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COURSE: MATHS 104

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

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

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

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

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

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

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

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

$= \frac{2x^3 \ln x}{3} - \frac{2x^3}{9} dx = \frac{3 \times 2x^3 \ln x - 2x^3}{9} dx$

$= \frac{2x^3(3\ln x - 1)}{9} + C = \frac{2x^3 \ln x - 1}{3} + C$

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

2 $3te^{2t}$

$u = 3t \qquad \frac{du}{dt} = 3$

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

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

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

$= \int 3te^{2t} = \left(\frac{3te^{2t}}{2} - \frac{3}{4}e^{2t}\right)dt$

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

3 $x^2 \sin x$

$u = x^2 \qquad du = 2x\,dx \qquad \frac{dv}{dx} = \sin x\,dx$

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

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

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

$u = x, \frac{dv}{dx} = \cos x, \frac{du}{dx} = 1, dv = \cos dx, v = \sin x$

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

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

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

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

4. $\cos 5x \cos 6x$

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

Recall $\frac{1}{2}[\cos(A+B) + \cos(A-B) = \cos A \cos B$

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

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

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

$$= \frac{-\sin 11x}{22} + \frac{\sin x}{2} + c$$

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

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

$$= \frac{1}{2}\int [\sin(7x+2x) + \sin(7x-2x)] dx$$

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

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

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

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