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MAT 104

find the integral of the following

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

Solution

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

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

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

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

$$e^x \sin x - \left[\begin{array}{l} u = \cos x \quad dv = e^x \\ du = -\sin x \quad v = e^x \end{array} \right.$$

$$e^x \sin x - \left[e^x \cos x - \int e^x - \sin x \, dx \right.$$

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

$$\text{Let } I = \int e^x \sin x \, dx$$

$$I = e^x \sin x - e^x \cos x - I$$

$$2I = e^x \sin x - e^x \cos x$$

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

Therefore,

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

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

$U = \ln x \qquad dv = 2x^2$

$dv = \frac{1}{x} \qquad V = \frac{2x^3}{3}$

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

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

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

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

$du = 2x \qquad V = -\cos x$

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

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

$-x^2 \cos x + \left[\begin{array}{ll} U = 2x & dv = \cos x \\ dU = 2 & V = \sin x \end{array} \right.$

$-x^2 \cos x + \left[2x \sin x - \int 2 \sin x \right.$

$-x^2 \cos x + 2x \sin x - \left[\begin{array}{ll} U = 2 & dv = \sin x \\ du = 0 & V = -\cos x \end{array} \right.$

$-x^2 \cos x + 2x \sin x - 2\cos x \int -\cos x (0) \, dx$

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

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

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

$du = 1$ $\quad v = \sin x$

$\int x \cos x \, dx = x \sin x - \int \sin x \, (1) \, dx$

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