



MACHAKOS UNIVERSITY

University Examinations 2020/2021 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

SECOND YEAR SPECIAL /SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

SCO 213: NUMERICAL ANALYSIS

DATE: 25/3/2021

TIME: 2.00-4.00 PM

INSTRUCTION TO CANDIDATES

ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS

QUESTION ONE COMPULSORY (30 MARKS)

- a) If 0.182 is the approximate value of $\frac{2}{11}$ find the absolute, relative and percentage errors. (4 marks)
- b) Construct the forward difference table, where $f(x) = \frac{1}{x}$, $x = 1(0.2)2,4D$ (4 marks)
- c) For the following table of values, estimate $f(7.5)$, using Newton's backward difference interpolation formula (5 marks)
- d) If $f(x)$ is a polynomial of n^{th} degree in x , then $\Delta f(x)$ is again a polynomial of degree $n - 1$ (5 marks)
- e) Set up Newton iteration for computing the square root of a given positive number. Using the same find the square root of 2 exact to six decimal places. (6 marks)
- f) Find a root of the equation $x^3 + x^2 - 1 = 0$ on the interval $[0,1]$ with an accuracy of 10^{-4} (6 marks)

QUESTION TWO (20 MARKS)

- a) Show that the operators Δ and E commute. (2 marks)
- b) Solve $x^3 - 9x + 1 = 0$ for the root between $x = 2$ and $x = 4$, by bisection method. (5 marks)
- c) Solve the equation $x^3 = \sin x$. Considering various $\phi(x)$, discuss the convergence of the solution. (5 marks)
- d) How accurately should the length and the time of vibration of a pendulum should be measured in order that the computed value of g be correct to 0.01% (8 marks)

QUESTION THREE (20 MARKS)

- a) Deduce the error in quotient and its absolute error (4 marks)
- b) Using Aitken's scheme and the following values evaluate $\log_{10} 301$

x	300	304	305	307
$\log_{10} x$	2.4771	2.4829	2.4843	2.4871

(5 marks)

- c) Find the cubic polynomial which takes the following values;
 $f(1) = 24$, $f(3) = 120$, $f(5) = 336$, and $f(7) = 720$. hence or otherwise, obtain the value of $f(8)$. (5 marks)
- d) Evaluate $\int_0^1 e^{-x^2} dx$ by means of Trapezoidal rule with $n = 10$ (6 marks)

QUESTION FOUR (20 MARKS)

- a) Find the polynomial of lowest degree which assumes the values 10, 4, 40, 424 and 620 at $x = -2, 1, 3, 7$ and 8. (6 marks)
- b) Construct the difference table for the following data and locate the error in the second column.

x	3.6	3.61	3.62	3.63	3.64	3.65	3.66	3.67	3.68
$f(x)$	0.11204	0.12020	0.12835	0.13646	0.14460	0.15270	0.16078	0.16885	0.17690
	6	4	0	2	0	2	8	7	8

(7 marks)

- c) Find the interpolating polynomial by Newton's divided formula for the following table and then calculate $f(2.1)$.

x	0	1	2	4
$f(x)$	1	1	2	5

(7 marks)

QUESTION FIVE (20 MARKS)

- a) Derive the Newton-Raphson iterative formula

$$x_n = x_{n-1} - \frac{f(x_{n-1})}{f'(x_{n-1})}, n \geq 1$$

For the solution of the non-linear equation $f(x) = 0$.

(10 marks)

- b) Use the method in a.) to find the root of the equation $\tan x = x$ near $x = 4.5$ correct to four decimal places.

(10 marks)