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MECHANICAL ENGINEERING
19/ENG06/016 SERIAL NO.; 111
MAT 104 ASSIGNMENT (Mrs. Funmilayo Saka)

Integrate the following with respect to their variable;

1. $3te^{2t}$

Solution

$$\int 3te^{2t}\,dt$$

$u = 3t$, $dv = e^{2t}$

$\frac{du}{dt} = 3$, $v = \frac{e^{2t}}{2}$

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

$$\int 3te^{2t}dt = 3t\left(\frac{e^{2t}}{2}\right) - \int \frac{e^{2t}}{2} \cdot 3\,dt$$

$$= \frac{3te^{2t}}{2} - \int \frac{3e^{2t}}{2}\,dt$$

$$\therefore \int 3te^{2t}\,dt = \left[\frac{3te^{2t}}{2} - \frac{3e^{2t}}{4}\right] + C$$

2. $x^2 \sin x$

Solution

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

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

$\frac{du}{dx} = 2x \quad , \quad v = -\cos x$

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

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

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

$u = 2x \quad , \quad dv = \cos x$

$\frac{du}{dx} = 2 \quad , \quad v = \sin x$

$\Rightarrow 2x \sin x - \int 2 \sin x$

$= 2x \sin x + 2\cos x$

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

$= 2x \sin x - x^2 \cos x + 2\cos x + C$

$= \cancel{2x \sin x + \cos x((x^2+2)) + C}$

$= 2x \sin x - (x^2 - 2)\cos x + C$

3. $\sin 7x \cos 2x$

Solution

$\int \sin \underset{A}{7x} \cos \underset{B}{2x} \, dx = \frac{1}{2}\left[\sin(A+B) + \sin(A-B)\right]$

$= \frac{1}{2}\left[\sin(7x+2x) + \sin(7x-2x)\right]$

$= \frac{1}{2}\left[\sin 9x + \sin 5x\right]$

$\int \sin 7x \cos 2x \, dx = \frac{1}{2}\int \left[\sin 9x + \sin 5x\right]$

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$$\int \sin 7x \cos 2x \, dx = \frac{1}{2}\left[-\frac{\cos 9x}{9} - \frac{\cos 5x}{5}\right] + C$$

$$= \cancel{\tfrac{1}{2}} \; -\frac{\cos 9x}{18} - \frac{\cos 5x}{10} + C$$

4. $\dfrac{(2x - 3x^2)}{1 - x}$

Solution:

$$\int \frac{(2x - 3x^2)}{1-x} \, dx$$

multiply through by -1

$$\Rightarrow \int \frac{(3x^2 - 2x)}{(x-1)} \, dx$$

$$\begin{array}{r|l} & 3x + 1 \\ \hline x - 1 & 3x^2 - 2x \\ & \underline{3x^2 - 3x} \\ & \quad x - 0 \\ & \quad \underline{x - 1} \\ & \qquad 1 \end{array}$$

$$\therefore \int \frac{(3x^2 - 2x)}{(x-1)} \, dx = \int (3x+1) \, dx + \int \frac{1}{x-1} \, dx$$

$$= \frac{3x^2}{2} + x + \ln(x-1) + C$$