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COURSE CODE: MAT104
MATRIC NO: 19/MHS11/103

COVID-19 ASSIGNMENT

1. $y = \frac{1}{(x-2)}$: State the domain and codomain

→ The function is defined for all real numbers except 2.

→ The co-domain is the set of real numbers except $y = 0$.

→ The domain is the set of real numbers except 2.

2. $K = \ln v$

$$\frac{dk}{dv} = \frac{1}{v}$$

3a. $3x - 3y - 2 = 0$

$$-3y = 2 - 2x$$

$$y = \frac{2-2x}{-3}$$

$$y = \frac{2x-2}{3} ; \frac{2(x-1)}{3}$$

b. $x^2 + y^2 = 4$

$$y^2 = 4 - x^2$$

$$y = \pm\sqrt{4 - x^2}$$

4. $P = \sin^{-1} t$, find the derivative of P.

$$P = \frac{t}{\sin} \qquad t = \sin P \ldots (*)$$

$$\frac{dt}{dp} = \cos P ; \frac{dp}{dt} = \frac{1}{\cos P}$$

Recall, $\cos^2 y + \sin^2 y = 1$

$$\cos y = \pm\sqrt{1 - \sin^2 y}$$

But $t = \sin P$, $\cos P = \sqrt{1 - t^2}$

$\therefore dP/dt = \frac{1}{\sqrt{1-t^2}}$

5. If $f(x) = 2x^2 - 5$ and $g(x) = 4x - 2$, find $f \circ g(x)$ and $g \circ f(x)$

$$f(x) = 2x^2 - 5 ; g(x) = 4x - 2$$

$$f \circ g(x) = 2(4x-2)^2 - 5$$

$$= 2(16x^2 - 16x + 4) - 5$$

$$= 32x^2 - 32x + 8 - 5$$

$$= 32x^2 - 32x + 3$$

$$g \circ f(x) = 4(2x^2 - 5) - 2$$

$$= 8x^2 - 20 - 2$$

$$= 8x^2 - 22$$

6. Show that $f(x) = f_e(x) + f_o(x) - f(x)$

If $f(x) = 3x^2 - 2x + 1 = 0$

$$F_e(x) = \frac{f(x) + f(-x)}{2}$$

$$F(-x) = 3(-x^2) - 2(-x) + 1$$

$$= 3x^2 + 2x + 1$$

$$Fe(x) = \frac{3x^2 - 2x + 1 + (3x^2 + 2x + 1)}{2}$$

$$= \frac{6x^2 + 2}{2} = 3x^2 + 1$$

$$F(x) = \frac{3x^2 - 2x + 1 - (3x^2 + 2x + 1)}{2}$$

$$= -4x/2 = -2x$$

$$Fe(x) + F_o(x) = 3x^2 + 1 - 2x$$

$$= 3x^2 - 2x + 1$$

7. Differentiate $y = \cos x$ according to 1st principle

$$y = \cos x$$

$$y + \delta y = \cos(x + \delta x)$$

subtract y from both sides

$$\delta y = \cos(x + \delta x) - y$$

but $y = \cos x$

$$\therefore \delta y = \cos(x + \delta x) - \cos x \quad \cdots (*)$$

consider from trig

~~cos (A+~~

$$\cos(A+B) = \cos A \cos B - \sin A \sin B$$

$$-\cos(A-B) = \cos A \cos B + \sin A \sin B$$

$$\cos(A+B) - \cos(A-B) = -2\sin A \sin B \quad (2*)$$

compare $(*)$ and $(2*)$

$$A + B = x + \delta x \quad \cdots (i)$$

$$A - B = x \quad \cdots (ii)$$

Adding equation (i) & (ii)

$$2A = 2x + \delta x$$

$$A = \frac{2x + \delta x}{2} = \frac{\cancel{2}x}{\cancel{2}} + \frac{\delta x}{2}$$

$$A = x + \frac{\delta x}{2}$$

If $A = x + \frac{\delta x}{2}$

From eq (ii)

$$B = A - x$$

$$B = x + \frac{\delta x}{2} - x$$

$$B = \frac{\delta x}{2} + \cancel{x} - \cancel{x}$$

$$B = \frac{\delta x}{2}$$

$(*)$ compare eq $*$ and $2*$

$$\cos(x + \delta x) - \cos x = -2\sin\left(x + \frac{\delta x}{2}\right) \sin\left(\frac{dx}{2}\right)$$

