University of Vavuniya

First Examination in Information Technology - 2019

First Semester - December 2020/January 2021

Held on October/November 2021

IT1122 Foundation of Mathematics

Online Examination

Question-Set 1 of 2

- Time Allowed : **30 Minutes**
- This is a closed-book examination.

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1. (a) Suppose A is the set of distinct letters in the word **"MATHEMATICS"**, B is the set of distinct letters in the word **"STATISTICS"**, C is the set of distinct letters in the word **"CHEMIST"**, and D is the set of distinct letters in the word **"TACTICS"**. The universe **U** is the set of English alphabet. Find each of the following:

   i. $A \cap B$

   ii. $A \cup (B \cap C)$

   iii. $B \cap (C \cup D)$

   iv. $(A \cup B \cup C \cup D)^c$ [20%]

   (b) Let $A = \{x, y\}$, $B = \{1, 2, 3\}$, and $C = \{a, b\}$. Find each of the following:

   i. $P(B)$

   ii. $A \times B \times C$ [15%]

[This question is continued on the next page]

(c) Let $f : \mathbb{R} \longrightarrow \mathbb{R}$ be defined by $f(x) = 3x + 1$. Determine whether the function $f(x)$ invertible. If so, find the inverse function f^{-1}. [20%]

(d) Let $f : \mathbb{R} \longrightarrow \mathbb{R}$ and $g : \mathbb{R} \longrightarrow \mathbb{R}$ be defined by $f(x) = 4x - 3$ and $g(x) = x^2 + 2$ for all x$\in \mathbb{R}$. Find $g \circ f$ and $f \circ g$. [20%]

(e) Let R be the relation on the set A = {1, 2, 3, 4, 5}. The relation R: A $\longrightarrow$ A, R = {(1, 1), (2, 2), (2, 3), (3, 2), (4, 2), (4, 4)}. Determine whether R is ***reflexive***, ***symmetric*** or ***transitive***. [15%]

(f) Find R^2 if R is a relation from {0, 1, 2, 3} to {1, 2, 3} where R = {(1, 1), (2, 4), (3, 4), (4, 2)}. [10%]

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Question-Set 2 of 2

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2. (a) State the *converse, contrapositive, and inverse* of the following conditional statement.

"If the square of an integer m is even, then the integer m must be even." [15%]

(b) Show that $\neg(p \vee (\neg p \wedge q))$ and $\neg p \wedge \neg q$ are logically equivalent using Boolean algebra identities. [15%]

(c) Prove each of the following using truth table:

i. $(p \longrightarrow q) \longleftrightarrow (\sim p \vee q)$ is a tautology.

ii. $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$ [30%]

[This question is continued on the next page]

(d) Express each of the following statements in a symbolic form by defining propositions:

i. "I am innocent and i have an alibi."

ii. "If the label does not read 'POISON' then i can drink it."

iii. "You can take the flight if and only if you buy a ticket."

iv. "You cannot ride the roller coaster if you are under 4 feet tall unless you are older than 16 years old."

[20%]

(e) Express each of the following statements in symbolic form using quantifiers, predicates, and logical connectives:

i. "All hummingbirds are richly colored."

ii. "No large bird live on honey."

iii. "There is an adult in your neighbourhood who knows kung-fu but not karate."

iv. "Not everybody is your friend or someone is not perfect." [20%]

3. (a) Using properties of Boolean algebra, simplify each of the following functions:

i. $(A + B)(A + C)$

ii. $\overline{AB}(\overline{A} + B)(\overline{B} + B)$ [20%]

(b) Simplify each of the following Boolean expressions using Karnaugh map:

i. $F(A, B, C) = \bar{A}\bar{B}\bar{C} + \bar{A}BC + \bar{A}B\bar{C} + AB\bar{C} + A\bar{B}C + ABC$

ii. $F(A, B, C) = \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$ [20%]

(c) Draw a reduced circuit for the simplified Boolean expressions obtained in part (b). [20%]

(d) Define a Finite State Machine. [10%]

[This question is continued on the next page]

(e) Consider the finite-state machine M defined by the state table shown in Table 1.

Table 1

State	Input 0	Input 1
S_0	S_1	S_2
S_1	S_1	S_2
S_2	S_3	S_4
S_3	S_1	S_2
S_4	S_3	S_4

Draw the state diagram for the finite state machine M. [30%]