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Mechanical Engineering

MAT 104

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

let $v = \ln x$, $du = x^{1/2}$

$\frac{dv}{dx} = \frac{dx}{x}$, $u = \frac{2x^{3/2}}{3}$

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

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

$\int \frac{2x^{1/2}}{3} \cdot \frac{dx}{x} \Rightarrow \int \frac{2x^{1/2}}{3} \cdot dx$

$\int \frac{2x^{1/2}}{3} \cdot dx = \frac{4x^{3/2}}{9} + c$

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

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

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

$\rightarrow A = 6t$, $B = t$

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

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

$= \int \cos 7t + \cos 5t$

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

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

Since m is odd, $u = \cos x$

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

$\therefore \sin^2 x + \cos^2 x = 1$

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

$\int \sin^3 x \cos^4 x \, dx = \int \sin x \cdot \sin^2 x \cdot u^4$

$= -\int \sin^2 x \cdot u^4 \, du$

$= -\int (1 - \cos^2 x) \cdot u^4 \, du$

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

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

$= \int \left(\frac{u^{6+1}}{7} - \frac{u^{4+1}}{5}\right) du$

$= \int \left(\frac{u^7}{7} - \frac{u^5}{5}\right) du$

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

$\int \sin^3 x \cos^4 x \, dx = \frac{(\cos x)^7}{7} - \frac{(\cos x)^5}{5}$

$+ c$