Name: Opoola Daniel Oluwasey
Matric No: 19/ENG05/056
Department: Mechatronics
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1) Integrate: $x^2 \sin x \, dx$

1.) $\int u \frac{dv}{dx} dx = uv - \int v \frac{du}{dx} dx$

Let $u = x^2$ and $\frac{dv}{dx} = \sin x$

$v = -\cos x \quad du/dx = -\cos x$

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

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

$\int x \cos x \, dx$

let $u = x \quad dv/dx = \cos x$

$du/dx = 1 \quad v^2 = \sin x$

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

$= x \sin x + \cos x$

$\therefore \int x^2 \sin x \, dx = -x^2 \cos x + 2[x \sin x + \cos x]$

$= -x^2 \cos x + 2[x \sin x + \cos x] + C$

2.) $3te^{2t}\,dt$

$$\int u\frac{dv}{dt}\,dt = uv - \int v\,\frac{du}{dt}\,dt$$

let $u = 3t$ $\quad dv/dt = e^{2t}$

$du/dt = \cancel{3}\,3$ $\quad v = \frac{1}{2}e^{2t}$

$$\therefore \int 3te^{2t}dt = 3t.\left(\tfrac{1}{2}e^{2t}\right) - \int \tfrac{1}{2}e^{2t}(3)\,dt$$

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

$$= 3\left[\tfrac{1}{2}te^{2t} - \tfrac{1}{4}e^{2t}\right] + c$$

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

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

$$\int u\,dv/dx\,dx = uv - \int v\,\frac{du}{dx}\,dx$$

let $u = \ln x$ $\quad dv/dt = \cancel{2}\,2x^2$

$du/dx = 1/x$ $\quad v = 2/3\,x^3$

$$\int \ln x\,2x^2\,dx = \ln x\left(2/3\,x^3\right) - \int 2/3\,x^3\left(1/x\right)dx$$

$$= 2/3\,x^3\ln x - \int 2/3\,x^2\,dx$$

$$= \frac{2}{3}x^3\ln x - 2/9\,x^3 + c$$

$$= \frac{2}{3}x^3\ln x - \frac{2}{9}x^3 + c$$

$$= 2\left[\frac{1}{3}x^3\ln x - \frac{1}{9}x^3\right] + c$$

4) $\int (2x - 3x^2)/(1-x)\, dx$

soln

$$\int \frac{2x}{1-x}\, dx * - \int \frac{3x^2}{1-x}\, dx$$

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

$$\frac{3}{2}x^2 + x + \ln(|-x+1|) + c.$$