



NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PHYSICS
2025_1 EXAMINATION

COURSE CODE: **PHY314**

COURSE TITLE: **NUMERICAL ANALYSIS**

CREDIT UNIT: **2**

TIME ALLOWED: **(2 HRS)**

INSTRUCTION: *Answer question 1 and any other two questions*

QUESTION 1

(a) i. What are Truncation Errors (3 marks)
ii. Explain how truncation error arises in a numerical approximation of a function $f(x)$. (3 marks)

(b) Given $x = 3.141592653589793$ is the value of the constant ratio π correct to 15 decimal places and $x^* = 3.14159265$ be an approximation of x . Compute the following quantities.

- i. The error (3 marks)
- ii. The absolute error (3 marks)
- iii. The relative error (3 marks)

(c) Differentiate between round off and truncation errors. (5 marks)

(d) If a number $x = 0.070502$ is rounded to three significant figures, calculate the rounding error. (5 marks)

QUESTION 2

(a) How does the Gauss-Seidel method differ from the Jacobi method. (5 marks)

(b) Solve the system of equations using Jacobi and Gauss-Seidel iterative methods, using two iterations for both methods: $4x - y = 3; -x + 3y = 5$ (10 marks)

QUESTION 3

(a) Approximate $\int_0^2 e^{-x^2} dx$ using the Trapezoidal Rule with $n = 4$. (10 marks)

(b) Given these practical scenarios, state the numerical method that should be used; (5 marks)

- i. For Continuous Functions with a Known Interval
- ii. For Fast Convergence and High Precision
- iii. When Derivatives Are Difficult to Compute
- iv. When Exploring New Functions
- v. For Simple Problems or Educational Purposes: Fixed-Point Iteration

QUESTION 4

(a) Compare the characteristics of the methods used to solve the roots of algebraic and transcendental equation. (8 marks)

(b) Consider the matrix: $A = \begin{pmatrix} 4 & 2 & 3 \\ 4 & 8 & 6 \\ 7 & 8 & 10 \end{pmatrix}$. Deduce if the matrix will converge and state the condition to check if an iterative method will converge. (7 marks)

QUESTION 5

(a) Use the Newton-Raphson method to find the root of $f(x) = x^3 - 2x - 5$ with an initial guess of $x_0 = 2$ (10 marks)

(b) What are the key limitations of the Newton-Raphson method. (5 marks)