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COURSE:- Mathematics 104.

1) Integrate the following

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

Solution

let $u = \ln x$, $dv = 2x^2$

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

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

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

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

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

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

2) $\int 3te^{2t} dt$

Solution

$u = 3t$, $dv = e^{2t}$

$du = 3dt$, $v = \frac{1}{2} e^{2t}$

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

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

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

$\int 3te^{2t} dt = \frac{3}{2} te^{2t} - \frac{3}{2}\left[\frac{1}{2} e^{2t}\right] + C$

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

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

Solution

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

$du = 2x \, dx$ $\quad v = \cos x$

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

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

$u = 2x$, $dv = \cos x$

$du = 2 \, dx$, $v = \sin x$

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

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

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

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

Solution:

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

$\cos A \cos B = \frac{1}{2} [\cos A + B] + \cos [A - B]$

$\cos 5x - \cos 6x = \frac{1}{2} [\cos 11x - \cos x]$

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

$\int \cos 5x \cos 6x \, dx = \frac{1}{2} \left(\frac{\sin 11x}{11} - \frac{\sin x}{1} \right) + C$

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

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

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

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

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

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

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

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

or

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