



NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI-ABUJA
FACULTY OF COMPUTING
DEPARTMENT OF COMPUTER SCIENCE
2025_2 EXAMINATIONS

CIT 335: Computational Science & Numerical Methods

Credit: 3 units

TIME ALLOWED: 2½ Hours

INSTRUCTION: Answer Question 1 and any other THREE (3) Questions

Question 1

- a. Discuss the notational device that can be used to treat continuous and discrete case simultaneously. (4 marks)
- b. Enumerate the useful properties of inner product. (5 marks)
- c. Write short note on the term orthogonal systems. (4 marks)
- d. Give an elementary example of how computers perform backward error analysis? (3 marks)
- e. Highlight the condition of THE problem:
 $f: \mathbb{R}^n \rightarrow \mathbb{R}, y = x_1 x_2 \dots x_n$. (6 marks)
- f. Briefly describe the reason why a real number cannot in general be represented exactly in a computer? (3 marks)

Question 2

- a. Discuss how a cancellation error can occur in the computation of algebraic identity:
 $(a - b)^2 = a^2 - 2ab + b^2$; where $a = 1.8, b = 1.7$ (3 marks)
- b. Derive a bound for the relative error in floating point representation. (7 marks)
- c. Describe the basic features that differentiate the fixed-Point data structured numbers from the floating-point numbers. (5marks)

Question 3

- a. Use a schematic diagram to illustrate a cancellation error phenomenon of arithmetic operations. (6 marks)
- b. Briefly explain the three error types that affect the result of a numerical computation. (3marks)
- c. Write short note on the following:
 - a. Complex floating-point numbers (2 marks)
 - b. How to avoid rounding errors in a computer system arithmetic operation (2 marks)
 - c. Euclidean algorithm (2 marks)

Question 4

- a. Considering an exact value of variable $a = \sqrt{2}$, and its' approximate $\bar{a} = 1.414$ to briefly describe the basic concepts of errors. (7 marks)
- b. Derive the error propagation formula for Multiplication. (5 marks)
- c. The unit roundoff in a binary floating-point system is $\mu = 0.5 \cdot 2^{-t}$, how many digit must we have in a decimal system with approximately the same unit roundoff? (3 marks)

Question 5

- a. Summarize in a table, the types of approximation and their associated norms. (6 marks)
- b. Describe the model of a machine arithmetic? (3 marks)
- c. What is a complex floating-point number? (2 marks)
- d. Discuss the term Symmetric rounding. (4 marks)

Question 6

- a. Discuss extensively how researchers view the concept of real number, both in the field of mathematics and computer. (7 marks)
- b. Calculate the rounding error (R_c) associated with the rounding up and chopping of following numbers:
 - a. 1.23767
 - b. 0.774501
 - c. 6.3225
 - d. 6.3235(8 marks)