$\delta y = -2\sin\left(x + \frac{\delta x}{2}\right)$ …

$\frac{\delta y}{\delta x} - 2\sin(x + \delta$ …

$\delta y = -\sin(x$ …

$\frac{\delta y}{\delta x} = -\sin$ …

A standa…

lim sin…

$\delta x \to 0$

Find ans…

$\lim \frac{\delta y}{dx}$ …

$\lim_{\delta x \to 0} \frac{\delta y}{\delta}$ …

8. If $y =$ …

$$\delta y = -2\sin\left(x + \frac{\delta x}{2}\right)\sin\left(\frac{\delta x}{2}\right)$$

$$\frac{\delta y}{\delta x} - 2\sin(x + \delta x/2)\sin(\delta x/2)$$

$$\delta y = \frac{-\sin(x + \delta x/2)\sin(\delta x/2)}{\delta x/2}$$

$$\frac{\delta y}{\delta x} = -\sin(x + \delta x/2)\frac{\sin(\delta x/2)}{\delta x/2} \quad \ldots (4)$$

standard limit

$$\lim_{\delta x \to 0} \frac{\sin(\delta x/2)}{\delta x/2} = 1$$

Find limit (4) as $\delta x \to 0$

$$\lim \frac{\delta y}{dx} = \lim -\sin(x + \delta x/2)\frac{\sin(\delta x/2)}{\delta x/2}$$

$$= -\sin(x + 0)\cdot 1$$

$$= -\sin(x)$$

$$\lim_{\delta x \to 0} \frac{\delta y}{\delta x} = \frac{dy}{dx} = -\sin x$$

8. If $y = 3t^2$ and $x = \frac{1}{t^2}$ Find dy/dx

$$\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx}$$

$$= \frac{dy}{dt} \div \frac{dx}{dt}$$

$$\frac{dy}{dt} = 6t \quad ; \quad \frac{dx}{dt} = -\frac{2}{t^3}$$

$$\frac{dy}{dx} = 6t \div \frac{-2}{t^3}$$

$$= \overset{3}{\cancel{6}}t \times \frac{t^3}{-\cancel{2}}$$

$$= 3t \times t^3$$

$$= -3t^4$$

9. Find dy/dx if $y = x^2 \cos 2x\, e^{4x}$

Taking $\log_e$ of both side

$$\ln y = \ln x^2 + \ln\cos 2x + \ln e^{4x}$$

Differentiating wrt x

$$\frac{1}{y}\frac{dy}{dx} = \frac{1}{x^2}(2x) + \frac{1}{\cos 2x}(-2\sin 2x) + 4$$

$$\frac{1}{y}\frac{dy}{dx} = \frac{2}{x} - \frac{2\sin 2x}{\cos 2x} + 4$$

Multiplying both sides by y

$$\frac{dy}{dx} = y\left(\frac{2}{x} - \frac{2\sin^2 x}{\cos 2x} + 4\right)$$

But $y = x^2 \cos 2x\, e^{4x}$

$$\frac{dy}{dx} = x^2 \cos 2x\, e^{4x} \times \frac{2}{x} - \frac{2\sin^2 x}{\cos 2x} + 4$$

10. Given that $y = \sin(3x^3+5)$ find the derivative of y

$y = \sin(3x^3+5)$

Let $u = 3x^3+5$: $\frac{du}{dx} = 9x^2$

$y = \sin u$: $\frac{dy}{du} = \cos u$

$\therefore \frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

$= \cos u \times 9x^2$

$\frac{dy}{dx} = 9x^2 \cos u$

but $u = 3x^2+5$

$\frac{dy}{dx} = 9x^2 \cos(3x^2+5)$