ELIZADE UNIVERSITY, ILARA-MOKIN,
ONDO STATE
FACULTY OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SECOND SEMESTER EXAMINATION, 2019/2020 ACADEMIC SESSION

COURSE TITLE: ENGINEERING MATHEMATICS III

COURSE CODE: GNE 315

EXAMINATION DATE: 18th February, 2020

COURSE LECTURER: Dr. Akinwumi A. Amusan

TIME ALLOWED: 3 hours

HOD's SIGNATURE

INSTRUCTIONS:

1. ATTEMPT ANY FIVE QUESTIONS
2. ANY INCIDENT OF MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM SHALL BE SEVERELY PUNISHED.
3. YOU ARE NOT ALLOWED TO BORROW CALCULATORS AND ANY OTHER WRITING MATERIALS DURING THE EXAMINATION.
4. ELECTRONIC DEVICES CAPABLE OF STORING AND RETRIEVING INFORMATION ARE PROHIBITED.
5. DO NOT TURN TO YOUR EXAMINATION QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO

Question #1 [12 Marks]

(a) Given that:

$$3x_1 + 2x_2 + x_3 = 1$$
$$x_1 - x_2 + 3x_3 = 5$$
$$2x_1 + 5x_2 - 2x_3 = 0$$

Apply the <u>row transformation method</u> to obtain the values of x_1, x_2 and x_3. (5 marks)

(b) Determine whether or not the following set of linear equation is consistent. What type of solution exists if consistent? (4 marks)

$$\begin{pmatrix} 1 & 3 & -2 \\ 4 & 5 & 2 \\ 1 & 3 & 4 \end{pmatrix}\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 6 \\ 3 \\ 7 \end{pmatrix}$$

(c) Given that matrix $\mathbf{A} = \begin{pmatrix} 2 & 7 & 6 \\ 3 & 1 & 5 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 4 & 0 \\ 3 & 7 \\ 1 & 5 \end{pmatrix}$, evaluate $|(\mathbf{A}.\mathbf{B})^T|$ (3 marks)

Question #2 (12 Marks)

(a) Given that:

$$x_1 - 2x_2 - x_3 + 3x_4 = 4$$
$$2x_1 + x_2 + x_3 - 4x_4 = 3$$
$$3x_1 - x_2 - 2x_3 + 2x_4 = 6$$
$$x_1 + 3x_2 - x_3 + x_4 = 8$$

Solve for x_1, x_2, x_3, and x_4 using <u>Gaussian elimination technique</u> (6 marks)

(b) Solve for x in the following equation using the appropriate <u>properties of determinants</u> (4 marks)

$$\begin{vmatrix} 5 & x & 3 \\ x+2 & 2 & 1 \\ -3 & 2 & x \end{vmatrix} = 0$$

(c) Write an example of 4×4 skew symmetric matrix? (2 marks)

Question #3 (12 Marks)

(a) Given that:

$$\mathbf{B} = \begin{pmatrix} 1 & 2 & 1 \\ 3 & -4 & -2 \\ 5 & 3 & 5 \end{pmatrix}$$

(i) Evaluate $\mathbf{B}^{-1}$ (3 marks)

(ii) Show that $\mathbf{B}.\mathbf{B}^{-1} = \mathbf{I}$ (2 marks)

(b) Determine the eigenvalues and eigenvectors for the equation $\mathbf{A}.\mathbf{x} = \boldsymbol{\lambda}.\mathbf{x}$, where $\mathbf{A} = \begin{pmatrix} 2 & 7 & 0 \\ 1 & 3 & 1 \\ 5 & 0 & 8 \end{pmatrix}$

(6 marks)

(c) Transform the point $(\rho, \phi, z) = (1, \frac{\pi}{6}, 5)$ in cylindrical coordinate system into a point in Cartesian / rectangular coordinate system.

(1 mark)

Question #4 (12 Marks)

(a) Solve the following partial differential equation by numerical technique

$$2\frac{\delta f(x,y)}{\delta x} - \frac{3}{2}\frac{\delta f(x.y)}{\delta y} = 0$$

For $0 \leq x \leq 1$ and $0 \leq y \leq 1$

Given that the boundary conditions are

$f(0, x) = 3x + 4$

$f(1, x) = 3x + 8$

$f(y, 0) = 4y + 4$

$f(y, 1) = 4y + 7$

Take a mesh of size $\frac{1}{3}$ in the x-direction and $\frac{1}{4}$ in the y-direction

(10 marks)

(b) Solve the differential equation $\frac{dy}{dx} = \frac{(1+2x)}{(1+3y)}$

(2 marks)

Question #5 (12 Marks)

(a) In a test on breakdown voltages, V kilovolts, for insulation of different thicknesses, t millimetres, the following results shown in Table Q5 were obtained:

Table Q5

t	2.0	3.0	5.0	10	14	18
V	153	200	282	449	563	666

If the law connecting V and t is $V = at^n$, determine the values of the constants a and n.

(7 marks)

(b) Solve the differential equation $(x^2 + 2xy)\frac{dy}{dx} = xy - 3y^2$

(5 marks)

Question #6 (12 Marks)

(a) Given the law relating quantities d and R as:

$$R = a + \frac{b}{d^2}$$

Obtain the best values for a and b from the set of corresponding data given Table Q6:

Table Q6

d	0.1	0.2	0.3	0.5	0.8	1.5
R	5.78	2.26	1.60	1.27	1.53	1.10

(7 marks)

(b) Solve the differential equation $y - \frac{3}{x}\frac{dy}{dx} = y^4 \cos x$ (5 marks)

Question #7 (12 Marks)

(a) Briefly explain the concept of Optimization and Linear Programming Problem in Engineering (4 marks)

(b) Use the graphical technique to minimize

$P = -4x + 6y$

Subject to the constraint

$-x + 6y \geq 24$

$2x - y \leq 7$

$x + 8y \leq 80$

$x, y \geq 0$

(8 marks)