UNIVERSITI POLYTECH MALAYSIA
UPTM

FINAL EXAMINATION

BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) IN CYBER SECURITY
BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) IN COMPUTER APPLICATION DEVELOPMENT
BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) IN BUSINESS COMPUTING

COURSE	:	**DISCRETE MATHEMATICS/ DISCRETE STRUCTURE**
COURSE CODE	:	**MAT2123/ MAT2093**
DURATION	:	**3 HOURS**

INSTRUCTIONS TO CANDIDATES:

1. This question paper consists of **SIX (6)** questions.
2. Answer ALL questions in the Answer Booklet provided.
3. Please check to make sure that this examination pack consists of:
   i. The Question Paper
   ii. An Answer Booklet
   iii. Appendix 1(1) and Appendix 1(2)
4. Do not bring any material into the examination hall. Electronic calculator is allowed.
5. Please write your answer using permanent ink.

MYKAD/ PASSPORT NO : _____

ID. NO. : _____

LECTURER : _____

SECTION : _____

DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO

This question paper consists of 8 printed pages including the front page

QUESTION 1

a. Given the universal set $\xi = \{x | x \in \mathbb{Z}^+,\ x\ is\ even, x \leq 20\}$ with subsets:

$A = \{2,6,10,14,18\}$

$B = \{x | x \in \xi,\ x \leq 12\}$

$C = \{4,10,12,16,18\}$

i. List all the elements in ξ and B.

(2 marks)

ii. Find $|A \backslash ((A \cap B) \cup C)'|$

(5 marks)

b. A lecturer surveys a class of 71 students to study their use of AI tools when doing assignments. The results show:

42 students use ChatGPT (C)
38 students use Grammarly (G)
36 students use QuillBot (Q)
20 students use both ChatGPT and Grammarly
18 students use both ChatGPT and QuillBot
23 students use both Grammarly and QuillBot
67 students use at least one of the three AI tools

i. How many students use all three AI tools?

(3 marks)

ii. Draw a Venn diagram to illustrate the data.

(4 marks)

iii. How many students use ChatGPT only?

(1 mark)

(Total: 15 marks)

QUESTION 2

a. A software company wants to form a mobile app development team from a pool of experts consisting of 9 frontend developers, 8 backend developers, 5 UI/UX designers, and 6 QA testers. The team must include 3 frontend developers, 3 backend developers, 2 UI/UX designers, and 2 QA testers.

How many different ways can the team be formed?

(3 marks)

b. A university develops a student AI-access system using the digits 0, 1, 2, 3, 5, 6, 8 and 9 (repetition is allowed):

i. How many four-digit passcodes can be formed?

(2 marks)

ii. How many five-digit passcodes greater than 50,000 can be formed?

(3 marks)

iii. From part (ii), how many of these numbers are odd?

(4 marks)

c. Find the number of different arrangements that can be formed using all the letters in the word "PROGRAMMING".

(3 marks)

(Total: 15 marks)

QUESTION 3

a. Construct a truth table to show the following statement is tautology, contingency or contradiction.

$$[(p \vee r) \rightarrow q] \leftrightarrow (\neg q \wedge r)$$

(5 marks)

b. Given the following argument:

If the web application is input-validated, then SQL injections are prevented.
If SQL injections are prevented, then the database integrity is maintained.
If the database integrity is maintained, then system availability improves.
The web application is input-validated.

i. Write the primary propositions using variables p, q, r and s.

(2 marks)

ii. List all the hypotheses.

(4 marks)

iii. By using rules of inference, determine the relevant conclusion of the argument.

(4 marks)

c. Use algebraic law to simplify the following compound proposition:

$$\neg(p \rightarrow q) \vee (\neg p \wedge \neg q)$$

(5 marks)

(Total: 20 marks)

QUESTION 4

a. Given the function $f: \mathbb{Z} \to \mathbb{Z}$ such that $f(x) = 3x + 1$

i. Sketch the graph of $f(x)$.

(3 marks)

ii. State the domain and range of $f(x)$.

(2 marks)

iii. Determine whether $f(x)$ is one-to-one. Give a reason for your answer.

(2 marks)

iv. Determine whether $f(x)$ is onto. Give a reason for your answer.

(2 marks)

b. Given that $\mathcal{R}$ is a relation on a set $A = \{1,2,4,5,7\}$ and $\mathcal{R} = \{(x,y) | \, xRy \leftrightarrow x \times y \; is \; even\}$.

i. List all elements of $\mathcal{R}$.

(4 marks)

ii. Determine whether R is an equivalent relation or a partial order.

(2 marks)

(Total: 15 marks)

QUESTION 5

a. Given the following expression:

$$\frac{3x-y^2}{8m+5}$$

i. Draw a full binary tree for the above expression.

(4 marks)

ii. Determine the root of the tree.

(2 marks)

iii. State the sibling of 5 and y.

(2 marks)

iv. State the height of the tree.

