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Maths 104
MBBS
19/MHS01/363

(1) $2x^2 \ln x$

soln

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

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

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

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

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

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

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

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

(2) $3te^{2t}$

soln

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

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

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

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

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

$$= \frac{3te^{2t}}{2} - \frac{1}{2} \times \frac{3}{2} e^{2t} + C$$

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

(3) $x^2 \sin x$

soln

$u = x^2 \qquad dv = \sin x$

$\frac{du}{dx} = 2x \qquad v = -\cos x$

$du = 2x\,dx$

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

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

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

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

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

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

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

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

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

soln

$A = 5x, \; B = 6x$

but,

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

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

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

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

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

<u>soln</u>

$A = 7x, \; B = 2x$

Recall that;

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

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

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

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