INFORMATION AND COMMUNICATIONS UNIVERSITY

SCHOOL OF ENGINEERING
DEPARTMENT OF INFORMATION COMMUNICATION & TECHNOLOGY

ICE0112: HIGHER MATHEMATICS 1

END OF SEMESTER EXAMINATION

JUNE 2023

Time allowed: 3 HOURS plus 5minutes reading time:

Instructions to Candidates:

1. **Check that you have the correct examination paper in front of you.**
2. **Answer question ONE (1) and ANY OTHER THREE questions from SECTION B.**
3. **All questions must be answered in the answer booklet only.**
4. **Write down the number of questions that you have answered on the cover of the examination answer booklet.**
5. **Non-Programmable Electronic Calculators are allowed**
6. **No books, files or other mechanical / electronic aids are permitted.**
7. **There shall be no form of communication between students during the examination. Any students caught doing this will be disqualified.**
8. **Write down your PARTICULARS clearly on the examination answer booklet.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A: Compulsory

QUESTION 1

a) Consider the subsets A = [-2, 5), B = (-1, 3) and C = [-3, 4) of the universal set **R**. Find the set (A' n C) U B and display the answer on the number line. **[6 Marks]**

b) The quadratic equation $3x^2 + 4x - 2 = 0$ has roots α and β. Find:

i) $\alpha^2 - \beta^2$ **[4 Marks]**

ii) $\frac{1}{\alpha} + \frac{1}{\beta}$ **[4 Marks]**

c) x -1 and x +1 are factors of the polynomial $P(x) = x^3 + ax^2 + bx + c$

When P(x) is divided by x -2, the remainder is 12. Find the values of a, b, c **[11 Marks]**

SECTION B

Answer any three (3) questions

QUESTION 2

a) Given that θ is acute and that $\cot \emptyset = 1/\sqrt{2}$, . Find values of $\sin \emptyset, \cos \emptyset, \tan \emptyset, \text{cosec } \emptyset, \sec \emptyset$, leave your answers in surd form. **[6 Marks]**

b) i) Given that f(x) = 4 x -2, Confirm that $f^{-1}(f(x)) = x$ **[4 Marks]**

ii) Solve for x in $\log_4 x + \log_2 x = 9$, *show your working.* **[5 Marks]**

c) Graph the following quadratic equation $y = 3 + 2x - x^2$, showing all your working **[10 Marks]**

QUESTION 3

a) Convert $10\angle 30^\circ$ into a + j b form, correct to 4 significant figures. **[5 Marks]**

b) Determine, in polar form: $10\angle 60^\circ + 3\angle 30^\circ - 2\angle 45^\circ$ **[5 Marks]**

c) Let $Z_1 = 2 - j3$ and $Z_2 = 3 + j2$. Determine (i) Z_1 / Z_2, (ii) $Z^2_1 - (1/Z^2_2)$ in the form **a+ *jb*** where a and b are real numbers **[7 Marks]**

d) Using the synthetic division find the quotient and the remainder when $x^3 - 2x^2 + 9$ is divided by x + 2 **[8 Marks]**

QUESTION 4

a) Rationalize the denominator of i) $\frac{4\sqrt{2}+1}{2\sqrt{2}+3}$ ii) $\frac{2}{2\sqrt{3}-3}$ **[7 Marks]**

b) Given that $\boldsymbol{p} = 2\boldsymbol{i} + 2\boldsymbol{j} - 6\boldsymbol{k}$, $\boldsymbol{q} = -\boldsymbol{i} + \boldsymbol{j} + 2\boldsymbol{k}$ and $\boldsymbol{r} = 2\boldsymbol{j} - 4\boldsymbol{k}$, evaluate and simplify the following vectors in $\boldsymbol{i}, \boldsymbol{j}, \boldsymbol{k}$ form: i) $-\boldsymbol{p} + 2q$ ii) $\boldsymbol{p} + 3\boldsymbol{q} + 3\boldsymbol{r}$ **[8 Marks]**

c) Prove the following identities

i) $\sec x - \cos x = sinxtanx$

ii) $(1 - \cos^2\theta)\csc^2\theta = 1$ **[10 Marks]**

QUESTION 5

a) Evaluate $\begin{vmatrix} j2 & -j3 \\ (1+j) & j \end{vmatrix}$ **[8 Marks]**

b) Solve: log(4x+1)-log(2x+9)=0 **[7 Marks]**

c) Find the domain and the range of the function $f(x) = 2 + \sqrt{(x-1)}$ and sketch the graph. **[10 Marks]**

END OF EXAMINATION PAPER