(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2017/2018 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER

SPECIAL/SUPPLEMENTARY EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: **MAT 251**

COURSE TITLE: **ENGINEERING MATHEMATICS I**

DATE: 11 ~~17~~ 19/10/18 **TIME:** 8AM -10 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

QUESTION ONE (30 MARKS)

a) Find the nth derivative of $y = x^2 e^{3x}$ at $x = 1$. (7 marks)

b) Express $\frac{2+i}{7-3i}$ in the form $a + bi$ and find its modulus. (4 marks)

c) Given that $x - 2, 2x - 6, 4x - 8$ form an arithmetic progression:
Determine:
   (i) The value of x;
   (ii) The sum of the first 8 terms. (5 marks)

d) Using Maclaurin's series, find the first four (non-zero) terms for the function $f(x) = \sin 2x$. (6 marks)

e) Solve for $x$given $\sinh x = 2$, (4 marks)

f) Given the matrices

$$A = \begin{pmatrix} -2 & 0 & 1 \\ -1 & -1 & -2 \\ 1 & 4 & 2 \end{pmatrix} \text{ and } B = \begin{pmatrix} 0 & -1 & 1 \\ 3 & -2 & 2 \\ 1 & 2 & 7 \end{pmatrix},$$

Determine $C = B^2 + 2A$. (5 marks)

QUESTION TWO (20 MARKS)

(a) State and prove Leibnitz's theorem. (6 marks)

(b) Express $cos^7\theta$ in $cosines$ of multiples of θ. (7 marks)

(c) Solve the differential equation$\frac{d\theta}{dt} = 3e^{2t-2\theta}$. (3 marks)

(d) Evaluate $\begin{vmatrix} x & 3 & 2 \\ 1 & 1 & x \\ x & 1 & 2 \end{vmatrix} = 28$ (4 marks)

QUESTION THREE (20 MARKS)

(a) Use Taylor's theorem to determine the power series for $\sin(\frac{\pi}{3} + h)$ as far as the term in h^4, and hence determine the value of $\sin 57°$ correct to five decimal places. (8 marks)

(b) Use Maclaurin's series to expand the function $f(x) = cos^2x$ in ascending powers of x upto the term inx^6. Hence evaluate $\int_1^2 \frac{cos^2x}{x^3} dx$. (12 marks)

QUESTION FOUR (20 MARKS)

(a) i) State de Moivres theorem (1 mark)

ii) Solve the binomial equation $z^3 + 64 = 0$ and locate the roots in the Argand diagram. (9 marks)

(b) Show that

$32sin^4\theta cos^2\theta = \cos 6\theta - 2\cos 4\theta - \cos 2\theta - 2$. (10 marks)

QUESTION FIVE (20 MARKS)

(a) Given $\begin{bmatrix}1\\0\\1\end{bmatrix}$ as one of the eigenvectors of the matrix $A = \begin{bmatrix}2 & -1 & 0\\-1 & 3 & y\\0 & y & x\end{bmatrix}$.

Determine;

(i) The values of x and y. (5 marks)

(ii) All the eigenvectors of A. (10 marks)

(b) In two closed loops of an electrical circuit, the currents flowing are given by the simultaneous equations:

$$I_1 + 2I_2 = -4$$

$$3I_2 + 5I_1 = 1$$

Use determinants to find the values of I_1 and I_2 (5 marks)