



MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2016/2017

SECOND YEAR FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE, BACHELOR OF MATHEMATICS AND BACHELOR OF EDUCATION WITH INFORMATION TECHNOLOGY

MAIN CAMPUS

MMA 217: NUMERICAL CONVERGENCE

Date: 3rd December, 2016

Time: 3.30 - 6.30 pm

INSTRUCTIONS:

- Answer question ONE and any other TWO questions.
- Start each question a fresh page
- Indicate question numbers clearly at the top of each page.
- Scientific Calculators may be used.
- Observe further instructions on the answer booklet.



Question 1 [30 Marks]

(a) Suppose that

$$x = \frac{5}{7} \quad \text{and} \quad y = \frac{1}{3}$$

using 5 digit chopping determine the relative error for $x+y$. [5 Marks]

(b) For the data

x	-2	-1	0	1	2	3
y = f(x)	15	5	1	3	11	25

Construct the forward difference formula. Hence find $f(0.5)$ [5 Marks]

(c) Evaluate $\sqrt{42}$ correct to 5 decimal places using Newton-Raphson iterative methods [5 Marks]

(d) Apply Romberg's integration method to evaluate

$$\int_0^{1.2} \frac{dx}{1+x}$$

[6 Marks]

(e) Solve the system of linear equations using Gauss Jacobi iterative scheme.

$$\begin{bmatrix} 4 & 1 & 1 \\ 1 & 5 & 2 \\ 1 & 2 & 3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 2 \\ -6 \\ 4 \end{bmatrix}$$

Take initial approximation $x_i = 0, \quad i = 1, 2, 3$ [5 Marks]

(f) Compute and interpret the condition number for

$$f(x) = \sin x \quad \text{for } a = 0.51\pi$$

[4 Marks]

Question 2 [20 Marks]

- (a) A slider in a machine moves along a fixed straight rod. Its distance $x(m)$ are given in the following table for various values of time $t(\text{seconds})$

$t(\text{sec})$	1	2	3	4	5	6
$x(m)$	0.0201	-0.0844	0.3444	1.0100	2.3660	4.7719

Find the velocity and acceleration at time $t = 6\text{seconds}$ [10 Marks]

- (b) Solve the following equation using Gauss Seidel's iteration method starting with initial approximation as $x_1 = 0.9$, $x_2 = -3.1$, and $x_3 = 0.9$ and show step by step iterations giving your answer correct to 4dp

$$\begin{bmatrix} 3x_1 - 6x_2 - x_3 \\ -4x_1 + x_2 + 2x_3 \\ x_1 - 3x_2 + 7x_3 \end{bmatrix} = \begin{bmatrix} -8 \\ 23 \\ 17 \end{bmatrix}$$

[10 Marks]

Question 3 [20 Marks]

- (a) Evaluate

$$\int_0^{1.2} \frac{dx}{1+x^2}$$

Using Simpson's taking 7 ordinates $\frac{1}{3}$

[6 Marks]

- (b) Find the missing entry in the following data

x	0	1	2	3	4	5
$y=f(x)$	1	3	11	-	189	491

[7 Marks]

- (c) Using Lagrange interpolation formula, find the value of y corresponding to $x=10$ from the following set of data

x	5	6	9	11
$y = f(x)$	380	-2	196	508

[7 Marks]

Question 4 [20 Marks]

(a) Derive the equation of interpolating polynomial for the given table

x(degree)	0	1	2	3	4	5
y =f(x)	3	2	7	24	59	118

[10 Marks]

(a) Use Newton's forward interpolation formula to find the value of $\cos 51^\circ$ from the following set of data

x	45°	50°	55°	60°
y =cos x	0.7071	0.6248	0.5736	0.5

[10 Marks]

Question 5 [20 Marks]

(a) Determine the root of the equation

$$\sin x + 3 \cos x - 2 = 0$$

using secant method. Take initial approximation $x_0 = 0$ and $x_1 = 1.5$

[10 Marks]

(b) Find the largest root of the equation

$$f(x) = x^6 - x - 1 = 0$$

accurate within $\epsilon = 0.001$ using bisection method

[8 Marks]

(c) Convert

$1A4E_{16}$

into a denary number

[2 Marks]

===== END =====