14/ENG/0 2019

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COURSE MAT 104
DEPT COMPUTER ENGINEERING
MTN ~~MECHATRONICS~~

(1.) $y = (2\cos 3x)/x^3$

$\ln y = \ln 2\cos 3x - \ln x^3$

$\frac{d}{dx}(\ln y) = \frac{d}{dx}(\ln 2\cos 3x) - \frac{d}{dx}(\ln x^3)$

$\frac{1}{y}\left(\frac{dy}{dx}\right) = \frac{1}{2\cos 3x}(-6\sin 3x) - \frac{1}{x^3}(3x^2)$

$\frac{1}{y}\cdot\frac{dy}{dx} = \frac{-3\sin 3x}{\cos 3x} - \frac{3x^2}{x^3}$

$\frac{dy}{dx} = y\left(-\frac{3\sin 3x}{\cos 3x} - \frac{3}{x}\right)$

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

2 $y = xe^{2x}$ $u = x$, $v = e^{2x}$

$\frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$

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

$x \cdot e^{2x} \cdot 2 + e^{2x} \times 1$

$2e^{2x} + e^{2x}$

$\frac{d^2y}{dx^2} = 2x\frac{de^{2x}}{dx} + e^{2x}\cdot 2x\frac{}{dx} + \frac{de^{2x}}{dx}$

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

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

$d^2y/dx^2 = 4\,dy/dx + 4y = 0$

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

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

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

$d^2y/dx^2 + 4\,dy/dx + 4y = 0$ //

3. $\int e^x \sin 2x\,dx$

$u = \sin 2x \quad dv = e^x$

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

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

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

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

$u = 2\cos 2x \quad dv = e^x$

$du = -2\sin 2x \quad v = e^x$

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

$e^x 2\cos 2x + 2\sin 2x\,e^x dx$

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

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

let $I = \int e^x 2\sin 2x\,dx$

$I = e^x 2\sin 2x - e^x 2\cos 2x - I$

$2I = e^x 2\sin 2x - e^x 2\cos 2x$

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

$$\therefore \int e^x \sin 2x \, dx = \tfrac{1}{2}\left[e^x 2\sin 2x - e^x 2\cos 2x + C\right]$$