



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

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) Why is approximation necessary in numerical computations. (5 marks)
- (b) Briefly discuss the main types of errors that arise due to approximation, citing examples? (8 marks)
- (c) A physicist measures the length of a metal rod to be 8.25 cm, while the actual length is 8.30 cm.
- i. Calculate the absolute error in the measurement. (3 marks)
- ii. Determine the relative error in the measurement. (3 marks)
- iii. Find the percentage error in the measurement. (3 marks)
- (d) Obtain the Runge-Kutta method from Taylor's series by applying a first order approximation to the series. (8 marks)

QUESTION 2

- (a) Given the function values $f(1) = 2.0$, $f(2) = 2.5$, $f(3) = 3.6$, compute the forward difference table up to the second-order difference. (10 marks)
- (b) Using your results from (a), estimate the function value at $x = 1.5$ using linear interpolation. (10 marks)

QUESTION 3

- (a) Apply the Trapezoidal Rule to approximate the integral $I = \int_1^3 (x^2 + 1)dx$, using two subintervals. (10 marks)
- (b) i. At what number of subintervals n would the error be 0.02. (6 marks)
- ii. Compute the percentage error if the exact integral is 10.67. (4 marks)

QUESTION 4

- (a) i. Use the Bisection Method for two iterations to estimate the root of $f(x) = x^3 - x - 2$ in the interval $[1, 2]$. (9 marks)
- ii. If the exact root is 1.52, compute the absolute error after two iterations. (5 marks)
- (b) List any three (3) demerits of the Newton-Raphson Method. (6 marks)

QUESTION 5

- (a) i. Apply Euler's Method to approximate $y(0.3)$ for the initial value problem:

$$\frac{dy}{dx} = 2x + y, \quad y(0) = 1$$

using a step size of $h = 0.1$ (8 marks)

- ii. Compare the approximate value obtained in (a) with the exact solution $y(x) = -(2x + 2) + 3e^x$ and compute the absolute error. (6 marks)
- (b) Explain how truncation error arises in a numerical approximation of a function. (6 marks)