ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

SEMESTER I EXAMINATION, 2016/2017 ACADEMIC SESSION

COURSE TITLE: ENGINEERING MATHEMATICS III

COURSE CODE: GNE 315

EXAMINATION DATE: 7TH APRIL, 2017

COURSE LECTURER: DR R. O. Alli-Oke

HOD's SIGNATURE

TIME ALLOWED: 3 HRS

INSTRUCTIONS:

1. ANSWER **QUESTION 1** AND ANY OTHER TWO QUESTIONS **(TOTAL OF 3 QUESTIONS)**
2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM.
3. YOU ARE **NOT** ALLOWED TO BORROW CALCULATORS AND ANY OTHER WRITING MATERIALS DURING THE EXAMINATION.

1)

a)

i) A square matrix represents a transformation on some vector space. What is the physical significance of eigenvalues (3 marks) and eigenvectors of a square matrix (3 marks)?

ii) Given that $A = \begin{bmatrix} 3 & 6 & -8 \\ 0 & 0 & 6 \\ 0 & 0 & 2 \end{bmatrix}$. Determine the eigenvalues of A (3 marks) and eigenvectors of A. (3 marks)

b) Prove that matrix multiplication is not commutative. *Hint:* $AB \neq BA$. (8 marks)

2)

a) Explain briefly the terms "*row echelon form*" and "*reduced row echelon form*". (4 marks)

b) Consider the following system of linear equations,

$$x + 3y + 2z = 7$$
$$2x + y - 1z = 5$$
$$-x + 2y + 3z = 4$$

i) Determine the augmented matrix A. (3 marks)

ii) Reduce the augmented matrix A to row echelon form. (10 marks)

iii) Determine the solutions (if any) to the above system of linear equations. (3 marks)

3)

a) Show that matrix addition is associative and distributive. (4 marks)

b) Consider the following system of linear equations,

$$x + 3y + 2z = 7$$
$$2x + y - 1z = 5$$
$$-x + 2y + 3z = 4$$

i) Determine the coefficient matrix B. (3 marks)

ii) Compute the inverse of the coefficient matrix B. (10 marks)

iii) Determine the solutions (if any) to the above system of linear equations. (3 marks)

4)

a) The displacement x of a particle in simple harmonic motion is given by $x = \cos(2t) + \sin(2t)$. Show that the differential equation describing the displacement x is given by $\frac{d^2x}{dt^2} + 4x = 0$. (6 marks)

b) Use exact methods or otherwise to solve the ordinary differential equation (ODE) obtained in (a) for $x(t)$, given that $x(0) = 1$ and $x'(0) = 2$. (3 marks)

c) Use forward differences to numerical approximate the derivative of $\cos x$ at $x = \frac{\pi}{3}$ radians. Express your workings in 8 significant figures. *Hint:* $f'(a) = \frac{f(a+h)-f(a)}{h}$

i) $h = 1,\ 0.01,\ 001.$ (6 marks)

ii) Determine the true value of $\cos x$ at $x = \frac{\pi}{3}$ radians. (2 marks)

iii) Explain your observations of the results obtained in (i) and (ii). (3 marks)