



UGANDA INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

END OF SEMESTER TWO EXAMINATIONS

ACADEMIC YEAR 2024/2025

DEPARTMENT: ICT

SEMESTER: TWO

PROGRAMME(S): HIGHER EDUCATION CERTIFICATE-ENGINEERING

YEAR OF STUDY: ONE

COURSE: ADVANCED MATHEMATICS

COURSE CODE : HECE 121

DATE: SATURDAY 21ST JUNE 2025

TIME: 9AM- 12PM

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)

1. The function $f(x) = x^3 + px^2 - 5x + q$ has a factor $(x-2)$ and has a remainder -5 when divided by $(x+3)$. Find the value of p and q . (4 Marks)

2. Show that: $\tan(\pi/4 + A/2) = \frac{1 + \sin A}{\cos A}$ (4 Marks)

3. Determine the values p for which matrix, $p = \begin{bmatrix} 3-x & 2 & 2 \\ 2 & 4-x & 1 \\ -2 & -4 & -1-x \end{bmatrix}$ is singular. (4 Marks)

4. Express $5+12i$ in polar form (4 Marks)

5. Show that $\frac{d}{dx}(\tan^{-1}x^x) = \frac{(1+\ln x)x^x}{1+x^{2x}}$ (4 Marks)

6. Given the information in the table below;

X	0.9	1.0	1.1	1.2
f(x)	0.260	0.242	0.218	0.192

Use linear interpolation to find;

i) The value of $f(1.04)$

ii) The value of x corresponding to $f(x) = 0.23$ (4 Marks)

7. Prove that: $\int \tan \theta \, d\theta = \ln \sec \theta + c$, where c is a constant of integration. (4 Marks)

8. Given that $C = \begin{bmatrix} 3 & 5 & 8 \\ -6 & 2 & -4 \\ 7 & 0 & 1 \end{bmatrix}$. Find C^T and $|C|$ (4 Marks)

9. Find the values of $\cos 2\theta + \sin \theta = 0$ for $0^\circ \leq \theta \leq 360^\circ$ (4 Marks)

10. Solve the differential equation: $x(1-y)\frac{dy}{dx} + y = 0$, given that $y=1$ when $x = e$.

(4 Marks)

SECTION B (60 Marks)

Attempt ONLY THREE questions in this section.

QUESTION 1.

- (a) The function $f(x) = x^3 + px^2 - 5x + q$ has a factor $(x-2)$ and has a remainder -5 when divided by $(x+3)$. Find the value of p and q . (5 Marks)
- (b) Factorise the expression $2x^3 + 3x^2 - 32x + 15$ completely. (5 Marks)
- (c) Express the function $f(x) = 2x^2 + 8x + 9$ in the form $2(x+a)^2 + b$, and hence find the minimum value of the function. (5 marks)
- (d) Sketch the curve for $y = x^2(3-x)$ (5 Marks)

QUESTION 2.

- (a) Solve the following equations for x :
 - (i) $\sin 2x = \sqrt{3} \cos^2 x$ for $-180^\circ \leq x \leq 180^\circ$ (5 Marks)
 - (ii) $2 \cos x + 3 \sin x = 2$ for $0^\circ \leq x \leq 360^\circ$ (5 Marks)
- (b) Given that $x = \sec \mu + \tan \mu$ and $y = \sec \mu - \tan \mu$, by eliminating μ from the two equations. Show that: $xy = 1$. (3 Marks)
- (c) prove that: $\frac{\cos A + \cos B}{\sin A + \sin B} = \cot \frac{A+B}{2}$,
- (d) Hence deduce that: $\frac{\cos A + \cos B}{\sin A + \sin B} = \tan^C / 2$, where A, B and C are angles of a triangle (7 Marks)

QUESTION 3.

- (a) Use Newton-Raphson iterative formula to show that the cube root of a number N is given by $\frac{1}{3} \left[2x_n + \frac{N}{x_n^2} \right]$ and hence taking $x_0 = 2.5$, determine $\sqrt[3]{10}$ and correct to 3 decimal places. (8 Marks)
- (b) Use trapezium rule to estimate the $\int_1^{1.4} (x + \tan x) dx$ using 4 sub-intervals
- (c) Given that $Z_1 = -1 + i\sqrt{3}$ and $Z_2 = -1 - \sqrt{3}$ (4 Marks)
 - (i) Express $\frac{Z_1}{Z_2}$ in the form $a + ib$, where a and b are real numbers (4 Marks)
 - (ii) Find $\left| \frac{Z_1}{Z_2} \right|$ (3 Marks)

QUESTION 4

- (a) (i) Given $y = (\sin x)^x$, Find $\frac{dy}{dx}$ (4 Marks)
- (ii) If $y = \sqrt{\frac{1+\sin x}{1-\sin x}}$, show that $\frac{dy}{dx} = \frac{1}{1-\sin x}$. (6 Marks)
- (b) Determine the following;
 - (i) $\int \sin^2 5x \, dx$ (5 Marks)

(ii) $\int x^2 \ln x \, dx$

(5 Marks)

QUESTION 5

(a) Solve the differential equation: $\frac{dy}{dx} = \frac{\sin 2x}{y^2}$, given that $y=1$ and $x=0$ (5 Marks)

(b) COVID-19 virus in a certain Country increase at a rate proportional to the total number of virus present. If the number increases from 1000 to 2000 in 1 hour,

(i) How many viruses will be present after $\frac{3}{2}$ hours (8 Marks)

(ii) How long will it take for the number of viruses in a Country to become 4000? (4 Marks)

(iii) Outline any three measures on how COVID-19 virus can be controlled from spreading from one person to another.

(3 Marks)

END