

UNIVERSITY PARTNER



4MM013 - Computational Mathematics

Mathematics Assignment-1

Full Marks: 10

University ID : 2332917 Submitted by

: Niraj Chaudhary

Submitted on : Subash Khatiwada

1. State the definition of a function and a composite function. [2Marks]

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Q.No:- 1

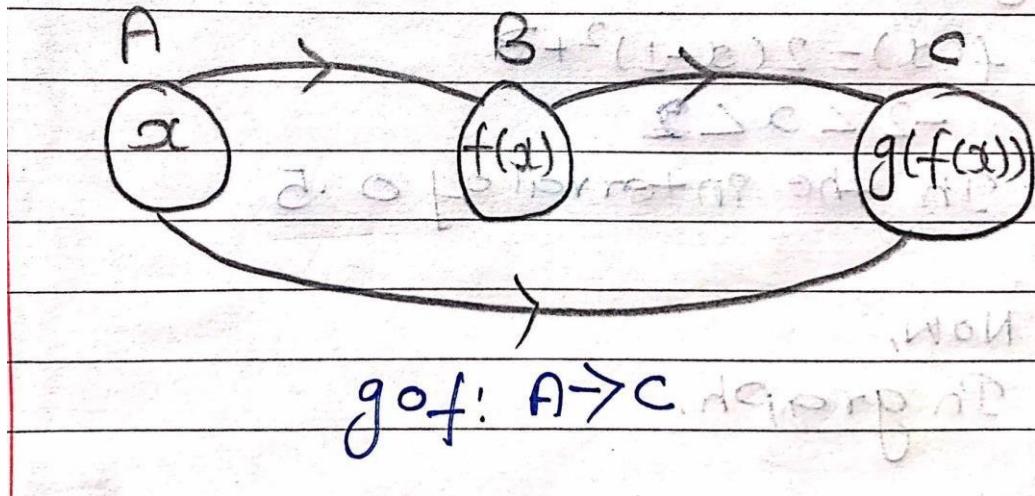
A function is defined as a relation between a set of inputs having one output each. In simple words, a function has a domain and co-domain or range.

A function is generally denoted by $f(x)$ where x is the input. The general representation of a function is $y(x)$.

Let $f: A \rightarrow B$ and $g: B \rightarrow C$. The composition of f with g is a function from A into C defined by $(gof)x = g[f(x)]$ and is denoted by gof .

To find the composite function of f and g , first find the image of x under f and then find the image of $f(x)$ under g .

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Let f and g be functions defined as follows:

$$f: R \rightarrow R, f(x) = \frac{x-3}{x+1}, f(2) = ? \text{ and}$$

$$g: R \rightarrow R, g(x) = \frac{1}{x}, x \neq 0$$

Calculate $(f \circ g)(x)$ and $(g \circ f)(x)$.

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Q1

Given,

$$f: \mathbb{R} \rightarrow \mathbb{R}, f(x) = \frac{x-3}{x+1}, f(2) = ?$$

Now,

$$f(2) = \frac{2-3}{2+1} = \frac{-1}{3}$$

$$\text{Find, } g: \mathbb{R} \rightarrow \mathbb{R}, g(x) = \frac{1}{x}, x \neq 0$$

$$(f \circ g)(x)$$

$$f(g(x))$$

$$f\left(\frac{1}{x}\right)$$

$$\frac{\frac{1}{x}-3}{x}$$

$$\frac{\frac{1}{x}+1}{x}$$

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$$= \frac{1-3x}{1+x}$$

$$= \frac{1-3x}{1+x}$$

$$(f \circ g)(x) = \frac{1-3x}{1+x} \text{ Ans,,}$$

Again,

$$f(x) = \frac{x-3}{x+1}$$

$$g(x) = \frac{1}{x}$$

$$(g \circ f)(x)$$

$$g(f(x))$$

2. Solve the following using the inverse matrix method:

[2 Marks]

$$6x - y = 0$$

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$$= g\left(\frac{1-3x}{1+x}\right)$$

$$= \frac{1}{\frac{1-3x}{1+x}}$$

$$= \frac{1+x}{1-3x}$$

$$(g \circ f)(x) = \frac{1+x}{1-3x}$$

$$\therefore (f \circ g)(x) = \frac{1-3x}{1+x} \text{ and}$$

$$(g \circ f)(x) = \frac{1+x}{1-3x}$$

$$2x - 4y = 1$$

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Q.NO :- 2

SOLN.

