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C.C: MAT104
DEPT: MBBS
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1) $\sin^6 x$

$\Rightarrow \int \sin^6 x \, dx$

$\Rightarrow \int (\sin^3 x)^2 (\sin x)$

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

$\rightarrow \frac{1}{8}\int (1 - 2\cos 2x + \cos^2 2x)(1 - \cos 2x)$

$\Rightarrow \frac{1}{8}\int \left(1 - 2\cos 2x + \frac{1+\cos 4x}{2}\right)(1 - \cos 2x)$

$= \frac{1}{16}\int \left(1 - \cos 2x + \frac{1+\cos 4x}{2}\right)(1 - \cos 2x)$

$\Rightarrow \frac{1}{16}\int (3 - 4\cos 2x + \cos 4x - 3\cos 2x + 4\cos^2 2x - \cos 4x \cos 2x)$

$= \frac{1}{16}\int (3 - 7\cos 2x + \cos 4x + 2 \times 2\cos^2 2x - \frac{1}{2} \times 2\cos 4x \cos 2x)$

$= \frac{1}{32}\int (10 - 15\cos 2x + 4\cos 4x - \cos 6x)\, dx$

$= \frac{1}{32}\left[10x - \frac{15\sin 2x}{2} + \frac{6\sin 4x}{4} - \frac{\sin 6x}{6}\right] + C$

$= \frac{5x}{8} - \frac{15\sin 2x}{64} + \frac{3\sin 4x}{64} - \frac{\sin 6x}{192} + C$ ///

$= \frac{1}{32}\int (6 - 14\cos 2x + 2\cos 4x + 4 + 4\cos 4x - \cos 6x - \cos 2x)$

$= \frac{1}{32}\int (10 - 15\cos 2x + 6\cos 4x - \cos 6x)$

$\Rightarrow \frac{1}{32}\left[10x - \frac{15\sin 2x}{2} + \frac{6\sin 4x}{4} - \frac{\sin 6x}{6}\right] + C$

$\Rightarrow \frac{5x}{16} - \frac{15\sin 2x}{64} + \frac{3\sin 4x}{64} - \frac{\sin 6x}{192} + C$ ///

2) $\int \cos^4 x \sin^3 x$

$\Rightarrow u = \cos x$

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

$\sin^2 x = (1 - \cos^2 x)$

$\Rightarrow \int \cancel{\sin x} \cdot \sin^2 x \cdot u^4 \cdot \frac{-du}{\cancel{\sin x}}$

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

$\Rightarrow -\int (u^4 - u^6) \cdot du$

$\Rightarrow -\left[\frac{u^5}{5} - \frac{u^7}{7} \right] + c$

$\Rightarrow \frac{u^7}{7} - \frac{u^5}{5} + c$

$\Rightarrow \frac{(\cos x)^7}{7} - \frac{(\cos x)^5}{5} + c$ //

$\Rightarrow \frac{\cos^7 x}{7} - \frac{\cos^5 x}{5} + c$ //

3) $\int \cos x \sin^3 x$

; $u = \sin x$

$du/dx = \cos x \Rightarrow dx = du/\cos x$

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

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

$\Rightarrow \frac{\sin^4 x}{4} + c$ //