



ALUPE UNIVERSITY
COLLEGE
Bastion of Knowledge...

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OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, RESEARCH AND STUDENTS' AFFAIRS

UNIVERSITY EXAMINATIONS

2018 /2019 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER REGULAR EXAMINATION

**FOR THE DEGREE OF BACHELOR OF SCIENCE
(COMPUTER SCIENCE/ASC)**

COURSE CODE: MAT 110

COURSE TITLE: BASIC CALCULUS

DATE: 10TH DECEMBER, 2018

TIME: 9.00 AM – 12.00 PM

INSTRUCTION TO CANDIDATES

- SEE INSIDE

THIS PAPER CONSISTS OF 3 PRINTED PAGES

PLEASE TURN OVER



MAT 110
REGULAR-MAIN EXAM
 MAT 110: BASIC CALCULUS

STREAM: BSc. CS & ASC

DURATION: 3 Hours

INSTRUCTION TO CANDIDATES

- i. Answer **ALL** questions from section A and any **THREE** from section B
- ii. Do not write on this question paper

SECTION A: [31 MARKS]: ANSWER ALL QUESTIONS

Question One : [16 marks]

(a) Define the following:

- i) A finite set [2 marks]
- ii) A function [2 marks]

iii) Given that A is a set of odd numbers less than 20 and B is the set of prime numbers less than 20, list the numbers of $A, B, A \cap B, A \cup B$ [4 marks]

(b) Given that $f(x) = 10 + x$ and $g(x) = x^3$

- i) Write down the functions $f \circ g$ and $f^{-1} \circ g$ [2 marks]
- ii) Find the values of $f \circ g(2)$ and $f^{-1} \circ g(4)$ [2 marks]

(c) Find, from the first principles, the derivative of the function $f(x) = 3x^2$ [4 marks]

Question Two : [15 marks]

(a) Differentiate the following:

- i. $y = \frac{2}{3x^3}$ [2 marks]
- ii. $y = (3x + 2)^4$ [2 marks]
- iii. $y = (x^2 - 3)(x + 1)^2$ [2 marks]
- iv. $y = \frac{x}{\sqrt{1+x^2}}$ [3 marks]

(b) Find $\frac{dy}{dx}$ of the curve $x^2 + 2xy - 2y^2 + x = 2$ at the point $(-4, 1)$ [3 marks]

(c) Find the turning values of y on the graph $y = f(x)$, where $f(x) = 5 + 24x - 9x^2 - 2x^3$ and distinguish between them [3 marks]

SECTION B [39 MARKS]: ANSWER ANY THREE QUESTIONS

Question Three : [13 marks]

(a) Find $\lim_{x \rightarrow 0} \frac{\sin^2 3x}{x \sin 2x}$ [4 marks]

(b) If $x = t^3 + t^2$, $y = t^2 + t$ then find $\frac{dy}{dx}$ in terms of t [3 Marks]

(c) Find the derivative of the function $x^3 + 3x^2y + y^3 = 1$ [3 marks]

(d) If $x = a(t^2 - 1)$, $y = 2a(t + 1)$, find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ in terms of t [3 marks]

Question Four : [13 marks]

(a) Find $\frac{dy}{dx}$ of the following:

i. $y = (x^2 + 1)e^x$ [3 marks]

ii. $y = 2^x$ [3 marks]

(b) Compute the limit $\lim_{u \rightarrow 3} \frac{u^2 - 9}{u^2 - 4u + 3}$, show your work [3 marks]

(c) Prove from the first principles that $\frac{d}{dx}(\sin x) = \cos x$ [4 marks]

Question Five : [13 marks]

(a) Differentiate the following:

i. $\sin(2x + 3)$ [3 marks]

ii. $\cos^2 x$ [3 marks]

iii. $\sin x^0$ [3 marks]

(b) A farmer has 60 m of fencing material which he can put against an already existing fence to form a rectangular plan to enclose animals. What is the maximum area which can be enclosed? [4 marks]

Question Six : [13 marks]

(a) Find the equation of the tangent and normal to the curve $x^2 + xy + y^2 = 2$ at point (1, 2) [4 marks]

(b) Evaluate $\int_1^3 (x^2 + 3x + 5)dx$ [3 marks]

(c) State Rolle's theorem [3 marks]

(d) Find $\int (x \sin x)dx$ [3 marks]

Question Seven : [13 marks]

(a) Determine whether or not the function below is continuous at $x = 2$

$$f(x) = \begin{cases} \frac{x^2 - 4}{x - 2}, & \text{if } x = 2; \\ 4, & \text{if } x \neq 2. \end{cases} \quad [3 \text{ marks}]$$

(b) A ball is thrown vertically upwards and its height after t seconds is S meters, where $S = 15t - 3t^2$. Find

i. The greatest height reached and the time it is reached [3 marks]

ii. The time when it returns to the origin levels [3 marks]

iii. Its velocity after 2s [2 marks]

iv. The acceleration when $t = 1.5$ s [2 marks]

