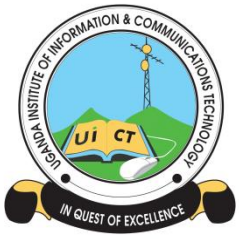
UGANDA INSTITUTE OF COMMUNICATIONS END OF SEMESTER ONE



INFORMATION AND TECHNOLOGY EXAMINATIONS

ACADEMIC YEAR 2023/2023

DEPARTMENT: ICT

SEMESTER: ONE

PROGRAMME(S): DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING (DEEE)
DIPLOMA IN ELECTRONICS COMMUNICATIONS ENGINEERING (DECE)

YEAR OF STUDY: ONE

COURSE: ENGINEERING MATHEMATICS I

COURSE CODE : EMT111

DATE: FRIDAY 8TH, DECEMBER 2023

TIME: 12:00 PM – 3:00 PM

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.

Question 1

(a) Function $f(x) = \frac{x-k}{3}$ and $g(x) = (5-x)^2$. If $f(-2) = 4$ find:

(i) value of k (ii) $fg(-1)$ **(4 marks)**

(b) (i) Complete the square and solve the equation $4x^2 - 12x - 7 = 0$

(ii) Let $f(x) = x^3 + 2x^2 - 5x - 6 = 0$.
Use long division to show that $x + 1$ is a factor of $f(x) = 0$.
Hence find all the roots of the equation. **(6 marks)**

(c) Matrix $\boldsymbol{A} = \begin{pmatrix} -3 & 0 & 1 \\ 0 & -1 & 2 \end{pmatrix}$ and $\boldsymbol{B} = \begin{pmatrix} -1 & 2 & 0 \\ 0 & -3 & 1 \\ 4 & 0 & -5 \end{pmatrix}$. Find:

(i) product **AB** (ii) det (**B**) **(5 marks)**

(d) (i) Find the real numbers p and q if $-q + ip = 2 - i$.

(ii) Simplify the product $(-1 - i2)(1 - i3)$ **(5 marks)**

(e) Given complex number $Z = -2 - i2$:

(i) Sketch on Argand diagram.

(ii) Find $|Z|$ and positive arg (Z) . **(4 marks)**

(f) Sketch a complete cycle of:

(i) $y = -2sinx$ (ii) $y = -\cos 2x$ **(4 marks)**

(g) Solve the equations in the range $0° \leq \theta \leq 360°$.

(i) $sin2\theta = -\frac{\sqrt{3}}{2}$ (ii) $cos2\theta = \frac{1}{\sqrt{2}}$ **(6 marks)**

(h) Find:

(i) $\frac{d}{dx}[\frac{1}{(3x^2+2)^3}]$ (ii) $\int (5-2x)^{19} dx$. **(6 marks)**

SECTION B [60 MARKS]

Attempt **ONLY THREE** questions in this Section.

Question 2

(a) Function $f(x) = x^2 - x - 6$ and $g(x) = x - 1$. Find values of x if:

(i) $f(x)g(x) = 0$ (ii) $fg^{-1}(x) = 0$ **(6 marks)**

(b) Let $f(x) = 2x^3 + 3x^2 - 8x + 3$.

(i) Use factor theorem to show that $2x - 1$ is a factor of $f(x) = 0$.

(ii) Hence find all the factors of $f(x) = 0$. **(6 marks)**

(c) The roots of the equation $2x^2 - x - 3 = 0$ are m and n.

Express the roots in terms of the coefficients.

Hence find the value of expression $\frac{1}{m^2} + \frac{1}{n^2}$ **(4 marks)**

(d) Sketch on the same axes the graphs:

(i) $y = x^3$ and $y = (x + 1)^3$ (ii) $y = e^{-x}$ and $y = -lnx$ **(4 marks)**

Question 3

(a) Let matrix $\boldsymbol{A} = \begin{pmatrix} 2x \\ -3y \\ 4z \end{pmatrix}$ and $\mathbf{IA} = \begin{pmatrix} 2 \\ -6 \\ -8 \end{pmatrix}$

Substitute for identity matrix $\mathbf{I}$ and Hence find x, y and z. **(2 marks)**

(b) Matrix $\mathbf{B} = \begin{pmatrix} 0 & 3 & 6 \\ 4 & 0 & -5 \\ -1 & 2 & 0 \end{pmatrix}$. Find:

(i) cofactor matrix **C** of **B** (ii) adj (**B**). **(8 marks)**

(c) Given linear equations:

$p + 2q - 3r = 4$

$2p - q + r = -4$

$p + q - 2r = 2$

(i) Write the corresponding augmented matrix.

(ii) Transform the matrix into row reduced echelon form

(iii) Find the values of p, q and r. **(10 marks)**

Question 4

(a) Find a and b given equations:

(i) $4 - i5 = (a + ib) - (-1 + i)$

(ii) $(-a - ib)(-1 + i2) = 8 + i$ **(5 marks)**

(b) Given $Z = -2 + i\sqrt{3}$:

(i) Convert Z to polar form

(ii) Simplify Z^8 **(6 marks)**

(c) Given $1 - i2$ is one of the roots of a quadratic equation:

(i) State the second root.

(ii) Hence find the equation. **(4 marks)**

(d) Let $3z^3 - 8z^2 + 5z - 2 = 0$, where Z is a complex number.

Find all the roots of the equation. **(5 marks)**

Question 5

(a) Sketch in the interval $[-2\pi, 2\pi]$:

(i) $y = tan\frac{x}{3}$ (ii) $y = cosec2x$ **(4 marks)**

(b) Solve equations in the interval $[-2\pi, 2\pi]$:

(i) $tan3\theta = -1$ (ii) $cos2\theta + sin\theta = 0$ **(6 marks)**

(c) Express in terms of exponentials:

(i) $cosh2x$ (ii) $sinh2x$ **(2 marks)**

(d) Solve the equations:

(i) $sinh2x = \frac{3}{4}$ (ii) $3sinh2x - cosh2x = 1$ **(8 marks)**

Question 6

(a) (i) Find $\frac{dy}{dx}$ given $x^2 + y^2 - 2xy = 0$.

(ii) Prove $\frac{dy}{dx}(sinx) = cosx$ **(8 marks)**

(b) Find:

$(i) \int x^2 e^{x^3}\, dx$ $(ii) \int sin^2 x \cos x\, dx$ **(6 marks)**

(c) Evaluate:

$(i) \int_2^3 \frac{x}{\sqrt{x^2 - 3}} dx$ $(ii) \int_0^{\pi/6} tan\, 2x\, dx$ **(6 marks)**

END