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COURSE CODE: MAT 104.

① $x^2 \sin x \, dx$

② $3te^{2t} \, dt$

③ $2x^2 \ln x \, dx$

④ $\frac{(2x-3x^2)}{(1-x)} \, dx$

① $\int x^2 \sin x$

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

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

using $uv = \int u\,dv$

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

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

Let $u = 2x$ and $dv = \cos x$

$\frac{du}{dx} = 2$ and $v = \sin x$

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

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

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

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

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

② $3te^{2t}$

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

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

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

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

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

$$3t\left(\frac{e^{2t}}{2}\right) - \frac{1}{2}\int 3e^{2t}\,dt$$

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

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

(3) $2x^2 \ln x\,dx$

let $u = 2x^2$, $dv = \ln x$

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

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

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

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

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

$$= 2x - 4 + C$$

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

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

which can now be

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

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