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19/ENG05/048
MECHATRONICS ENGINEERING
~~third~~
MAT 104 ASSIGNMENT.

* Find the Integral of the following:

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

LIATE using Integration by part $\int u dv = uv - \int v du$

$u = \sin x$
$dv = e^x$
$v = \int e^x = e^x$
$\frac{du}{dx} = + \cos x$

$\therefore \int e^x \sin x dx = \sin x (e^x) - \int e^x (+\cos x)$

$\cancel{= \sin x (e^x) + \int e^x \cos x}$

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

$\int e^x \cos x$; $u = \cos x$, $\frac{du}{dx} = -\sin x$, $dv = e^x$, $v = \int e^x = e^x$

$\therefore \int e^x \cos x = \cos x (e^x) - \int e^x (-\sin x)$

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

$\therefore \int e^x \sin x \, dx = e^x \sin(x) - \left(e^x \cos(x) + \int e^x \sin(x) \, dx \right)$

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

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

$$\frac{\cancel{2} \int e^x \sin(x) \, dx}{\cancel{2}} = \frac{e^x \sin(x) - e^x \cos(x)}{2}$$

$$\therefore \int e^x \sin x \, dx = \frac{e^x [\sin(x) - \cos(x)]}{2} + C$$

(2) $\int 2x^2 \ln x \, dx$; $\int u dv = uv - \int v du$

$u = \ln x$ $\quad \frac{du}{dx} = \frac{1}{x}$
$dv = 2x^2$ $\quad v = \frac{2x^3}{3}$

$\therefore \int 2x^2 \ln x \, dx = \ln x \left(\frac{2x^3}{3}\right) - \int \frac{2x^{\cancel{3}\,2}}{3} \times \frac{1}{\cancel{x}}$

$= \left(\frac{2x^3}{3}\right) \ln x - \frac{2}{3}\int x^2 \, dx$

$= \left(\frac{2x^3}{3}\right) \ln x - \frac{2}{3}\left[\frac{x^3}{3}\right] + c$

$\therefore \int 2x^2 \ln x \, dx = \left(\frac{2x^3}{3}\right) \ln x - \frac{2x^3}{9} + c_4$

LIATE

(3) $\int x^2 \sin x \, dx$; $\int u dv = uv - \int v du$

$u = x^2$ $du = 2x$

$dv = \sin x$ $v = -\cos x$

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

$= -x^2 \cos x + \int 2x \cos x$

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

$u = 2x$ $du = 2$

$dv = \cos x$ $v = \sin x$

$\therefore \int 2x \cos x = 2x \sin x - 2\int \sin x$

$\therefore \int 2x \cos x = 2x \sin x - 2[-\cos x] + c$

$\therefore \int 2x \cos x = 2x \sin x + 2\cos x + c$

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

$\therefore \int x^2 \sin x \, dx = -x^2 \cos x + 2x \sin x + 2\cos x + c_4$

LIATE

(4) $\int x \cos x \, dx$; $\int u dv = uv - \int v du$

$u = x$ $dv = \cos x$

$du = 1$ $v = \sin x$

$\therefore \int x \cos x \, dx = x(\sin x) - \int \sin x \, (1)$

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

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

$\int x \cos x \, dx = x \sin x + \cos x + c_4$