INTERNATIONAL UNIVERSITY OF EAST AFRICA
'Learning to Succeed'

FACULTY OF ENGINEERING

END OF SEMESTER EXAMINATIONS 2025

PROGRAMME: DIPLOMA IN ELECTRICAL ENGINEERING

YEAR/SEM: 1/1

COURSE CODE: DEE 1103

ENGINEERING MATHEMATICS 1

15/04/2025

TIME: 2:00 PM– 5:00PM

INSTRUCTIONS TO CANDIDATES:

- **ATTEMPT FOUR QUESTIONS : TWO FROM SECTION A AND TWO FROM SECTION B (100 MARKS).**
- **DO NOT OPEN THIS EXAMINATION UNTIL YOU ARE TOLD TO DO SO**
- **ALL ROUGH WORK SHOULD BE IN YOUR ANSWER BOOKLET**
- **THE TIME ALLOWED FOR THIS EXAMINATION IS STRICTLY THREE HOURS**
- **ON THE FIRST PAGE OF YOUR ANSWER BOOKLET**
    - **WRITE YOUR REGISTRATION NUMBER PROPERLY**
    - **WRITE THE COURSE NAME AND COURSE CODE**
    - **WRITE EXAMINATION VENUE**
    - **DO NOT WRITE, DRAW OR SCRATCH ANYTHING ELSE ON THE FIRST PAGE**
    - **WRITING UNNECESSARY INFORMATION LIKE PHONE NUMBERS IN THE FIRST PAGE SHALL ANNUL YOUR EXAM**
    - **ANSWER BOOKLETS THAT DO NOT CARRY THE REQUIRED INFORMATION, OR THAT HAVE UNNECESSARY WRITING IN THE FIRST PAGE SHALL NOT BE MARKED**

SECTION A

1. Given a system of equations; $\begin{pmatrix}1 & 1 & 1\\ 2 & 3 & 4\\ 3 & 1 & 2\end{pmatrix}\begin{pmatrix}x\\ y\\ z\end{pmatrix} = \begin{pmatrix}6\\ 20\\ 13\end{pmatrix}$, find the determinants of the following matrices;

$\begin{pmatrix}1 & 1 & 1\\ 2 & 3 & 4\\ 3 & 1 & 2\end{pmatrix}, \begin{pmatrix}6 & 1 & 1\\ 20 & 3 & 4\\ 13 & 1 & 2\end{pmatrix}, \begin{pmatrix}1 & 6 & 1\\ 2 & 20 & 4\\ 3 & 13 & 2\end{pmatrix}, \begin{pmatrix}1 & 1 & 6\\ 2 & 3 & 20\\ 3 & 1 & 13\end{pmatrix}$. Hence solve the above system of equations by Crammer's rule. (**25 marks**)

2. (a) Express the following in partial fractions (10 marks)

(i) $\frac{3x^2-21x+24}{(x+1)(x-2)(x-3)}$

(ii) $\frac{3x^2+-2x+5}{(x-1)(x^2+5)}$

(b) Find the greatest and least values of the following (10 marks)

(i) $11 + x - x^2$

(ii) $2x^2 - 4x + 5$

(c) Find the value of k for which the equation

(d) $\frac{x^2-x+1}{(x-1)} = k$ has repeated roots. What are the repeated roots (5 marks)

3. (a) Obtain the remainders when

(i) $5x^3 - 6x^2 + 3x + 14$ is divided by $(x-2)$

(ii) $2x^4 + 6x^3 - 7x^2 + 9x + 11$ is divided by $(x+3)$ (15 marks)

(b) Use long division to obtain the quotient and remainder when

(i) $x^3 + 3x^2 - 4x - 12$ is divided by $x^2 + x - 6$

(ii) $2x^4 - 8x^3 + 5x^2 + 4$ is divided by $x - 3$ (10 marks)

4. (a) Define the logarithm of a number to base x from your definition. Write the equivalent statement for the following logarithms

