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MECHANICAL ENGINEERING
MAT 104
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1) $y = \frac{2\cos 3x}{x^3}$ $\quad \frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

$u = 2\cos 3x \quad v = x^3 \quad v^2 = (x^3)^2 = x^6$

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

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

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

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

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

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

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

$u = x \quad v = e^{2x}$

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

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

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

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

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

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

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

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

$$4y = 4xe^{2x}$$

$$\frac{d^2y}{dx^2} - \frac{4dy}{dx} + 4y = 4xe^{2x} + 4e^{2x} - 8xe^{2x} + 4e^{2x} + 4e^{2x}$$

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

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