$$6x - y = 0$$

$$2x - 4y = 1$$

Writing in the matrix form

$$\begin{bmatrix} 6 & -1 \\ 2 & -4 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

$$A = \begin{bmatrix} 6 & -1 \\ 2 & -4 \end{bmatrix}, X = \begin{bmatrix} x \\ y \end{bmatrix}$$

$$B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

$$\boxed{X = A^{-1}B}$$



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Here, $|A| = \begin{vmatrix} 6 & -1 \\ -1 & 2 \end{vmatrix}$

$$= 6 \times (-4) + 1 \times 2 = -22$$

And,

$$X = A^{-1} B$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{|A|} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix} \cdot B$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{-22} \begin{vmatrix} -4 & 1 \\ -2 & 6 \end{vmatrix} \cdot \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{-22} \begin{vmatrix} 1 \\ 6 \end{vmatrix}$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{-22} \begin{bmatrix} 1 \\ 6 \end{bmatrix}$$

$$\therefore x = \frac{1}{-22}, \quad y = \frac{-3}{11}$$

3. Calculate the inverse of the following functions:

[2 Marks]

a. $f(x) = \frac{6}{2-x} + x$

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Q.No:- 3a

Soln

$$f(x) = \frac{6+x}{7}$$

$$\text{Let, } y = \frac{6+x}{7} \quad \text{--- (1)}$$

Interchanging y in x in eqn (1)

$$x = \frac{6+y}{7}$$

$$7x - 6 = y$$

$$y = 7x - 6$$

$$f^{-1}(x) = 7x - 6$$

\therefore The inverse of the following function is $7x - 6$

b. $f(x) = \frac{3}{x}$

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Q.No: 3b

Qn,

$$f(x) = \frac{3}{2-x}$$

$$\text{Let, } y = \frac{3}{2-x} \quad \text{--- (1)}$$

Interchanging y in x in eqn ①

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

$$\text{or, } 2x - xy = 3$$

$$\text{or, } x(2-y) = 3$$

Dividing x by both sides

$$\text{or, } \frac{x(2-y)}{x} = \frac{3}{x}$$

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$$\text{Or, } 2-y = \frac{3}{x}$$

$$\text{Or, } 2 - \frac{3}{x} = y$$

$$\text{Or, } y = \frac{2x-3}{x}$$

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

∴ The inverse of the following

$$\text{function is } \frac{2x-3}{x}$$

4. Sketch the graph of the following functions:

[2 Marks]

$$f(x) = 2(x-1)^2 + 3, -2 < x < 2 \text{ In the interval of } x=0.5$$

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Q.No :- 4

\Rightarrow Soln.

