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MECHATRONICS ENGINEERING   MAT104
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Find the integral of the following

1. $\int \sin 7x \cos 2x \, dx$

solution

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

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

$$\int \frac{1}{2}\left[\sin(9x) + \sin(5x)\right] dx$$

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

$$\therefore \int \sin 7x \cos 2x \, dx = -\frac{1}{18}\cos 9x - \frac{1}{10}\cos 5x + C$$

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

solution

$$\cos A \cos B \, dx = \frac{1}{2}\left[\cos(A+B) + \cos(A-B)\right] dx \quad A = 3x \quad B = x$$

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

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

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

$$\therefore \int \cos 3x \cos x \, dx = \frac{1}{8}\sin 4x + \frac{1}{4}\sin 2x + C$$

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

solution

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

$u = \sin x$

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

$dx = du / \cos x$

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

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

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

$$-U^{-1} + C$$

$$\int \frac{\cos x}{\sin^2 x} = -\frac{1}{U} + C$$

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

$$\int \frac{\cos x}{\sin^2 x} = -\operatorname{Cosec} x + C$$

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

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

$$\int_1^2 3\cdot(3)^3 y\, dy$$

$$\int_1^2 81y\, dy$$

$$\left[\frac{81y^2}{2}\right]_1^2$$

$$\frac{81(2)^2}{2} - \frac{81(1)^2}{2}$$

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

$$\frac{324 - 81}{2} = \frac{243}{2} = 121\cdot5$$

$$\therefore \int_1^2 \int_0^3 (9x^2y)\, dx = 121\cdot5$$