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Chemical Engineering
MAT 104 Assignment

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

Using LIATE partial integration rule,
Ln before Algebraic
$\therefore u = \ln x \quad \frac{du}{dx} = \frac{1}{x} \quad du = \frac{1}{x} dx$

$dv = x^{1/2} = x^{0.5} \; ; \; v = \frac{x^{0.5+1}}{0.5+1} = v = \frac{x^{1.5}}{1.5}$

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

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

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

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

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

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

$= \ln x \cdot \frac{2x^{3/2}}{3} - \frac{4x^{3/2}}{9} + C$

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

2 $\int 2 \cos 6t \cdot \cos t \, dt$

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From Multiplication of trig functions
$\cos A \cdot \cos B = \frac{1}{2}[\cos(A+B) + \cos(A-B)]$
Where $A = 6t$
$B = t$

$\Rightarrow \cos 6t \cos t \, dt = \frac{1}{2}[\cos(7t + t) + \cos(6t - t)]$

$= \frac{1}{2}[\cos(7t) + \cos(5t)]$

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

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

$= 2\left(\frac{1}{2}\left[\frac{\sin 7t}{7} + \frac{\sin 5t}{5}\right)\right) + C$

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

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

Let $\cos x = t$; $\frac{dt}{dx} = -\sin x \Rightarrow \frac{dx}{dt} = \frac{1}{-\sin x} \Rightarrow dx = \frac{1}{-\sin x} dt$

$\Rightarrow \int \sin^3(x) \cos^4 x \left(\frac{1}{-\sin x}\right) dt$

$\int -\sin^2 x \cos^4 x \, dt$

From identities ; $\sin^2 x = 1 - \cos^2 x$

$= \int -(1 - \cos^2 x) \cos^4 x \, dt$

Recall, $\cos x = t$

$= \int -(1 - t^2) t^4 \, dt$

$= \int (t^4 - t^6) \, dt \Rightarrow \int -t^4 + t^6 \, dt$

$= -\int t^4 \, dt + \int t^6 dt$

$= \frac{-t^5}{5} + \frac{t^7}{7}$

Substitute $\cos x = t$

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