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MATRIC NO: 19/ENG09/013
DATE: 20/05/2020

Answers to the Assignment

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

using trig identity

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

$A+B = 7x + 2x = 9x$

$A-B = 7x - 2x = 5x$

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

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

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

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

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

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

using trig identity

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

$$\therefore \int \cos 3x \cos x \, dx = \int \frac{\cos(A+B) + \cos(A-B)}{2} \, dx$$

where,

$A+B = 3x + x = \cancel{4x}$

$A-B = 3x - x = 2x$

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

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

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

$$= \frac{1}{8} \sin 4x + \frac{1}{4} \sin 2x + C$$

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

Let $u = \sin x$; $\therefore \frac{du}{dx} = \cos x$

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

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

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

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

$$= \left[\frac{u^{-2+1}}{-2+1}\right] + c$$

$$= \left[\frac{u^{-1}}{-1}\right] + c$$

$$= -\frac{1}{u} + c$$

$$\therefore \int \frac{\cos x}{\sin^2 x}\, dx = -\frac{1}{\sin x} + c$$

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

Solution

$$\int_0^3 9x^2 y \, dx = \left[\frac{9x^3 y}{3}\right]_0^3 = \left[\frac{9(3)^3 y}{3} - \frac{9(0)^3 y}{3}\right]$$

$$= 81y$$

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

$$= \left[\frac{81(2)^2}{2} - \frac{81(1)^2}{2}\right] = \frac{243}{2} = 121.5 \text{ sq. uni}$$