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Course: Mat 102
Dept:- Aeronautics
College:- Engineering
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(1) Find the integral of the following.

(a) $\int e^x \sin x\,dx$.

Let $u = \sin x$; $du = \cos x\,dx$; $dv = e^x dx$; $v = e^x$

$\therefore \int e^x \sin x\,dx = uv - \int v\,du$

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

consider $\int e^x \cdot \cos x\,dx$ from eqn (i)

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

into the formula

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

$\therefore \int e^x \cos x\,dx = \cos x \cdot e^x + \int e^x \sin x\,dx \ldots (ii)$

sub eqn (ii) into eqn (i).

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

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

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

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

Divide through by two

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

$$\int e^x \sin x\,dx = \frac{\sin x}{2} e^x - \frac{\cos x}{2} e^x + c$$

(b) $\int 2x^2 \ln x\,dx$

Solution

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

from LIATE

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

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

~~$\therefore \int \ln 2x^2$~~

$\therefore \int \ln 2x^2 dx = \ln x \cdot \left[\frac{2x^3}{3}\right] - \left[\int \frac{2x^3}{3} \right] 2x^2$

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

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

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

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

$= \qquad = \frac{2}{3}x^3 \ln x - \frac{2}{9}x^3$

$\therefore \int 2x^2 \ln x\, dx = \frac{2x^3}{3}\ln x - \frac{2}{9}x^3 + C_4$

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

<u>Solution</u>

$\int x^2 \sin x\, dx$ from LIATE

$u = x^2$; $du = 2x\,dx$; $dv = \sin x\,dx$; $v = -\cos x$

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

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

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

$\int x^2 \sin x\, dx = -x^2\cos x + \int 2x \cos x\,dx \ldots (i)$

consider $\int 2x \cos x\, dx$

$u = 2x$; $du = 2dx$; $v = \sin x$; $du = \cos dx$

$\int 2x \cos x\, dx = 2x \sin x - \int \cancel{2x} \sin x . 2dx$

$\int 2x \cos x\, dx = 2x \sin x - 2\int \sin x\, dx \ldots \cancel{(ii)}$

$\int 2x \cos x\, dx = 2x \sin x + 2\cos x \ldots (ii)$

Sub into eqn(i)

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

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

~~$du = \sin x$~~ ~~du~~ $u =$

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

<u>Solution.</u>

$\int x \cos x\, dx$

from LIATE

$u = x$; $du = dx$; $v = \sin x$; $du = \cos x$

$\int x \cos x \, dx$

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

$\int u \, dv = x \cdot \sin x - \int \sin x \, dx$

$\int u \, du = x \sin x - (-\cos x)$

$\int u \, du = x \sin x + \cos x + c$