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19/ENG07/016.

PETROLEUM ENGINEERING.

MATHS 104.

Find the integral of the following:

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

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

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

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

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

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

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

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

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

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

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

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

Let $I = \int e^x \sin x \, dx$.

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

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

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

$\therefore \int e^x \sin x \, dx = \frac{1}{2}\left[e^x \sin x - e^x \cos x\right] + C$

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

$u = \ln x \quad dv = 2x^2$

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

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

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

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

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

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

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

$du = 2x \quad v = -\cos x$

$\frac{du}{dx} = 2x$

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

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

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

Let $u = -2x, \quad du = \cos x$

$du/dx = -2x \quad v = \sin x$

$\therefore (-2x)(\sin x) - \int (\sin x)(-2) dx$

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

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

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

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

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

4. $x \cos x \, dx$

$\int x \cos x \, dx$

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

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

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

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

$\therefore \int x \cos x \, dx = x \sin x + \cos x + C$