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Math 104 Assignment:

Integrate the following:

1.) $3te^{2t}$

$$\int 3te^{2t}\,dt$$

$u = 3t$ $dv = \frac{e^{2t}}{2}$

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

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

$$= 3t \cdot \frac{e^{2t}}{2} - \int \frac{e^{2t}}{2} \cdot 3\,dt$$

$$= \frac{3t \cdot e^{2t}}{2} - \frac{3}{2}\int e^{2t}\,dt = \frac{3te^{2t}}{2} - \frac{3e^{2t}}{4} + c$$

2.) $x^2 \sin x$

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

Let $u = x^2$ $dv = \sin x\,dx$ $\int u \cdot dv = uv - \int v\,du$

$du = 2x\,dx$ $v = -\cos x$

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

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

$u = x$ $dv = \cos x\,dx$

$du = 2dx$ $v = \sin x$

$$= -x^2\cos x + 2\left[x\sin(x) - \int \sin x\,dx\right] + c$$

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

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

$$= \int \sin 7x \cos 2x\,dx$$

$$\sin a \cdot \cos b = \tfrac{1}{2}\left[\sin(a+b) + \sin(a-b)\right]$$

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

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

$$= \frac{1}{2}\int \sin 9x\,dx + \frac{1}{2}\int \sin 5x\,dx$$

$$= \frac{1}{2}\left(\frac{-\cos(9x)}{9}\right) + \frac{1}{2}\left(\frac{-\cos 5x}{5}\right) + C$$

$$= -\frac{1}{18}\cos 9x - \frac{1}{10}\cos 5x + C$$

4.) $\dfrac{2x-3x^2}{1-x} = \int \dfrac{2x-3x^2}{1-x}\,dx$

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

$$\begin{array}{r} 3x+1 \\ -x+1 \;\overline{)\; -3x^2+2x} \\ -(-3x^2+3x) \\ \hline 0 - x \\ -(-x+1) \\ \hline 0 \text{ R } -1 \end{array}$$

$= 3x + 1 - \frac{1}{1-x}$

Dividing polynomially; $\int \left[3x+1-\frac{1}{1-x}\right]dx$

$$= \frac{3x^{1+1}}{1+1} + \frac{x^{0+1}}{0+1} - \int \frac{1}{1-x}$$

$= \int \frac{1}{1-x}$ Let $u = 1-x$ $du/dx =$

$\int -du/u = \ln u = -\ln|1-x|$

$$= \int \frac{2x-3x^2}{1-x}dx = \frac{3x^2}{2} + x + \ln|1-x| + C$$