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MAT104 ASSIGNMENT

1. $\sin^6 x$

$$\int \sin^6 x \, dx = \int \sin^2(x)^3 \, dx$$

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

$$= \int (\tfrac{1}{2})^3 \left[1-\cos(2x)\right]^3$$

$$= \int \tfrac{1}{8}\left[1-\cos(2x)\right]^3 dx$$

$$= \int \tfrac{1}{8} \int \left[1 - 3\cos(2x) + 3\cos^2(2x) - \cos^3(2x)\right] dx$$

$$= \tfrac{1}{8}\int dx - \tfrac{3}{8}\int \cos(2x)\,dx + \tfrac{3}{8}\int \cos^2(2x)\,dx - \tfrac{1}{8}\int \cos^3(2x)\,dx$$

$$= \frac{x}{8} - \frac{3\sin(2x)}{16} + \frac{3x}{16} + \frac{3\sin(4x)}{64} - \frac{\sin(2x)}{16} + \frac{\sin^3(2x)}{48} + c$$

$$= \frac{x}{8} + \frac{3x}{16} - \frac{3}{16}\sin(2x) + \frac{3}{64}\sin(4x) - \frac{1}{6}\sin(2x) + \frac{1}{48}\sin^3(2x) + C$$

$$\therefore \int \sin^6 x \, dx = \frac{5(x)}{16} - \frac{3}{16}\sin(2x) + \frac{3}{64}\sin(4x) - \frac{1}{6}\sin(2x) + \frac{1}{48}\sin^3(2x) + C$$

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2. $\cos^4 x \sin^3 x$

$$\int \cos^4 x \sin^3 x \, dx = \int \sin(x) \cdot \sin^2(x) \cdot \cos^4(x)\,dx$$

$$= \int \sin(x) \cdot \left[1-\cos^2(x)\right] \cdot \cos^4(x)\,dx$$

Let $u = \cos x$

$du = -\sin(x)\,dx$

$-du = \sin(x)\,dx$

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

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

$= \int (u^6 - u^4) \, du = \frac{u^7}{7} - \frac{u^5}{5} + C$

But $u = \cos x$

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

3. $\cos x \sin^3 x$

Let $u = \sin x$

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

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

$= \int u^3 \cdot du = \frac{u^4}{4} + C$

But $u = \sin x$

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