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Department: Computer Engineering
Level: 100
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1) $3te^{2t}$

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

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

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

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

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

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

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

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

2) $\int x^2 \sin x$

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

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

Using $Uv - \int v du$

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

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

$\left[\begin{array}{l} \text{let } U = -2x \text{ and } dv = \cos x \\ du/dx = -2x \text{ and } V = \sin x \end{array}\right]$

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

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

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

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

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

3) $\int \sin 7x \cos 2x$

let $A = 7x$, $B = 2x$

$\int \sin 7x \cos 2x = \frac{1}{2}\left[\sin(7x+2x) + \sin(7x - 2x)\right]$

$\int \sin 7x \cos 2x = \frac{1}{2}\left[\sin 9x + \sin 5x\right]$

$= \frac{1}{2}\int\left[\frac{\sin 9x}{9} + \frac{\sin 5x}{5}\right]$

$= -\frac{\cos 9x}{18} - \frac{\cos 5x}{10} + c$

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

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

which can now be

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

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