cdot \frac{2x^3}{3} - \frac{2}{3}\int x^3 \cdot \frac{1}{x}$$

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

(iii) $x^2 \sin x\,dx$

Solution

$\int x^2 \sin x\,dx \quad u = x^2 \quad du = 2x\,dx \quad v = -\cos x \quad dv = \sin x$

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

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

$-x^2 \cos x + 2\int x \cos x\,dx$ (let $u = x \quad du = 1\,dx \quad dv = \cos x \quad v = \sin x$

$-x^2 \cos x + 2[x \sin x - \int \sin x \cdot dx]$

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

(iv) $x \cos x\,dx$

$\int x \cos x\,dx \quad u = x \quad du = x\,dx \quad v = \sin x \quad dv = \cos x$

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

$\int x \cos x\,dx = x \sin x + \int x\,d(\sin x)\,dx$

$x \sin x + \int x \sin x\,dx$ let $u = x \quad du = 1\,dv = \sin x \quad v = \cos x$

$= x \sin x + x[x \cos x - \int \cos x \cdot dx]$

$= x \sin x + x^2 \cos x + x \cos x + C$ //