NATIONAL OPEN UNIVERSITY OF NIGERIA
Plot 91, Cadastral Zone, Nnamdi Azikwe Expressway, Jabi, Abuja

FACULTY OF SCIENCES
DEPARTMENT OF MATHEMATICS
October Examination 2019

Course Code: MTH 307
Course Title: Numerical Analysis II
Credit Unit: 3 Hours
Total: 70 Marks
Instruction: Answer Question Number One and Any Other Four Questions

1. (a) Determine the number of non-zero coefficient in $(3x + 5)(x^2 - 1)$ **(3 Marks)**

    (b) What is the degree of polynomial involved in the exercise $(x + 1)(x^2 - \frac{2}{x})$? **(4 Marks)**

    (c) Write down the expansion of e^{-x} and e^{-3x} then estimate e^{-3} to 3 decimal places   **(8 Marks)**

    (d)   State the properties of inner products   **(7 Marks)**

2. The table below gives the reading from the rates of communal clashes among tribes in Nigeria

Time t	1	2	3	4	5	6	7	8
Reading y	4	7	6	10	40	48	59	170

Fit (a) A linear function to the data in the table   **(4 marks)**
    (b) A quadratic polynomial to the data in the table by the method of least squared
                                                                             (8 marks)

3. (a) State the standard rules in numerical analysis that can be used to estimate Quadrature
    formulas   **(4 Marks)**

    (b) Obtain or Derive the Trapezoidal rule   **(8 Marks)**

4. Fit a natural cubic spline to the data provided in Table below and use the same to estimate F(57) **(12 Marks)**

x	25	36	49	64	81
$y = f(x)$	5	6	7	8	9

5. (a) Given that the Legendre polynomial is given $P_n(x) = \frac{1}{2^n n!} \frac{d}{dx^n}[(x^2 - 1)^n]$ for n=0,1,2
   Find $P_1(x)$ and $P_2(x)$ **(4 Marks)**
   (b) Use the recurrence formula for the Legendre polynomial
   $P_{n+1}(x) = \left(\frac{2n+1}{n+1}\right) x . P_n(x) = \frac{n}{n=1}$ where $P_n(x)$ satisfies the Legendre's differential
   equation $(1 - x^2)P''_n(x) = -2x . P'_n(x) + n(n+1)P_n(x) = 0, for\ n = 3,4,5.$
   Find $P_3, P_4, P_5\ using\ P_0(x) = 1,\ P_1(x) = x$ **(8 Marks)**

6. (a) Write the error as the difference between exact y(x) and approximated values P(x) **(2 Marks)**

   (b) Given the Table below, use trapezoidal rule to integrate $\sqrt{x}$ between 1.0 and 1.3

   (4 Marks)

x	1.0	1.05	1.10	1.15	1.20	1.25	1.30
$\sqrt{x}$	1.00	1.025	1.049	1.072	1.095	1.118	1.140

   (c) Obtain the actual error and estimate the truncation error **(6 Marks)**