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MAT 104 Assignment

Mechatronics Engineering

(1) $\int \sin 7x \cos 2x\,dx$

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

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

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

$\sin A \cos B = \frac{1}{2}[\sin 9x - \sin 5x]$

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

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

$= -\frac{1}{18}\cos 9x + \frac{1}{10}\cos 5x + C$

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

$A = 3x \quad B = x$

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

$$\cos 3x \cos x = \frac{1}{2}\left[\cos(5x+x) + \cos(5x-x)\right]$$

$$\cos 3x \cos x = 1/2\left[\cos 6x + \cos 4x\right]$$

$$\int \cos 3x \cos x \, dx = \frac{1}{2}\left[\int \cos 6x + \int \cos 4x\right.$$

$$\int \cos 3x \cos x \, dx = \frac{1}{2}\left[\frac{1}{6}\sin 6x + \frac{1}{4}\sin 4x\right] + c$$

$$= \frac{1}{12}\sin 6x + \frac{1}{8}\sin 4x + C$$

(3) $\dfrac{\cos x}{\sin^2 x}\, dx$

Let $u = \sin x$ ---- (1)

$\dfrac{du}{dx} = \cos x$

$dx = du / \cos x$

$$\int \frac{\cos x}{\sin^2 x}\, dx = \int \frac{\cancel{\cos x}}{u^2} \times \frac{du}{\cancel{\cos x}}$$

$$= \int u^{-2}\, du$$

$$= \frac{u^{-1}}{-1} + c = -\frac{1}{u} + c \text{ --- (2)}$$

Substitute $u = \sin x$ into equ (2)

$$\frac{-1}{u} + c = \frac{-1}{\sin x} + c = -\operatorname{cosec} x + c$$

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

Consider the inner integral

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

$= \left[\frac{9x^3y}{3}\right]_0^3$

$= \left[\frac{9x^3y}{3}\right]^3 - \left[\frac{9x^3y}{3}\right]^0$

$= \frac{243y}{3} - 0$

$= 81y$

second integral

$\int_1^2 81y\,dy = \left[\frac{81y^2}{2}\right]_1^2$

$= \left[\frac{81y^2}{2}\right]^2 - \left[\frac{81y^2}{2}\right]^1$

$= \frac{81(4)}{2} - \frac{81(1)}{2}$

$= \frac{324}{2} - \frac{81}{2}$

$= 162 - 81/2 = 243/2$