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MATIO4 Assignment.

① $2x^2 \ln x$

$u = \ln x \quad dv = 2x^2$

$\frac{du}{dx} = \frac{1}{x}dx \quad v = \frac{2x^3}{3}$

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

$= \ln x \cdot \frac{2x^3}{3} - \int \frac{2x^3}{3} \cdot dx$

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

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

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

2) $3te^{2t}$

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

$du = 3dx \quad v = \frac{1}{2}e^{2t}$

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

$\int 3te^{2t} = 3t \cdot \frac{1}{2}e^{2t} - \int \frac{1}{2}e^{2t} \cdot 3dx$

$\int 3te^{2t} = \frac{3t}{2}e^{2t} - \int \frac{3}{2}e^{2t} \cdot dx$

$= \frac{3t}{2}e^{2t} - \frac{1}{2} \cdot \frac{3}{2}e^{2t} + c$

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

$x^2 \sin x \quad u = x^2 \quad dv = \sin x \quad du/dx = 2t \quad du = 2xdx$

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

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

$-x^2 \cos x + \left[\begin{matrix} u = 2x & dv = \cos x \\ du = 2dx & v = \sin x \end{matrix}\right]$

$= x^2 \cos x + uv - \int v\,du$

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

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

4) $\cos 5x \cos 6x$

$A = 5x \quad B = 6x$

Recall that :- $\cos A \cos B = \frac{1}{2}\left[\cos(A+B) - \cos(A-B)\right]$

$= \frac{1}{2}\left(\cos 11x + \cos x\right)$

$\int \cos 5x \cos 6x \, dx = \frac{1}{2}\left[\frac{\sin 11x}{11} + \sin x\right] + c$

$\therefore \int \cos 5x \cos 6x \, dx = \frac{\sin 11x}{22} + \frac{\sin x}{2} + c$

5) $\sin 7x \cos 2x$

$A = 7x \quad B = 2x$

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

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

$\therefore \int \sin 7x \cos 2x \, dx = \frac{-\cos 9x}{18} - \frac{\cos 5x}{10} + c$