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National University of Computer and Emerging Sciences, Lahore Campus

Course Name:	Applied Calculus	Course Code:	MT1001
Program:	Electrical Engineering	Semester:	Fall 2023
Duration:	1 hour	Total Marks:	40
Exam Date:	30-09-2023	Weight:	15
Section:	All	Page(s):	4
Exam Type:	Sessional 1	CLO #	1,2,3

~~Student Name:~~ Rubrics Roll No.__________ Section:__________

Instruction/Notes:
1. Do not forget to write your Name, Roll Number and Section.
2. Solve on the paper and Return.

Question No. 1 (CLO No. 1) Marks: 6+4+5

(a). **Illustrate** the given inequality in terms of intervals and find the solution set on the real number line.

$$2 < |x+9| \leq 7$$

$2 < |x+9|$

$x+9 > 2$ or $x+9 < -2$

$x > -7$ or $x < -11$

$|x+9| \leq 7 \rightarrow 1$

$-7 \leq x+9 \leq 7 \rightarrow 1$

$-16 \leq x \leq -2 \rightarrow 1$

$S.S. = [-16, -11) \cup (-7, -2] \rightarrow 2$

$\rightarrow 1$

(b). **Illustrate** the given inequality by using properties of absolute value

$$|x+3| < -5$$

4

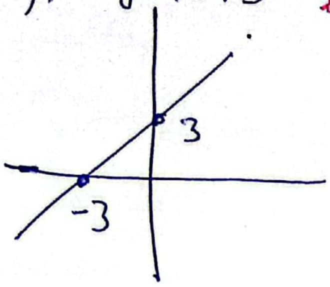
As we knew that, the absolute value interpreted the "distance" between two numbers on the number line and we also the knew that the distance can't be "-ve". So, above inequality has "no" solution.

0049

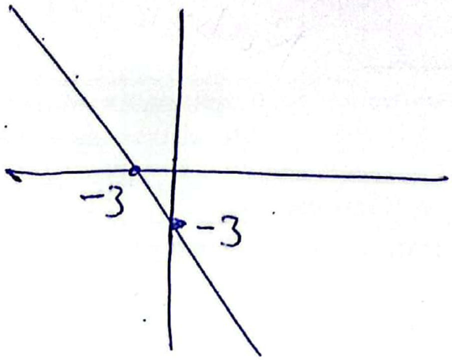
(c) Identify whether the given function is even, odd, or neither and also sketch the graph of the function $y = 1 + 9\sqrt{-(x+3)}$, not by plotting points, but by starting with the graph of one of the standard function.

