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Dept: Mechatronics Engineering
Course code: MAT 104

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1.) $\int e^x \sin x \, dx$

$u = e^x \qquad dv = \sin x \, dx$

$\frac{du}{dx} = e^x \qquad v = -\cos x$

$\therefore \int e^x \sin x \, dx = e^x x - \cos x - \int -\cos x \times e^x$

$= -e^x \cos x + \int \cos x \, e^x \quad \text{——①}$

From equation ①

$\int \cos x \, e^x$

$u = e^x \qquad dv = \cos x$

$du = e^x \qquad v = \sin x$

$\therefore \int \cos x e^x = e^x \sin x - \int e^x \sin x \, dx \quad \text{——②}$

Insert equation ② into ①

$\int e^x \sin x \, dx = -e^x \cos x + e^x \sin x - \int e^x \sin x \, dx$

$2\int e^x \sin x \, dx = e^x \sin x - e^x \cos x$

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

2.) $\int 2x^2 \ln x \, dx$

$u = \ln x \qquad dv = 2x^2$

$du/dx = 1/x \qquad v = 2x^3/3$

$\int u \, dv = uv - \int v \, du$

$\therefore \int 2x^2 \ln x \, dx = \frac{2x^3}{3} \ln x - \int \frac{2}{3} x^3 \times \frac{1}{x}$

$= \frac{2x^3}{3} \ln x - \int \frac{2x^2}{3} dx$

$= \frac{2x^3}{3} \ln x - \frac{2x^3}{9} + c$ //

3) $\int x^2 \sin x \, dx$

$u = x^2$ $\quad dv = \sin x \, dx$

$du/dx = 2x$ $\quad v = -\cos x$

$\int u \, dv = uv - \int v \, du$

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

$= -x^2 \cos x + 2\int x \cos x$ —— ①

From eqn ①

$\int x \cos x$

$u = x$ $\quad dv = \cos x \, dx$

$du/dx = 1$ $\quad v = \sin x$

$\int x \cos x = x \sin x - \int \sin x \, dx$

$= x \sin x - (-\cos x)$

$= x \sin x + \cos x + C$ —— ②

Insert eqn ② into eqn ①

$\therefore \int x^2 \sin x \, dx = -x^2 \cos x + 2(x \sin x + \cos x) + C$ //

4) $\int x \cos x \, dx$

$u = x$ $\quad dv = \cos x \, dx$

$du/dx = 1$ $\quad \therefore v = \sin x$

$\int x \cos x = x \sin x - \int \sin x$

$= x \sin x - (-\cos x)$

$= x \sin x + \cos x + C$ //