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DEPT: CIVIL ENGINEERING. MAT104

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

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

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

$\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

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

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

2. $y = xe^{2x}$

show that $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0$

let $u = x$ $v = e^{2x}$

$\frac{du}{dx} = 1$ $\frac{dv}{dx} = 2e^{2x}$

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

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

let $u =$

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

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

$= 2e^{2x} + 2e^{2x} + 4xe^{2x}$

$4\frac{dy}{dx} = 4(e^{2x} + 2xe^{2x}) \Rightarrow 4e^{2x} + 8xe^{2x}$

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$4y = 4(xe^{2x}) \Rightarrow 4xe^{2x}$

Then $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0$

$(4e^{2x} + 4xe^{2x}) - (4e^{2x} + 8xe^{2x}) + 4xe^{2x} = 0$

$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0$ is CORRECT.

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4) $\int e^x \sin 2x$

$v = e^x$ and $du = \sin 2x$

$dv = e^x dx$, $u = -\frac{\cos 2x}{2}$

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

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

$\int \frac{e^x \cos 2x}{2} = \frac{1}{2}\int e^x \cos 2x$

$\int e^x \cos 2x = \left(\frac{e^x \sin 2x}{2} - \int \frac{e^x \sin 2x}{2}\right)\frac{1}{2}$

$\therefore \int e^x \sin 2x = \frac{e^x \sin 2x}{4} - \frac{e^x \cos 2x}{2} - \int \frac{e^x \sin 2x}{4}$

let $\int e^x \sin 2x$ be $y$

$y = \frac{e^x \sin 2x}{4} - \frac{e^x \cos 2x}{2} - \frac{y}{4} + c$

$$\frac{5y}{4} = \frac{e^{x}\sin 2x - 2e^{x}\cos 2x + C}{\frac{e^{x}\sin 2x - 2e^{x}\cos 2x + C}{5}}$$

Putting the Value of y back

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