



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)