



NATIONAL OPEN UNIVERSITY OF NIGERIA
University Village, Plot 91, Cadastral Zone, Nnamdi Azikwe Express Way, Jabi-Abuja
FACULTY OF SCIENCES
DEPARTMENT OF MATHEMATICS
2025_2 EXAMINATIONS

Course Code: MTH307

Course Title: Numerical Analysis II

Credit Unit: 3

Time Allowed: 3 Hours

Total: 70 Marks

Instruction: Answer Question One (1) and Any Other 3 Questions

1. (a) Given the general second order Partial Differential Equation
 $L(u) = Au_{xx} + Bu_{xy} + Cu_{yy} - H(x, y, u, u_x, u_y) = 0$
Classify the following equation into Parabolic, Elliptic and Hyperbolic.
 - i. $u_t = u_{xx}$
 - ii. $u_{tt} = u_{xx}$
 - iii. $u_{xx} + u_{yy} = 0$ **(5 marks)**(b) When is Partial Differential Equation said to be Parabolic, Elliptic and Hyperbolic. **(5 marks)**
(c) Solve the Laplace equation $u_{xx} + u_{yy} = 0$, subject to the boundary conditions
 $u(x, 0) = 1, u(0, y) = 0, u(1, y) = 0, u(x, 1) = 1; 0 \leq x \leq 1, 0 \leq y \leq 1.$ **(15 marks)**
2. (a) Express the function $x^3 + 2x^2 - x - 3$ in terms of Legendre polynomials. **(7 marks)**
(b) Find the fourth degree least square polynomials to $|x|$ over $[-1, 1]$ by means of Legendre polynomials. **(8 marks)**
3. (a) Show that $T_n(x)$ satisfies the differential equation $(1 - x^2)y'' - xy' + n^2y = 0$ **(7 marks)**
(b) Convert the first 5 terms of the Taylor series expansion for e^x into Chebyshev polynomials. **(8 marks)**
4. (a) Enumerate the classification of least square approximation method and explain each. **(7 marks)**
(b) Derive the least square formula for discrete data. **(8 marks)**
5. (a) Distinguish between Hermite polynomial and cubic spline. **(7 marks)**
(b) Find the cubic spline given the data below

x	0	2	4	6
y	1	9	41	41

where $M_0 = 0$ and $M_3 = -12$. **(8 marks)**
6. (a) Define Simpson's $\frac{1}{3}$ rule. **(7 marks)**

(b) Evaluate $\int_0^{\frac{\pi}{3}} \sin x dx$ with $h = \frac{\pi}{12}$, correct to 5 decimal places using Trapezoidal rule.

(8 marks)