



**NAMIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY  
FACULTY OF HEALTH AND APPLIED SCIENCES**

**DEPARTMENT OF MATHEMATICS AND STATISTICS**

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| <b>QUALIFICATION:</b> Bachelor of science in Applied Mathematics and Statistics |                                       |
| <b>QUALIFICATION CODE:</b> 08BHAM   | <b>LEVEL:</b> 8                       |
| <b>COURSE CODE:</b> ADC801S   | <b>COURSE NAME:</b> ADVANCED CALCULUS |
| <b>SESSION:</b> JULY 2019   | <b>PAPER:</b> THEORY                  |
| <b>DURATION:</b> 3 HOURS  | <b>MARKS:</b> 100                     |

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| <b>SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION QUESTION PAPER</b> |                       |
| <b>EXAMINERS</b>   | DR ALFRED KAMUPINGENE |
| <b>MODERATOR:</b>  | DR. D. MAKINDE        |

**THIS QUESTION PAPER CONSISTS OF 2 PAGES INCLUDING THIS COVER PAGE**

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| <b>INSTRUCTIONS</b>  |  |
| <ol style="list-style-type: none"><li>1. Answer ALL the questions in the booklet provided.</li><li>2. Show clearly all the steps used in the calculations.</li><li>3. All written work must be done in blue or black ink and sketches must be done in pencil.</li><li>4. Start answering each of questions 1, 2, 3,4, and 5 on a new page.</li></ol> |  |

**PERMISSIBLE MATERIALS**

1. Non-programmable calculator without a cover.

**THIS QUESTION PAPER CONSISTS OF 2 PAGES** (Including this front page)

Question 1(16 marks)

Given the function  $f(x) = x^n$  where  $x \in [a, b]$ , prove that  $n(b-a)a^{n-1} < b^n - a^n < n(b-a) b^{n-1}$  by applying the Lagrange's Mean Value Theorem. (16)

Question 2(30 marks)

Factorise the following function  $f(x) = x^4 - 5x^3 + 5x^2 + x + 2$  in terms of powers of  $x - 2$ . (30)

Question 3(9 marks)

If  $\varphi(x, y, z) = xy^2z$  and  $\mathbf{A} = xz \mathbf{i} - xy^2 \mathbf{j} + yz^2 \mathbf{k}$ , find  $\frac{\partial^3(\varphi \mathbf{A})}{\partial z \partial x^2}$  at the point  $(2, -1, 1)$ . (9)

Question 4(32 marks)

Consider the vector field  $\mathbf{F} = (3x^2y^2z + 5y^3, 2x^3yz + 15xy^2 - 7z, x^3y^2 - 7y + 4z^3)$  with domain  $R^3$ .

4.1) Determine whether the above field is conservative. (12)

4.2) If the field is, indeed, conservative, find a potential function for it. (20)

Question 5(13 marks)

Suppose a firm has an order for 200 units of its product and wishes to distribute their manufacture between two of its plants, plant1 and plant2. Let  $q_1$  and  $q_2$  denote the outputs of plants 1 and 2, respectively, and suppose the total cost function is given by

$C = f(q_1, q_2) = 2q_1^2 + q_1q_2 + q_2^2 + 200$ . How should the output be distributed in order to minimise costs? (13)

**END OF PAPER**

**TOTAL MARKS: 100**