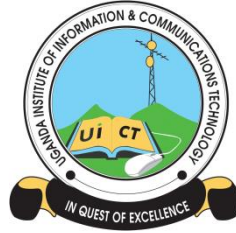


**UGANDA INSTITUTE OF  
COMMUNICATIONS**



**INFORMATION AND  
TECHNOLOGY**

**END OF SEMESTER ONE EXAMINATIONS**

**ACADEMIC YEAR 2022/2023**

**DEPARTMENT:** ICT

**SEMESTER:** ONE

**PROGRAMME(S):** DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING (DEEE)  
DIPLOMA IN TELECOMMUNICATIONS ENGINEERING (DTE)

**YEAR OF STUDY:** ONE

**COURSE:** ENGINEERING MATHEMATICS I

**COURSE CODE :** EMT111

**DATE:** FRIDAY 17TH, MARCH 2023

**TIME:** 9:00 AM – 12:00 NOON

**DURATION:** 3 HOURS

**INSTRUCTIONS:**

- (i) This paper contains two Sections: A (40 marks) & B (60 marks).**
- (ii) Attempt ALL questions in Section A, and ONLY THREE questions in Section B.**
- (iii) All questions in Section B carry equal marks.**
- (iv) Credit will be given for use of relevant examples and illustrations.**
- (v) Begin each number in Section B on a new page of the answer sheet.**
- (vi) DO NOT write on this question paper.**

**SECTION A [40 MARKS]**Attempt **ALL** the Questions in this section.(a) Functions  $f(x) = x^2 + 1$ ,  $g(x) = (x - 2)/3$  and  $h(x) = fg(x)$ .Find  $h(x)$  and  $h^{-1}(x)$ .**(4 marks)**(b) (i) Complete the square and solve the equation  $x^2 - 6x - 5 = 0$ .(ii) Show that  $2x - 1$  is a factor of  $2x^3 - 3x^2 - 3x + 2 = 0$ .

Hence find all roots of the equation.

**(6 marks)**(c) Matrix  $A = \begin{pmatrix} -3 & 1 & 4 \\ 5 & -6 & -2 \end{pmatrix}$  and  $B = \begin{pmatrix} -2 & 0 & -1 \\ 1 & -3 & 5 \\ 4 & 1 & 0 \end{pmatrix}$ . Find:(i)  $\mathbf{AB}$ .(ii)  $|\mathbf{B}|$ **(4 marks)**

(d) Given linear equations:

$$3x - 2y = -7$$

$$-4x + 5y = 14$$

(i) Put in matrix form.

(ii) Use Cramer's rule to find  $x$  and  $y$ .**(5 marks)**(e) (i) Find the real numbers  $p$  and  $q$  if  $q - ip = 2 + i$ .(ii) Simplify  $(-1 + i2)/(-1 - i3)$ **(6 marks)**(f) Given complex number  $Z = -1 - i\sqrt{3}$ :(i) Sketch on Argand diagram. (ii) Find  $|Z|$  and  $\arg(Z)$ .**(5 marks)**(g) Solve the equations in the range  $0^\circ \leq \theta \leq 360^\circ$ .

(i)  $\sin 2\theta = \frac{\sqrt{3}}{2}$

(ii)  $\cos 2\theta = -\frac{1}{2}$

**(6 marks)**

(h) Given:

(i)  $y = (1 - x^2)^8$ , find  $\frac{dy}{dx}$ .

(ii)  $\frac{dy}{dx} = (x^2 - 2)^3$ , find  $y$  in terms of  $x$ .

**(4 marks)**

**SECTION B [60 MARKS]**Attempt **ONLY THREE** Questions in this section.**Question 2**(a) Function  $f(x) = (x - 1)^2$ ,  $g(x) = \frac{x+1}{2}$  and  $h(x) = gf(x)$ . Find:

(i)  $h(x)$

(ii)  $h^{-1}(x)$

**(6 marks)**(b) (i) Use trial method and solve equation  $2x^3 + 5x^2 + x - 2 = 0$ .(ii) Show that  $2x - 1$  is a factor of  $f(x) = 2x^3 - 3x^2 - 3x + 2$ .Hence find all the roots of  $f(x) = 0$ .**(6 marks)**(c) The roots of the equation  $y = 2x^2 - x - 3 = 0$  are  $m$  and  $n$ .Find the value of  $\frac{1}{m^2} + \frac{1}{n^2}$ .**(4 marks)**

(d) Sketch the graphs:

(i)  $x = (y - 1)^3$

(ii)  $x = \ln y$

**(4 marks)****Question 3**

(a) Given linear equations:

$$5x - 4y = 13$$

$$-3x + 2y = -7$$

(i) Express in matrix form.

(ii) Use inverse matrix to find  $x$  and  $y$ .**(5 marks)**(b) Matrix  $\mathbf{P} = \begin{pmatrix} 0 & 3 & 6 \\ 4 & 0 & -5 \\ -1 & 2 & 0 \end{pmatrix}$ . Find:

(i) cofactor matrix

(ii)  $\text{adj}(\mathbf{P})$ .**(7 marks)**(c) (i) Matrix  $\mathbf{Q} = \begin{pmatrix} 0 & 1 & -3 \\ -1 & 0 & 4 \\ 1 & -2 & 0 \end{pmatrix}$ . If  $\mathbf{Q} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} -5 \\ 5 \\ 3 \end{pmatrix}$  find  $x, y$  and  $z$ .(ii) Matrix  $\mathbf{R} = \begin{pmatrix} 2 & 1 & -2 & 3 \\ 1 & -1 & -1 & 0 \\ 1 & 1 & 3 & 12 \end{pmatrix}$ .

Reduce to row echelon form.

**(8 marks)**

## ENGINEERING MATHEMATICS I

### Question 4

(a) Solve the equations:

(i)  $4 + i5 = (x + iy) - (1 - i)$

(ii)  $(x + iy)(1 + i2) = 2 + i5$

(4 marks)

(b) Simply  $(-1 + i2)^{20}$

(6 marks)

(c) Given  $z^3 - 2z^2 + 25z - 50 = 0$  where  $Z$  is a complex number, find all the roots of the equation.

(5 marks)

(d) Find the quadratic equation with a root  $-1 - i2$ .

(5 marks)

### Question 5

(a) Sketch a complete cycle of:

(i)  $y = 2\sin x$

(ii)  $y = \cos 2x$

(4 marks)

(b) Solve for  $x$  in the range  $0 \leq x \leq 2\pi$ .

(i)  $\sin 2x = 1/2$

(ii)  $\cos 2x = -1/2$

(6 marks)

(c) Express in terms of exponentials:

(i)  $\cosh 2x$

(ii)  $\sinh 2x$

(2 marks)

(d) (i) Given  $\sinh x = \frac{5}{12}$ , find  $\cosh x$ .

(ii) Solve equation  $4\cosh 2x - 2\sinh x = 7$

(8 marks)

### Question 6

(a) Find  $\frac{dy}{dx}$  in terms of  $t$ , given  $x = 2\cos^3 t$  and  $y = 3\sin^2 t$ .

(4 marks)

(b) Find  $\frac{dy}{dx}$ :

(i)  $y^2 - 3x^2y - x^2 = 0$

(ii)  $y = e^{2x} \sin 3x$

(7 marks)

(c) Evaluate:

(i)  $\int_{1/2}^3 x\sqrt{2x+3} dx$

(ii)  $\int_0^1 \frac{2x-3}{3x^2-9x+4} dx$

(7 marks)

END