Function is neither even nor odd → 1

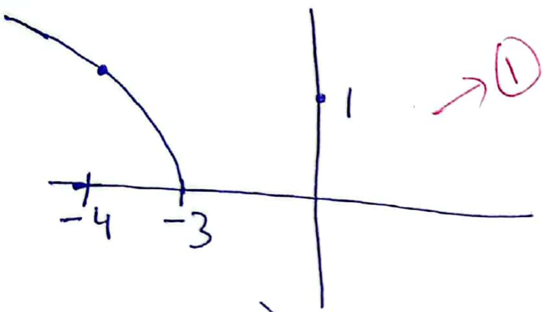
(a). $y = x+3$



(b). $y = -(x+3)$ → 1

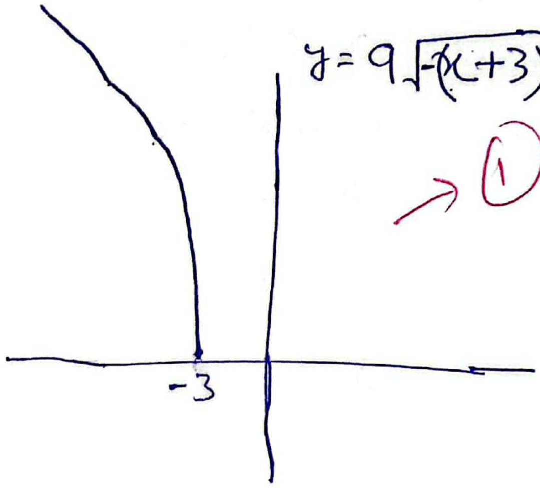


(c) $y = \sqrt{-(x+3)}$



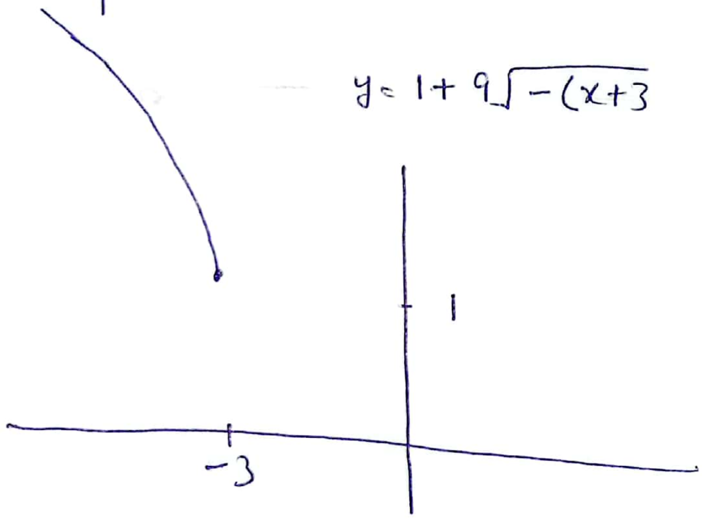
→ 1

(d) $y = 9\sqrt{-(x+3)}$



→ 1

(e) $y = 1 + 9\sqrt{-(x+3)}$ → 1



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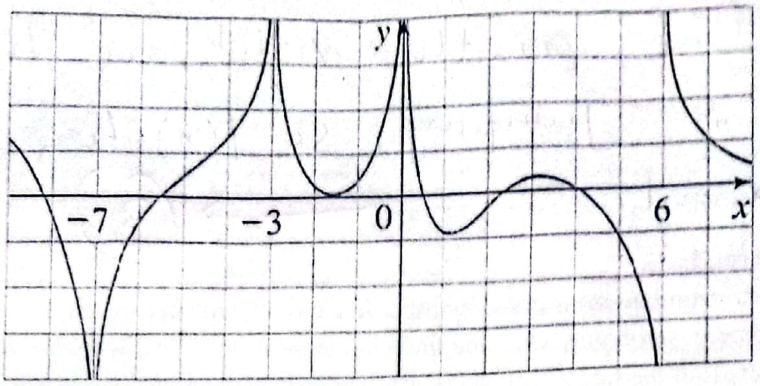
Question No. 2 (CLO No. 2) **Marks: 8+7**

(a). For the function f represented by the graph, provide the following information.



(i). Formulate $\lim_{x\to -7} f(x)$

$\lim_{x\to -7^-} f(x) = -\infty$ & $\lim_{x\to -7^+} f(x) = \infty$, So, $\lim_{x\to -7} f(x) = \infty$

(ii). Formulate $\lim_{x\to -3} f(x)$

$\lim_{x\to -3^-} f(x) = +\infty$ & $\lim_{x\to -3^+} f(x) = +\infty$, so $\lim_{x\to -3} f(x) = +\infty$

(iii). Formulate $\lim_{x\to 6} f(x)$

$\lim_{x\to 6^-} f(x) = -\infty$ and $\lim_{x\to 6^+} f(x) = +\infty$, so limit does not exist.

(iv). Determine the equations of the vertical asymptotes, if any.

$x = -7$, $x = -3$, $x = 0$ and $x = 6$.

(b). Determine the points where the function is discontinuous.

$$f(x) = \begin{cases} x^2 - 4, & x < 1 \\ 1, & x = 1 \\ -\frac{1}{2}x + 1, & x > 1 \end{cases}$$

Evaluate graphically the type of discontinuity shown in the piecewise function, and provide reasons for your answers.

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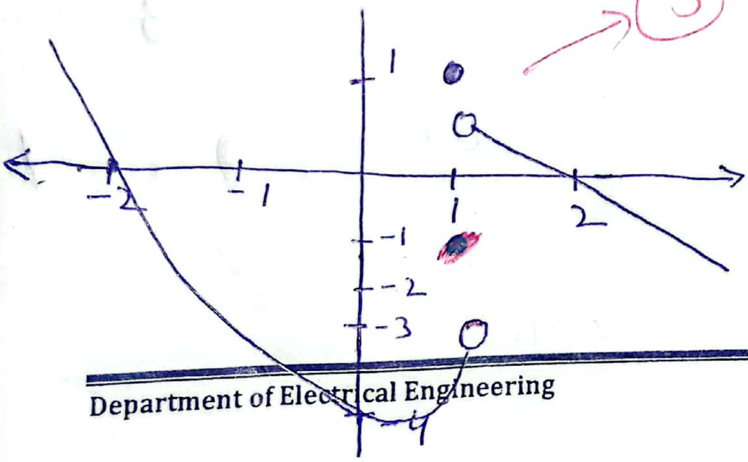

Function is discontinuous at only $x = +1$.

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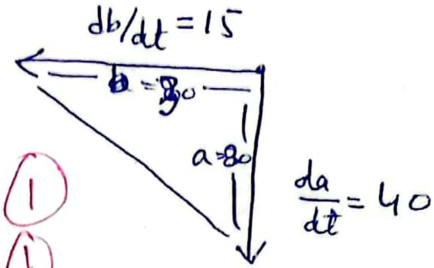
0049

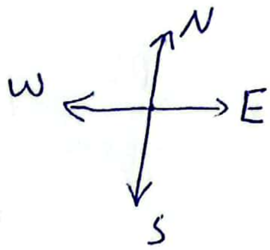
First portion of piecewise function describes parabola on left, a single pt. in the middle and a portion of a line on the right, as the value of function is Jumping, so $f(x)$ has Jump discontinuity at $x = 1$. → 3

Question No. 3 (CLO No. 3) **Marks: 10**

Two electric currents originate from the same point in a circuit. One current flows in a southerly direction with a rate of 40 amperes per hour (A/h), and the other current flows in a westerly direction at a rate of 15 A/h. After two hours, find the rate at which the distance between the two currents is increasing?

Given, $t = 2$ hrs. → 1





we know that

$d = S \times t$

$b = d_g = 15 \times 2 = 30$ → 1

$a = d_r = 40 \times 2 = 80$ → 1

By using Pythagorean th.,

$c^2 = a^2 + b^2 \Rightarrow c = 10\sqrt{73}$ → 2

Diff. w.r.t. t, to find rate of change,

$$2c\frac{dc}{dt} = 2a\frac{da}{dt} + 2b\frac{db}{dt} \Rightarrow c\frac{dc}{dt} = a\frac{da}{dt} + b\frac{db}{dt} \rightarrow 2$$

$$\Rightarrow \frac{dc}{dt} = \frac{1}{c}\left[a\frac{da}{dt} + b\frac{db}{dt}\right] = \frac{1}{10\sqrt{73}}\left[80(40) + 30(15)\right]$$

$$= \frac{3650}{85.4} = 42.72 \text{ A/h.}$$

The distance between two currents is increasing at the rate of 42.72 A/h. → 3

0049