CATHOLIC UNIVERSITY INSTITUTE OF BUEA
2020/2021 ACADEMIC YEAR
First Semester Examinations – February 2021

School		ENGINEERING			
Course Code	EMA 101	Course Title	Engineering Mathematics I		
Status	C	Credit Value	6	Department	MEE
Date	03/03/2021	Venue	Ngongi Hall, LH 8	Time	10:30 – 12:30
Course Master(s)		Yagaka Fokoua Gabriel			

Instructions :

- Answer **ALL** questions
- Penalty will be given for poor presentation of answers
- Electronic Calculators are allowed.

Question 1 (5marks)

What do you understand by the following notions: 1) a function, 2) domain of definition of a function, 3) continuous function, 4) jump and removable discontinuities, 5) left and right limits of a function.

Question 2 (10 marks)

1. Find the domain of definition of the following functions

   (i) $\quad f(x) = \dfrac{2}{x^2 - 2}$ (ii) $\quad g(x) = \sqrt{1 - x}$ (4 marks)

2. Show that the function g(x) is bijective and find its inverse. **(4 marks)**

3. Find the composite functions $(f \circ g)(x)$ and $(g \circ f)(x)$. **(2 marks)**

Question 2 (12 marks)

1. Evaluate the following limits and in case it does not exist explain why

   (i) $\lim\limits_{x \to 0} \dfrac{\sqrt{4+x}-2}{x}$ **(2 marks)** (ii) $\lim\limits_{x \to 2} \dfrac{|x-2|}{x^2+x-6}$ **(3 marks)** (iii) $\lim\limits_{x \to 0} \dfrac{x}{\sqrt{4+x}-\sqrt{4-x}}$ **(2 marks)**

2. Consider the following function:

$$f(x) = \begin{cases} x^2 - 1, & if \quad x \langle 1 \\ -3, & if \quad x = 1 \\ \dfrac{x - x^2}{1 - x} & if \quad x \rangle 1 \end{cases}$$

(a) Compute *f(1)* **(1 mark)**

(b) Find the left and the right limit of f at $a = 1$ (**2 marks**)

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(c) What can you say about the continuity of f at $a = 1$. **(2 marks)**

Question 3 (10 marks)

The mass, m grams, of a sample of radioactive iodine decays according to the formula

$$m = 15e^{-0.083t}$$

where t is the number of days after it is first observed

a) What is the initial mass of the sample? **(2 marks)**

b) What is the mass of the sample after 2 days? **(2 marks)**

c) Calculate the time it takes for the sample to halve its original mass. **(3 marks)**

d) Find the rate at which the sample is decaying when $t = 5$. **(3 marks)**

Question 4 (13 marks)

1) The bacteria population in a bottle at time t (in hours) has size $p(t) = 3000e^{0.5t}$. After how many hours will there be 5000 bacteria? **(4 marks)**

2) How many bacteria will there be in 12 hours? **(1 marks)**

3) Compute $f'(3)$ where $f(x) = x^2 - 8x$, using differentiation from first principle. **(4 marks)**

4) Compute $f'(a)$ and find the equation of the tangent line of the following functions

$$f(x) = \frac{1}{x+3}, \quad a = -2, \quad f(x) = x^{-2}, \quad a = -1. \quad \textbf{(4 marks)}$$

"Pessimists find a reason to stop when there seem to be no one.

Optimists find a reason to continue when there seem to be no one".

Yagaka F. Gabriel

Good Luck