NAME: Austin Oghenetevwe Ella
DEPARTMENT: MEDICINE AND SURGERY (MBBS)
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MAT 204

1 - $2x^2 \ln x$

Solution

$u = \ln x$

$\frac{du}{dx} = \frac{1}{x}, \quad du = \frac{1}{x}dx$

$dv = 2x^2 dx$

$dv = \int 2x^2 dx$

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

$udv = uv - vdu$

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

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

$= \frac{2}{3}x^3 \ln x - \frac{2x^3}{9} + c$

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

2 - $3t\, e^{2t}$

Solution

$u = 3t$

$\frac{dv}{dt} = 3, \quad du = 3dt$

$dv = e^{2t} dt$

$V = \frac{e^{2t}}{2}$

$udv = uv - vdu$

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

$= \frac{3t}{2}(e^{2t}) - \frac{3}{2}\frac{e^{2t}}{2} + C$

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

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

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

Solution

$u = x^2$

$du = 2x dx$

$dv = \sin x dx$

$V = -\cos x$

$udv = uv - vdu$

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

$x^2 \sin x dx = -x^2 \cos x + 2 \quad x \cos x dx$

but $\int x \cos x dx = ?$

$x \cos x dx$

$u = x$

$du = dx$

$dv = \cos x\, dx$

$v = \sin x$

$x \cos x\, dx = x \sin x - \sin x\, dx$

$= x \sin x - (-\cos x)$

$= x \sin x + \cos x$

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

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

4- $\cos 5x \cos 6x\, dx$

Solution

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

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

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

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

$\cos(-x) = \cos x$

$= \frac{1}{2}[\cos 11x + \cos x]$

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

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

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

5 : $\sin 7x \cos 2x\, dx$

Solution

$\sin 7x \cos 2x = \frac{1}{2}[\sin 9x + \sin 5x]$

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

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

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

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