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MATRIC NUMBER: 19/ENG02/036
COURSE: MAT 104

01) Find dy/dx, If $y = (2\cos 3x)/x^3$

Solution

$$y = \frac{2\cos 3x}{x^3}$$

Using quotient rule,

$u = 2\cos 3x$, $v = x^3$

$\frac{du}{dx} = -6\sin 3x$ $\frac{dv}{dx} = 3x^2$

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

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

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

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

$$= \frac{-6x\sin 3x - 6\cos 3x}{x^4}$$

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

solution

$y = xe^{2x}$

$\frac{dy}{dx} = 2xe^{2x}$

$\frac{d^2y}{dx^2} = 4xe^{2x}$

solve for,

$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y$

$4xe^{2x} - 4(2xe^{2x}) + 4(xe^{2x})$

$4xe^{2x} - 8xe^{2x} + 4xe^{2x}$

$8xe^{2x} - 8xe^{2x} = 0$

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04) $\int e^x \sin 2x\,dx$

Recall;

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

$u = \sin(2x)$, $dv = e^x$

$du = 2\cos 2x$, $v = e^x$

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

$= e^x \sin 2x - 2\left[e^x \cos 2x - (-2\int e^x \sin 2x\,dx)\right]$

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

$= e^x \sin 2x - 2e^x \cos 2x - 4\int e^x \sin 2x$

$\int e^x \sin 2x + 4\int e^x \sin 2x = e^x \sin 2x - 2e^x \cos 2x$

$5\int e^x \sin 2x = e^x \sin 2x - 2e^x \cos 2x + C$

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