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MAT 104 ASSIGNMENT.

a) $\int 2x^2 \ln x \, dx$

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

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

recall: $\int u \, dv = uv - \int v \, du$.

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

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

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

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

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

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

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

recall: $\int u\,dv = uv - \int v\,du.$

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

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

$$\int 3te^{2t}\,dt = \frac{3}{2}te^{2t} - \frac{3}{2}\left(\frac{1}{2}e^{2t}\right) + c.$$

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

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

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

$du = 2x\,dx$ $\qquad v = -\cos x.$

recall: $\int u\,dv = uv - \int v\,du.$

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

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

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

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

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

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

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

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

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

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

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

$\cancel{=\frac{1}{2}}$ $\therefore \cos 5x \cos 6x = \frac{1}{2}\left[\cos 11x - \cos x\right]$.

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

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

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

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

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

recall:

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

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

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

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

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