1. $\int \sin^6 x \, dx$

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

$$\int \sin^4 x (\sin^2 x) \, dx$$

$$= \int \sin^4 x (1 - \cos^2 x) \, dx$$

$$= \int (\sin^4 x - \sin^4 x \cos^2 x) \, dx$$

$$= \frac{-\cos^4 x}{4} + \frac{\cos^2 x}{2} + C$$

$$= \frac{\cos^2 x}{2} - \frac{\cos^4 x}{4} + C$$

$$\therefore \int \sin^6 x \, dx = \frac{\cos^2 x}{2} - \frac{\cos^4 x}{4}$$

2. $\int \cos^4 x \sin^3 x \, dx$

Let $u = \cos^4 x$

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

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

$$\int u^4 \cdot \sin^3 x \frac{du}{-\sin x}$$

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

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

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

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

$$= \frac{u^7}{7} - \frac{u^5}{5} + C$$

$$\therefore \int \cos^4 x \sin^3 x \, dx = \frac{\cos^7 x}{7} - \frac{\cos^5 x}{5} + C$$

3. $\int \cos x \sin^3 x \, dx$

Let $u = \sin x$

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

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

$$= \int u^3 \times \cos x \times \frac{du}{\cos x}$$

$$= \int u^3 \, du$$

$$= \frac{u^4}{4} + C$$

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

Akpoimoodor Okeadon
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MBBS
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