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)