(i) $log_2^{16} = 4$ (ii) $log_3^{27} = 3$

(iii) $log_{10}^{100} = 2$ (iv) $log_2^{3} = 5$ **(10 marks**

(b) If $x = a^n$, $y = a^m$

(i) Show that $log_a^{xy} = log_a^x + log_a^y$

(ii) $log_a^{\frac{x}{y}} = log_a^x - log_a^y$

(c) Show that $log_a^b = \frac{1}{log_b^a}$

hence solve the equation $log_3^x + 2log_x^3 = 3$ (15 marks)

5. Use row reduction to Echelon form to solve the simultaneous equations;

(a)

$$2x - y + z = 2$$
$$3x + 2y - 3z = 2$$
$$x - y + 5z = 5$$

(b)

$$x + 2y + z = 6$$
$$2x + 3y + 3z = 14$$
$$y + 2z = 8$$

(25 marks)

6. Use synthetic approach to obtain the remainders when

(b) $x^4 - 16$ is divided by $x + 1$

(c) $5x^3 - 6x^2 + 3x + 14$ is divided by $x + 1$

(d) $2x^4 + 6x^3 - 7x^2 + 9x + 11$ is divided by $x + 4$ (25 marks)

SECTION B

7. (a) Calculate the principal argument of:

(i) $\frac{(1-i)(\sqrt{3}-i)}{(1-i\sqrt{3})}$ (ii) $\frac{(1+i\sqrt{3})^4}{(1-i)^3}$

(iii) $\frac{2-\sqrt{3}+i}{2+\sqrt{3}+i}$

(b) Solve for x and y values in the equation $\frac{x}{2+3i}+\frac{y}{3-i}=\frac{6-13i}{9+7i}$

(25Marks)

8. Solve the equations:

(a) $3^{2x} + 3^{x+1} - 18 = 0$

(b) $\frac{16^x - 4^x}{4^x + 2^x} = 5(2^x) - 8$

(c) $\log_x 10 + \log_{x^2} 10000 = 3$ (25 marks)

9.(a) Given that the polynomial $f(x) = Q(x)g(x) + R(x)$ where $Q(x)$ is a quotient, $g(x) = (x-\alpha)(x-\beta)$ and $R(x)$ is a remainder. Show that;

$$R(x) = \frac{(x-\beta)f(\alpha) + (\alpha - x)f(\beta)}{\alpha - \beta}$$

(b) Given that $f(x) = (x-\alpha)^2 g(x)$, show that $f'(x)$ is divisible by $(x-\alpha)$

(c) A polynomial $P(x) = x^3 + 4ax^2 + bx + 3$ is divisible by $(x-1)^2$. Use your results above to find the values of a and b. Hence solve the equation $p(x) = 0$

(25marks)

10. (a) Express the following in the form $a + bi$.

(i) $\frac{1}{2+3i} + \frac{1}{2-3i}$

(ii) $\frac{1}{3+i} + \frac{1}{1+7i}$

(iii) $3 + 4i + \frac{25}{3+4i}$ **(10 marks)**

(b) Given that $z_1 = -1 - i\sqrt{3}$ and $z_2 = 1 + i$. Find the $\arg(z_1 z_2)$ *and* $\arg\left(\frac{z_1}{z_2}\right)$

(15marks)

11.(a) Given the complex numbers, $z_1 = r_1(\cos\theta_1 + i\sin\theta_1)$ and $z_2 = r_2(\cos\theta_2 + i\sin\theta_2)$, Show that $z_1 z_2 = r_1 r_2(\cos(\theta_1+\theta_2) + i\sin(\theta_1+\theta_2))$ and $\frac{z_1}{z_2} = \frac{r_1}{r_2}(\cos(\theta_1-\theta_2) + i\sin(\theta_1-\theta_2))$

(15 marks)

(b) Express $\sqrt{3}+i$ in modulus –argument form. Hence find $(\sqrt{3}+i)^{10}$ and $\frac{1}{(\sqrt{3}+i)^7}$ in the form of $a+bi$ (10 marks)

12. find the values of A, B, and C if

(a) $\frac{x^2-3}{(x^2+1)(x-2)} = \frac{Ax+B}{(x^2+1)} + \frac{C}{(x-2)}$

(b) $\frac{3}{x(x+2)(x^2+3)} = \frac{A}{x} + \frac{C}{x+2} + \frac{Cx+D}{x^2+3}$.

(25marks)

END