MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY ORDINARY EXAMINATION

2021/2022 ACADEMIC YEAR

THIRD YEAR **SECOND** SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

UNIT CODE: EES308

UNIT TITLE: NUMERICAL METHOD FOR ENGINEERING

DURATION: 2 HOURS

Instructions to candidates:

1. Answer question One and Any Other Two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

a) Consider the function $f(x) = \frac{e^x - 1}{x}$. Use the decimal format with five significant digits (apply rounding) to calculate (using a calculator) f(x) for x = 0.00275 (2marks)

b) Show that the matrix

$[b] = \begin{bmatrix} 0.1 & 0.2 & 0 \\ 0.4 & 0.1 & 0.2 \\ 0.2 & 0.1 & 0.8 \end{bmatrix}$ is the inverse of the matrix $[a] = \begin{bmatrix} -1.2 & 3.2 & -0.8 \\ 5.6 & -1.6 & 0.4 \\ -0.4 & -0.6 & 1.4 \end{bmatrix}$ `

(4marks)

c) Determine the solution of the equation $8 - 4.5(x - sinx) = 0$ by using the bisection method. The solution should have a tolerance of less than 0.0635 rad. Create a table that displays the values of a, b, x_{NS}, $f(x_{NS})$ and the tolerance for each iteration of the bisection process. Let the initial interval be a=2 and b=3. (6marks)

d) Given :

A= [2 5 1]

B= $\begin{bmatrix} 3 \\ 1 \\ 4 \end{bmatrix}$

Write a MATLAB code to evaluate A*B and B*A. Give answers (3marks)

e) Write the algorithm for Newton's method of solving nonlinear equations. (5marks)

f) Solve the following system of four equations using the Gauss elimination method.

$4x_1-2x_2-3x_3+6x_4=12$

$-6x_1-7x_2+6.5x_3-6x_4= -6.5$

$x_1+7.5x_2+6.25x_3+5.5x_4= 16$

$-12x_1+22x_2+15.5x_3-x_4=17$

(10marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

a) An array c is defined as shown:

$$c = \begin{bmatrix} 1.1 & -3.2 & 3.4 & 0.6 \\ -0.8 & 1.3 & -0.4 & 3.1 \\ -2.1 & 0.6 & 2.2 & 0.0 \\ 1.1 & 0.1 & 11.1 & -0.9 \end{bmatrix}$$

Determine the contents of the following sub arrays.

i. c(2,:)

ii. c(:, end)

iii. c(1:2, 2:end)
iv. c(6)
v. c(4,end)

(5marks)

b) Factor the following matrix $[a] = \begin{bmatrix} 6 & -7 & 2 \\ 4 & -5 & 2 \\ 1 & -1 & 1 \end{bmatrix}$ into an orthogonal matrix (Q) and an upper triangular matrix (R) (15marks)

QUESTION THREE (20 MARKS)

a) The fuel economy of a car (miles per gallon) varies with its speed. In an experiment, the following five measurements are obtained.

Speed (mph)	10	25	40	55	70
Fuel economy (mpg)	12	26	28	30	24

Determine the four-order polynomial in the Lagrange form that passes through the points. Use the polynomial to calculate the fuel economy at 65 mph. (10marks)

b) Consider the function f(x) = x^3. Calculate its first derivative at point x=3 numerically with forward, backward and central finite difference formulas and using points: x=2.75, x=3 and x=3.25 (10marks)

QUESTION FOUR (20 MARKS)

a) Evaluate $\int_0^3 e^{-x^2} dx$ using four-point Gauss quadrature. (10marks)

b) Use Euler's explicit method to solve the ODE $\frac{dy}{dx} = -1.2y + 7e^{-0.3x}$ from x = 0 to x=2.5 with initial condition y = 3 at x = 0 and using h = 0.5. (10marks)