Name: Adi Rejoice Sunun
Department: Medicine and Surgery
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course: Mat 104

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

Solution

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

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

$dv = 2x^2 \quad V = \frac{2x^3}{3}$

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

$\int u dv = \ln x \frac{2}{3}x^3 - \int \frac{2}{3}x^3 \cdot \frac{1}{x} dx$

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

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

$\int u dV = \ln x \frac{2}{3}x^3 - \frac{2}{3}\left(\frac{x^3}{3}\right) + c$

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

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

Solution

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

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

$dv = e^{2t} \quad V = \cancel{\frac{1}{2}et} \; \frac{1}{2}e^{2t}$

~~$\therefore \int 3te^{2t} = 3t \cdot \frac{1}{2}et^{2}$~~

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

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

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

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

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

Solution

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

$du = \frac{x^3}{3} dx \qquad V = -\cos x$

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

$\int x^2 \sin x \, dx = -x^2 \cos x - \int -\cos x \cdot \frac{x^3}{3} dx$

$\int x^2 \sin x \, dx = -x^2 \cos x + \int \cos x \cdot \frac{x^3}{3} dx$

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

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

Solution.

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

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

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

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

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

Solution.

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

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

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

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

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