(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2017/2018 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER

MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: **MAT 251**

COURSE TITLE: **ENGINEERING MATHEMATICS I**

DATE: 19/01/18 **TIME:** 9 AM -11 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

QUESTION ONE (30 MARKS)

a) Solve the equation $\frac{iy}{xi+1} - \frac{3y+4i}{3x+y} = 0$ given that x and y are real. (4 marks)

b) A d.c. circuit comprises three closed loops. Applying Kircoffs laws to the closed loops gives the following equations for current flow in milliamperes:

$$2I_1 + 3I_2 - 4I_3 = 26$$

$$I_1 - 5I_2 - 3I_3 = -87$$

$$-7I_1 + 2I_2 + 6I_3 = 12$$

Use determinants to solve for I_1, I_2 and I_3 (8 marks)

c) In an arithmetic progression the thirteenth term is 54 and the seventh term is three times the second term. Find the first term and the common difference, hence the sum of the first ten terms. (5 marks)

d) Express $sin^5\theta$ in $sines$ of multiples of θ. (7 marks)

e) Using Maclaurin's series, find the first four (non-zero) terms for the function $f(x) = \ln(1+x)$. (6 marks)

QUESTION TWO (20 MARKS)

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

ii) Find the nth derivative of $y = x^2e^{3x}$ at $x = 0$. (7 marks)

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

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

QUESTION THREE (20 MARKS)

(a) Given the matrices

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

Find $C = A^2 - 4B$. (5 marks)

(i) Determine matrix A whose eigenvalues are $\lambda_1 = 2, \lambda_2 = 1$ and $\lambda_3 = -1$and the corresponding eigenvectors are $e_1 = [1 \quad 3 \quad 1]^T$, $e_2 = [3 \quad 2 \quad 1]^T$, $e_3 = [1 \quad 0 \quad 1]^T$ respectively. (15 marks)

QUESTION FOUR (20 MARKS)

(a) Use Taylor's theorem to determine the power series for $\cos(\frac{\pi}{3} + h)$ as far as the term in h^4, and hence determine the value of $\cos 62°$ correct to five decimal places. (8 marks)

(b) Use Maclaurin's series to expand the function $f(x) = e^{sinx}$ in ascending powers of x upto the term in x^4 . Hence evaluate $\int_{0.1}^{0.4} 2xe^{sinx}\, dx$. (12 marks)

QUESTION FIVE (20 MARKS)

(a) i) Using De Moivres theorem, simplify $\frac{(\cos 5\theta - \mathrm{i} \sin 5\theta)^2 (\cos 7\theta + i \sin 7\theta)^{-3}}{(\cos 4\theta - i \sin 4\theta)^9 (\cos \theta + i \sin \theta)^5}$ (5 marks)

ii) Solve the equation $z^4 + 1 = 0$ and locate the roots in the Argand diagram. (8 marks)

(b) Show that $32sin^4\theta cos^2\theta = \cos 6\theta - 2\cos 4\theta - \cos 2\theta + 2$. (7 marks)