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~~BE~~ MECHANICAL ENGINEERING

19/ENG06/016 SERIAL NO.; 111

MAT 104 ASSIGNMENT

1. Find $\frac{dy}{dx}$ if $y = \frac{2\cos 3x}{x^3}$

Solution

$$y = \frac{2\cos 3x}{x^3} \quad \begin{matrix} - u \\ - v \end{matrix}$$

$$\frac{dy}{dx} = \frac{V\frac{du}{dx} - U\frac{dv}{dx}}{V^2}$$

$U = 2\cos 3x$; $du/dx = -6\sin 3x$

$V = x^3$; $dv/dx = 3x^2$

$$\therefore \frac{dy}{dx} = \frac{x^3(-6\sin 3x) - (2\cos 3x)3x^2}{(x^3)^2}$$

$$= \frac{-6x^3\sin 3x - 6x^2\cos 3x}{x^6}$$

$$= \frac{-6x^2(x\sin 3x + \cos 3x)}{x^6}$$

$$\therefore \frac{dy}{dx} = \frac{-6(x\sin 3x + \cos 3x)}{x^4}$$

2. If $y = xe^{2x}$, Show that the differential equation
$\frac{d^2y}{dx^2} - 4\, dy/dx + 4y = 0$

Solution

$$y = xe^{2x}$$
$$\frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$$
$$u = x \quad ; \quad \frac{du}{dx} = 1$$
$$v = e^{2x} \quad ; \quad \frac{dv}{dx} = 2e^{2x}$$

$$\therefore \frac{dy}{dx} = x(2e^{2x}) + e^{2x}(1)$$
$$= 2xe^{2x} + e^{2x}$$

$$\frac{d^2y}{dx^2} = \frac{d(2xe^{2x})}{dx} + \frac{d}{dx}(e^{2x})$$
$$= 2e^{2x} + 4xe^{2x} + 2e^{2x}$$
$$\frac{d^2y}{dx^2} = 4e^{2x} + 4xe^{2x}$$

$$\Rightarrow \frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0$$
$$= 4e^{2x} + 4xe^{2x} - 4(2xe^{2x} + e^{2x}) + 4(xe^{2x})$$
$$= 4e^{2x} + 4xe^{2x} - 8xe^{2x} - 4e^{2x} + 4xe^{2x}$$
$$= 4e^{2x} - 4e^{2x} + 4xe^{2x} - 8xe^{2x} + 4xe^{2x}$$
$$= \underline{\underline{0}}$$

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4. Find the integral of $e^x \sin 2x$ with respect to x.

<u>Solution</u>

$$u = \sin 2x \quad , \quad dv = e^x$$
$$du = 2\cos 2x\, dx \quad , \quad v = e^x$$

$$\int u\,dv = uv - \int v\,du$$
$$\int e^x \sin 2x\, dx = e^x \sin 2x - \int 2e^x \cos 2x\, dx$$
$$u = \cos 2x \quad , \quad dv = 2e^x$$
$$du = -2\sin 2x\, dx \quad , \quad v = 2e^x$$
$$\cos 2x(2e^x) - \int 2e^x(-2\sin 2x)\, dx$$
$$2e^x \cos 2x + \int 4e^x \sin 2x$$
$$\int e^x \sin 2x\, dx = e^x \sin 2x - 2e^x \cos 2x - \int 4e^x \sin 2x$$
$$\int e^x \sin 2x\, dx = e^x \sin 2x - 2e^x \cos 2x - 4\int e^x \sin 2x$$
Let $I = \int e^x \sin 2x\, dx$
$$I = e^x \sin 2x - 2e^x \cos 2x - 4I$$
$$5I = e^x \sin 2x - 2e^x \cos 2x$$
$$I = \frac{e^x \sin 2x - 2e^x \cos 2x}{5}$$

Thus,

$$\int e^x \sin 2x \, dx = \frac{e^x \sin 2x - 2e^x \cos 2x}{5} + C$$