MAT 104
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MECHATRONICS ENGINEERING
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1 $\int \sin 7x \cos 2x \, dx$

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

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

$\sin 7x \cos 2x = \frac{1}{2}[\sin(7x+2x) + \sin(7x-2x)]$

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

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

$= \frac{1}{2}\left[\frac{-\cos 9x}{9} - \frac{\cos 5x}{5}\right] + c$

$= \frac{1}{2}\left[\frac{-\cos 9x}{18} - \frac{\cos 5x}{10}\right] + C$

2 $\int \cos 3x \cos x \, dx$

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

$A = 3x \quad B = x$

$\cos 3x \cos x = \frac{1}{2}[\cos(3x+x) + \cos(3x-x)]$

$= \frac{1}{2}[\cos 4x + \cos 2x]$

$\int \cos 3x \cos x \, dx = \frac{1}{2}\int \cos 4x \, dx + \int \cos 2x \, dx$

$= \frac{1}{2}\left[\frac{\sin 4x}{4} + \frac{\sin 2x}{2}\right] + C$

$= \frac{\sin 4x}{8} + \frac{\sin 2x}{4} + C$

3 $\int \frac{\cos x}{\sin^2 x} dx$

~~$\int \frac{\cos x}{\sin}$~~

$\int \frac{\cos x}{u^2} dx$

$u = \sin x$

$du/dx = \cos x$

$dx = 1/\cos x \, du$

$\int \frac{\cos x}{u^2} \cdot \frac{1}{\cos x} du$

$\int \frac{1}{u^2} du$

$\frac{u^{-2+1}}{-2+1} + C$

$\frac{u^{-1}}{-1} + C$

$-\frac{1}{u} + C$

$-\frac{1}{\sin x} + C$

$= -\operatorname{cosec} + C$

4 $\int_1^2 \int_0^3 9x^2 y \, dx \, dy$

$\int_0^3 9x^2 y \, dx$

$\frac{9x^3 y}{3} \Big|_0^3$

$3x^3 y \Big|_0^3$

$3(3)^3 y - 0$

$= 81y$

$\int_1^2 81y \, dy$

$$\int_1^2 8ly\,dy$$

$$\frac{8ly^{i+1}}{2}\Big|_1^2$$

$$\frac{8ly^2}{2}\Big|_1^2$$

$$\frac{8l(2)^2}{2} - \frac{8l(1)^2}{2}$$

$$162 - \frac{81}{2}$$

$$= \underline{\underline{121.5}}$$