



MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR FIRST SEMESTER EXAMINATIONS FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

ECU 301 – ENGINEERING MATHEMATICS X

DATE:

TIME:

INSTRUCTIONS: Answer Question 1 And Any Other 2 Questions.

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Find the unique polynomial $p(x)$ of degree 2 or less such that $p(1) = 1, p(3) = 27, p(4) = 64$ using the Lagrange interpolation method. Hence evaluate $p(2)$ (5 marks)
- b) Find $y'(0)$ and $y''(0)$ from the following table using Newton's forward difference formula:

x	0	1	2	3	4	5
y	4	8	15	7	6	2

(5 marks)

- c) Obtain the value of $f'(0.04)$ using Bessel's formula given the table below:

x	0.01	0.02	0.03	0.04	0.05	0.06
f(x)	0.1023	0.1047	0.1071	0.1096	0.1122	0.1148

(5 marks)

- d) Apply Simpson's $\frac{3}{8}$ rule to evaluate $\int_0^2 \frac{dx}{1+x^3}$ by dividing the range into 8 equal parts (5 marks)
- e) Solve the equation $\frac{dy}{dx} = x^2 - y; y(0) = 1$ using Taylor's series method. Tabulate values of $y(0.1)$ (5 marks)
- f) Solve the equation $x^3 + 2x^2 = -0.4$ using Newton-Raphson method if the root lies between 0 and -3 (5 marks)

QUESTION TWO (20 MARKS)

- a) Using Lagrange's interpolation formula, find the value of $f(4)$ from the following table:

x	0	2	3	6
$f(x)$	-4	2	14	158

(6 marks)

- b) Use Gauss' backward interpolation formula to find $f(32)$ from the following table:

x	25	30	35	40
$f(x)$	0.2707	0.3027	0.3386	0.3794

(5 marks)

- c) Evaluate $\sqrt{28}$ to 4 decimal places using Newton's iterative method. Assume the root lies between 5 and 6 (5 marks)
- d) Find the reciprocal of 18 using Newton-Raphson method (to 5 decimal places). Assume the initial approximation to be $x_0 = 0.05$ (4 marks)

QUESTION THREE (20 MARKS)

- a) The table below gives the value of polynomial of degree 5. It is given that $f(4)$ is in error. Compute the correct the value of $f(4)$

x	1	2	3	4	5	6	7
$f(x)$	0.975	-0.6083	-3.525	-5.525	-6.3583	4.225	36.475

(10 marks)

- b) Use Stirling's formula to compute $f'(0.5)$ from the following table:

x	0.35	0.4	0.45	0.5	0.55	0.6	0.65
$f(x)$	1.521	1.506	1.488	1.467	1.444	1.418	1.389

(10 marks)

QUESTION FOUR (20 MARKS)

- a) A curve passes through the points (1,0.2), (2,0.7), (3,1), (4,1.3), (5,1.5), (6,1.7), (7,1.9), (8,2.1), (9,2.3). Using Weedle's rule, estimate the volume generated by revolving the area between the curve x axis and the ordinates $x = 1$ and $x = 9$ about the x axis (10 marks)
- b) Apply Romberg's method to evaluate $\int_4^{5.2} \log x dx$ given that $\ln 4 = 1.3863$, $\ln 4.2 = 1.4351$, $\ln 4.4 = 1.4816$, $\ln 4.6 = 1.526$, $\ln 4.8 = 1.5686$, $\ln 5 = 1.6094$, $\ln 5.2 = 1.6486$ (10 marks)

QUESTION FIVE (20 MARKS)

- a) Solve $\frac{dy}{dx} = 1 - y$, $y(0) = 0$ in the range $0 \leq x \leq 0.3$ using improved Euler's method. Hence compare with the exact solution. (10 marks)
- b) Using Runge-Kutta method of fourth order, solve for $y(0.1), y(0.2), y(0.3)$ given that $y' = xy + y^2$, $y(0) = 1$ (10 marks)