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

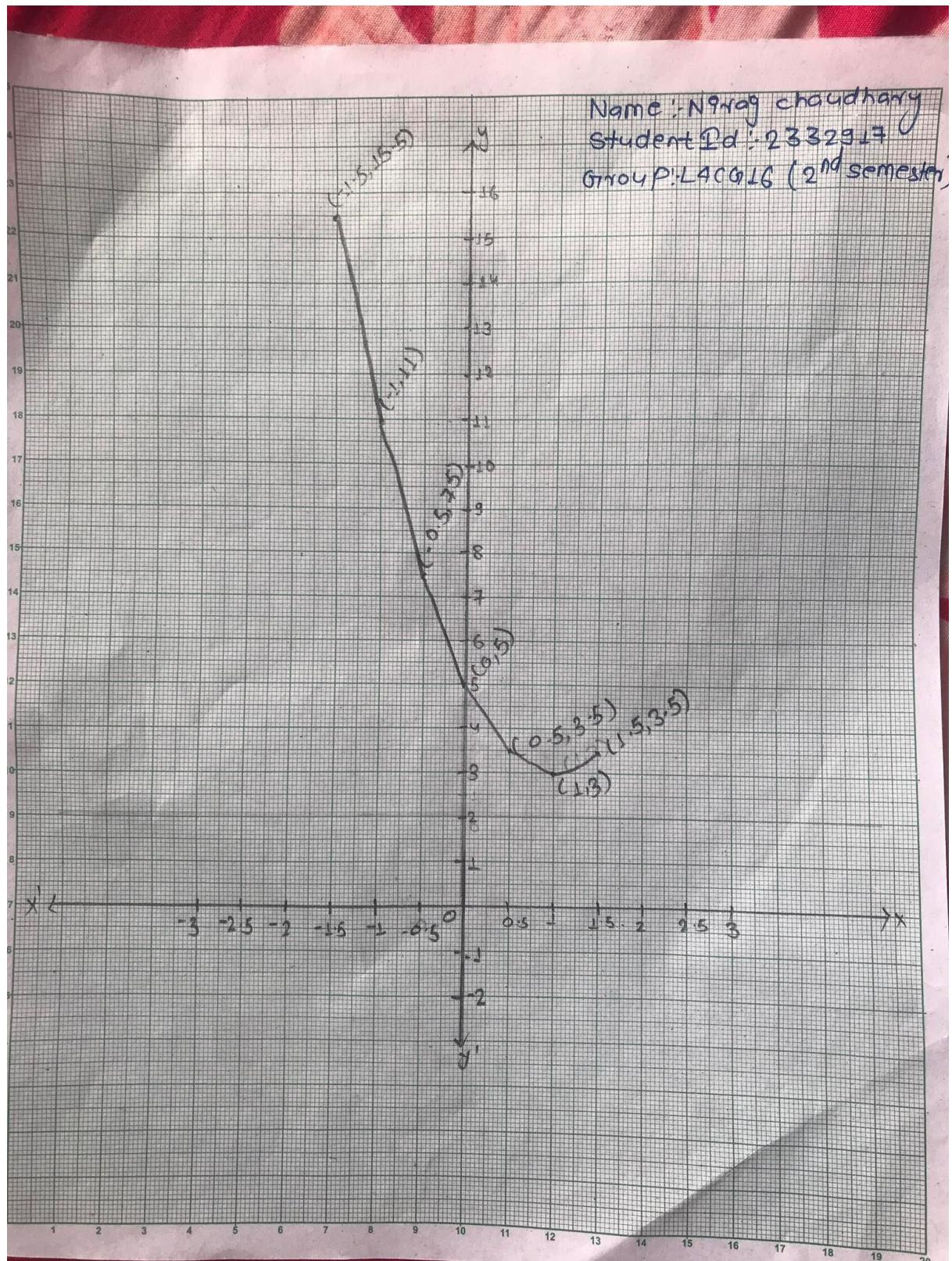
$$-2 < x < 2$$

In the interval of 0.5

Now,

In graph,

x	-1.5	-1	-0.5	0	0.5	1	1.5
y	15.5	11	7.5	5	3.5	3	3.5



5.

- a. Define gradient of a function. State the gradient and intercept of :
- $$2y + 8 = 6x$$

[2 Marks]

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Q.No :- 5a

The gradient of a function is a mathematical concept that measures the rate of change of the function with respect to its input variables. It is a vector-valued function that gives the direction and magnitude of the steepest ascent of the function at a given point.

formally, for a function $f(x_1, x_2, \dots, x_n)$, the gradient is defined as:

$$\nabla f = \left(\frac{df}{dx_1}, \frac{df}{dx_2}, \dots, \frac{df}{dx_n} \right)$$

where each component of the gradient vector represents the partial derivative of the function with respect to one of its input variable.

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SOLN

$$2y + 8 = 6x$$

The given equation is $2y + 8 = 6x$

To write this equation in the slope - intercept, we need to solve for y.

$$2y + 8 = 6x$$

$$2y = 6x - 8$$

Dividing 2 on both sides

$$y = 3x - 4$$

Now, we can see that the slope or gradient of the line is 3 and the y-intercept is -4.

∴ So, the gradient of the line is 3 and y-intercept is -4.

b.

Solve the following equations:

$$\frac{2}{x} - 17x + 2 = 0$$

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Q.No:- 5b

Soln

$$x^2 + \frac{17}{6}x + 2 = 0 \quad \text{--- (1)}$$

Comparing eqⁿ (1) with $ax^2 + bx + c$

$$a = 1, b = \frac{17}{6}, c = 2$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\frac{-\frac{17}{6} \pm \sqrt{\left(\frac{17}{6}\right)^2 - 4 \times 1 \times 2}}{2 \times 1}$$

$$= \frac{-\frac{17}{6} + \frac{1}{6}}{2}$$

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(+) sign

$$= -\frac{17}{6} + \frac{1}{6}$$

$$= \frac{-17 + 1}{6}$$

$$= \frac{-16}{6}$$

$$= -\frac{8}{3}$$

(-) sign

$$= -\frac{17}{6} - \frac{1}{6}$$

$$= \frac{-17 - 1}{6}$$

$$= \frac{-18}{6}$$

$$= -3$$

$$= -\frac{17}{6} + \frac{1}{6}$$

$$= \frac{-17 + 1}{6}$$

$$= \frac{-16}{6}$$

$$= -\frac{8}{3}$$

$$= -\frac{18}{6}$$

$$= -3$$

$$= -\frac{16}{3}$$

$$= -6$$

$$\therefore x = \left(-\frac{16}{3}, -6 \right)$$

The End

