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Course: MAT 104
Department: Computer Engineering
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1) $x^{1/2} \ln x$

$$\int x^{1/2} \ln x$$

$u = x^{1/2} \quad dv = \ln x$

$$\frac{du}{dx} = 1/2 x^{-1/2}$$

$$\int u \frac{dv}{dx} + \int v \frac{du}{dx}$$

$$\ln x \int \frac{dx^{1/2}}{dx} + x^{1/2} \int \frac{d \ln x}{dx}$$

$$\ln x \left[\frac{x^{3/2}}{3/2} \right] + x^{1/2} \left[\frac{1}{x} \right] + C$$

$$\frac{2 \ln x}{3} \cdot x^{3/2} + \frac{x^{1/2}}{x} + C$$

$$\frac{2x^{3/2} \ln x}{3} + \frac{\sqrt{x}}{x} + C$$

2) $2\cos 6t \cos t$

$2\int \cos 6t \cos t\,dt = 12\int \cos 6t \cos t\,dt$

$A = 6t \quad B = 1t$

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

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

$\frac{2}{2}[\cos 7t + \cos 5t]$

$\int 2\cos 6t \cos 6\,dt = \frac{1}{2}[2\cos 7t + \cos 5t$

$= \frac{2}{2}\left[\frac{\sin 7t}{7} - \frac{\sin 5t}{5}\right]$

$\frac{\sin 7t}{7} - \frac{\sin 5t}{5} + C$

3) $\int \sin^3 x \cos^4 x\,dx$

$U = \cos x$

$\frac{du}{dx} = -\sin x \Rightarrow dx = \frac{du}{-\sin x}$

$\int \cos^4 x \sin^3 x\,dx$

$\int U^4 \frac{-du}{\sin x}$

$-\int U^4 \sin^2 x\,du$

$-\int U^4 \sin^2 x\,du$

Recall that $\sin^2 x + \cos^2 x = 1$

$\sin^2 x = 1 - \cos^2 x$

$-\int \sin^2 x\, U^4\,du$

$-\int (1-\cos^2 x) U^4\,du$

but $U = \cos x$

$-\int (1-u^2) u^4\,du$

$$-(u^4 - u^6)\,du$$

$$-\left[\frac{u^{4+1}}{4+1} - \frac{u^{6+1}}{6+1}\right] + C$$

$$-\left[\frac{u^5}{5} - \frac{u^7}{7}\right] + C$$

$$\frac{(\cos x)^7}{7} - \frac{(\cos x)^5}{5} + C$$