(2 marks)

b. Consider the graph as shown in Figure 1.

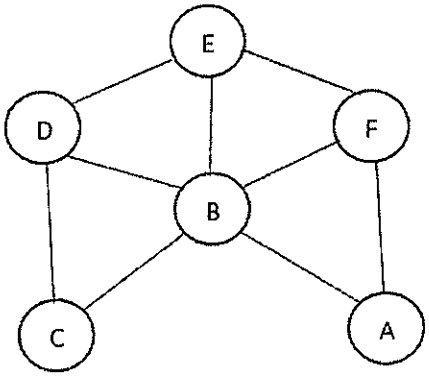

Figure 1

i. Find an Euler path, if possible. If it does not exist, give reason(s).

(3 marks)

ii. Find a Hamiltonian path and circuit, if possible. If it does not exist, give reason(s).

(3 marks)

c. A Huffman code is given in Figure 2.

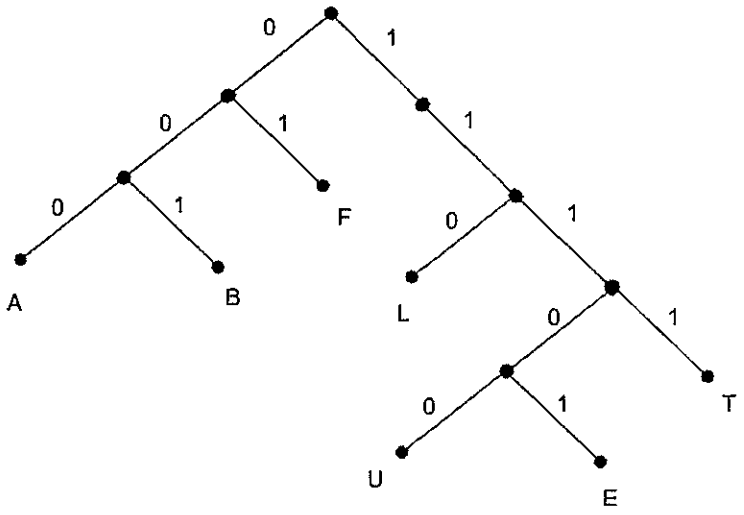

Figure 2

i. Decode the string: 111100000111011101.

(2 marks)

ii. Encode the word: FAULT.

(2 marks)

(Total: 20 marks)

QUESTION 6

a. Find the first five terms of the sequence defined by the following recurrence relation and initial condition.

$$a_1 = 4$$
$$a_n = 2a_{n-1} - 3 \ ; n \geq 2$$

(4 marks)

b. Apply the Mathematical Induction to show that the given statement is true for all $n \geq Z^+$.

$$P(n): 1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$$

(11 marks)

(Total: 15 marks)

(TOTAL: 100 MARKS)

END OF QUESTION PAPER

APPENDIX 1(1)

Rules of Inference

1. *Modus Ponens*: $\dfrac{P \quad P \to Q}{Q}$

2. *Modus Tollens:* $\dfrac{\neg Q \quad P \to Q}{\neg P}$

3. Hypothetical Syllogism: $\dfrac{P \to Q \quad Q \to R}{P \to R}$

APPENDIX 1(2)

Algebraic Laws for Propositional

1.	Double Negation	:	$\neg\neg P \Leftrightarrow P$
2.	Identity	:	$P \wedge T \Leftrightarrow P$ $P \vee F \Leftrightarrow P$
3.	Domination	:	$p \vee T \Leftrightarrow T$ $p \wedge F \Leftrightarrow F$
4.	Idempotent	:	$p \vee p \Leftrightarrow p$ $p \wedge p \Leftrightarrow p$
5.	Commutative	:	$p \vee q \Leftrightarrow q \vee p$ $p \wedge q \Leftrightarrow q \wedge p$ $p \leftrightarrow q \Leftrightarrow q \leftrightarrow p$
6.	Associative	:	$(p \vee q) \vee r \Leftrightarrow p \vee (q \vee r)$ $(p \wedge q) \wedge r \Leftrightarrow p \wedge (q \wedge r)$
7.	Distributive	:	$p \vee (q \wedge r) \Leftrightarrow (p \vee q) \wedge (p \vee r)$ $p \wedge (q \vee r) \Leftrightarrow (p \wedge q) \vee (p \wedge r)$
8.	De Morgan's	:	$\neg(p \wedge q) \Leftrightarrow \neg p \vee \neg q$ $\neg(p \vee q) \Leftrightarrow \neg p \wedge \neg q$
9.	Inverse	:	$p \vee \neg p \Leftrightarrow T$ $p \wedge \neg p \Leftrightarrow F$
10.	Implication	:	$p \rightarrow q \Leftrightarrow \neg p \vee q$
11.	Contrapositive	:	$p \rightarrow q \Leftrightarrow \neg q \rightarrow \neg p$
12.	Subtraction	:	$p \setminus q \Leftrightarrow p \wedge \neg q$