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MATH 104 ASSIGNMENT.

1. $\int 2x^2 \ln x \, dx$

Solution.

$u = \ln x$, $du = \frac{1}{x} dx$

$v = \frac{2x^3}{3}$ $dv = 2x^2$

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

$$= \ln x\left(\frac{2x^3}{3}\right) - \int \frac{2x^3}{3} \cdot \frac{1}{x} dx$$

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

$$= \frac{2x^3}{3}(\ln x) - \frac{2x^3}{9} + C$$

$$\int 2x^2 \ln x \, dx = \frac{2x^3}{3}\left[\ln x - \frac{1}{3}\right] + C$$

2. $\int 3t\, e^{2t}\, dt$

Solution.

$u = 3t$ $du = \frac{3t^2}{2} dx$

$v = \frac{1}{2}e^{2t}$ $dv = e^{2t}$

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

$$= 3t\left(\frac{1}{2}e^{2t}\right) - \int \frac{1}{2}e^{2t} \cdot \frac{3t^2}{2} dx$$

$$= \cancel{\frac{3}{2}t e^{2t}}\ \frac{3}{2}te^{2t} - \int \frac{3}{4}t^2 e^{2t} dx$$

$$\int 3te^{2t} dt = \frac{3}{2}te^{2t} - \frac{3}{\cancel{4t^2}}\cancel{t^2}e^{2t} + C$$

$$\therefore \int 3te^{2t} dt = \frac{3}{2}te^{3t} - \frac{3}{4}e^{2t} + C$$

3. $\int x^2 \sin x \, dx$.

Solution.

$u = x^2 \qquad du = \frac{x^3}{3} dx$

$v = -\cos x \qquad dv = \sin x$

$\therefore uv - \int v \, du$

$\Rightarrow x^2 \cdot (-\cos x) - \int (-\cos x) \cdot \left(\frac{x^3}{3}\right) dx$

$\Rightarrow -\cos x (x^2) - (-\sin x) + \frac{x^4}{12} + C$

$\Rightarrow \int x^2 \sin x \, dx = -\cos x (x^2) + \sin x \left(\frac{x^4}{12}\right) + C$

4. $\int \cos 5x \cos 6x \, dx$

Solution.

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

$A = 5x$ and $B = 6x$

$= \frac{1}{2}\left[\cos(5x+6x) + \cos(5x-6x)\right]$

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

$\int \cos 5x \cos 6x \, dx = \frac{1}{2}(\cos 11x - \cos x) \, dx$

$\int \cos 5x \cos 6x \, dx = \frac{1}{2}(\cos 11x - \cos x)$

$= \frac{1}{2}\left[\frac{\sin 11x}{11} - \sin x\right] + C$

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

5. $\int \sin 7x \cos 2x \, dx$

Solution

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

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

$$\int \sin 7x \cos 2x \, dx = \frac{1}{2}(\cos 9x + \sin 5x)\, dx$$

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

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