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MATRICULATION NUMBER: 18/ENG04/051

DEPARTMENT : ELECTRICAL/ELECTRONIC

COURSE CODE: MAT 104.

Pg (1)

Q 1

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

Solution

$y = 2\cos 3x / x^3$

Using Quotient Rule

$y = u/v$

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

$u = 2\cos 3x, \quad \frac{du}{dx} = -6\sin 3x$

$v = x^3, \quad \frac{dv}{dx} = 3x^2$

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

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

$$= \frac{-6x^2}{x^6}\left[x\sin 3x + \cos 3x\right]$$

$$= \frac{-6}{x^4}\left[x\sin 3x + \cos 3x\right]$$

Q2.

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

Solution

$$y = xe^{2x} \quad \ldots \quad (1)$$

Using Product Rule

$$y = uv$$

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

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

$$'' = 2xe^{2x} + e^{2x} \quad \ldots \quad (2)$$

Take the second derivative

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

$$'' = 4xe^{2x} + 4e^{2x} \quad \ldots \quad (3)$$

Multiply 4 to equation (1)

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

Multiply -4 to equation (2)

$$-4\frac{dy}{dx} = -8xe^{2x} - 4e^{2x} \quad \ldots \quad (5)$$

~~Multiply~~ Add equation (3), (4) and (5)

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

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

$$'' \quad '' \quad '' = 0 + 0$$

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

B(3)

3. Q3

Write your name, Matric number and department

ANSWER

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Q4

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

Solution

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

Using Integration by part

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

$$u = e^x, \quad du/dx = e^x$$

$$dv = \sin 2x, \quad V = -\frac{\cos 2x}{2}$$

$$= e^x \cdot \left(-\frac{\cos 2x}{2}\right) + \frac{1}{2}\int \cos 2x \cdot e^x \, dx$$

$$= -\frac{1}{2}e^x \cos 2x + \frac{1}{2}\int e^x \cos 2x \, dx$$

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

$$= -\frac{1}{2}e^x \cos 2x + \frac{1}{4}e^x \sin 2x - \frac{1}{4}\int \sin 2x \cdot e^x \, dx + C$$

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

where I denote reduction formular

$$= -\frac{1}{2}e^{x}\cos 2x + \frac{1}{4}e^{x}\sin 2x - \frac{1}{4}I + C$$

or

$$= \frac{-1}{4}e^{x}\left[2\cos 2x - \sin 2x + e^{-x} I\right] + C$$