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Petroleum Engineering
MAT 104 Assignment

1. $\int x^2 \sin x$

Let $u = x^2$ and $dv = \sin x$

$\frac{du}{dx} = 2x$ and $\frac{dv}{dx} = -\cos x$

Using $uv - \int v\,du$

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

$\cancel{-x^2 c}\ -x^2\cos x - \int -2x\cos x\,dx$

$\boxed{\text{Let } u = 2x \text{ and } du = \cos x \quad \frac{du}{dx} = -2x \text{ and } v = \sin x}$

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

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

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

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

$\therefore \int x^2 \sin x = -x^2\cos x - 2x\sin x - 2\cos x + c$

2 $3te^{2t}$

Solution

Let $u = 3t$ and $dv = e^{2t}$

$\cancel{\frac{du}{dt} = 3}$ $\int dv = \cancel{3} \int e^{2t}$

$du = 3dt$ $v = \frac{e^{2t}}{2}$

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

$3t\left(\frac{e^{2t}}{2}\right) - \int \frac{e^{2t}}{2} \times 3dt$

$3t\left(\frac{e^{2t}}{2}\right) - \frac{1}{2} \times \frac{3e^{2t}}{2} + c$

$\left[\frac{3te^{2t}}{2} - \frac{3e^{2t}}{4}\right] + c$

3. $2x^2 \ln x \, dx$

Let $u = 2x^2$ $\quad du = \ln x$

$\frac{du}{dx} = 4x$ $\quad v = 1/x$

$du = 4x \, dx$ $\quad v = 1/x$

using $uv - \int u \, dv = \int u \, dv$

$2x^2\left(\frac{1}{x}\right) - \int \frac{1}{x} \times 4x \, dx$

$= \frac{2x^3}{x} - \int \frac{4x}{x} \, dx$

$= 2x - 4 + C$

4 $\frac{2x - 3x^2}{1-x}$

$$\begin{array}{r|l} 1-x & 2x - 3x^2 \\ - & 2x - 2x^2 \\ \hline & -x^2 \\ & \cancel{2x} - x^2 + x^3 \\ \hline & -x^3 \end{array}$$

which can be

$\int (2x - x^2) \, dx + \int \frac{x^3}{1-x} \, dx$

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