Catholic University Institute of Buea (CUIB)

2019/2020 ACADEMIC YEAR

First Semester Examinations – MARCH 2020

School	ENGINEERING				
Course Code	EMA 201	Course Title	ENGINEERING MATHEMATICS III		
Status	C	Credit Value	6	Dept	Engineering
Date	05/03/2020	Venue	LH 2, LH 11	Time	8:00 – 11:00
Course Master(s)		Dr. Patrice Ndambomve			

INSTRUCTIONS

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

Question 1 (5 marks)

What do you understand by the following terms as used in numerical analysis?

i. Relative error **(1 mark)**

ii. Approximation error **(1 mark)**

iii. $e = O(h^q), e = O(hlogh)$ for an error e depending on h. **(3 marks)**

Question 2 (15 marks)

1. Consider the function $f(x) = x^2 - 2$ defined on the interval [1, 2] and let ϵ=0.01 be the tolerance and the starting point $x_0 = 1$. Using the Newton-Raphson method, approximate the root of the function $f(x)$ in the interval [1, 2]. **(5marks)**

2. Let $g(x) = x - \frac{1}{2}(x^2 - 2)$

   (i) Find the fixed points of g. **(2marks)**

   (ii) To which of the fixed points of g does the algorithm $x_{n+1} = x_n - \frac{1}{2}((x_n)^2 - 2)$ converge? **(4 marks)**

   (iii) Find the approximate value of the fixed point of g to which the algorithm converges using the starting point $x_0 = 1$. **(4 marks)**

Question 3 (8 marks)

Given the four data points (−1, 1), (0, 1), (1, 2), (2, 0), determine the interpolating piece-wise linear function.

Question 4 (13 marks)

Let f be an arbitrary continuous function and a and b with a < b be two real numbers.

1. For the numerical integration of f from a to b, what is the formula for the :
    - Midpoint rule;
    - Trapezoidal rule;
    - Simpson's rule. **(6 marks)**

2. For $f(x) = xe^x$, a = 0, and b = 2, find the approximate values of $\int_0^2 xe^x dx$ for each of the rules above. **(6 marks)**

3. Which of the rules gives the best approximation? **(1 mark)**

Question 5 (9 marks)

Consider the Initial Value Problem:

$$(IVP)\begin{cases} y'(t) = 2ty(t) \\ y(0) = 1 \end{cases}$$

Where y'(t) is the derivative of y with respect to t.

1. Write out the formula for the Euler method for the above *(IVP)*. **(1 mark)**
2. Use Euler method above to numerically solve *(IVP)* from t = 0 to t = 1.5 with a step size h = 0.5. **(3 marks)**
3. Calculate the error at each step, knowing that the exact solution obtained analytically is $y(t) = e^{t^2}$ **(5 marks)**

GOOD LUCK