INTI International University & Colleges

FINAL
Examination Paper

(COVER PAGE)

Session	:	**APRIL 2017**
Programme	:	Diploma In Information And Communication Technology (DICTN)
Course	:	**MAT1104: Discrete Mathematics**
Date of Examination	:	05 August, 2017 (Saturday)
Time	:	11:00am – 1:00pm Reading Time : Nil
Duration	:	2 Hours

Special Instructions :

Answer any **FOUR (4)** structured-type questions.

Materials permitted :
Non-Programmable Calculator

Materials provided :
Nil

Examiner(s)	:	**S.M. Elizabethrani Allappan** and Foong Jin Yuan
Moderator	:	Cheng Siak Peng

*This paper consists of **8** printed pages, including the cover page*

DIPLOMA IN INFORMATION AND COMMUNICATION TECHNOLOGY PROGRAMME (DICTN)
MAT 1104: DISCRETE MATHEMATICS
FINAL EXAMINATION: APRIL 2017 SESSION

Instruction: This question paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) Rewrite each of the terms of the following expression in binary and simplify the expression. Convert the final answer to octal and hexadecimal.

$$75.625_{10} + 100111.001_2 - 43.2_8 + 3C.4_{16}$$

(8 marks)

(b) Find the 16-bit computer representations of the following integers using sign modulus method.

(i) 1153 (3 marks)

(ii) -425 (3 marks)

(c) Find the 24-bit computer representations of the decimal number "– 0.828125", assuming 8 bits are used for the characteristic, and the exponent bias is $2^7 - 1$.

(7 marks)

(d) Perform the following calculation in BCD arithmetic:

$$2746 + 3534$$

(4 marks)

Question 2

(a) A Boolean expression is given as $F = \bar{x}y\bar{z} + \bar{x}yz$. Simplify this circuit using Boolean algebra. Draw the logic circuits before and after simplification.

(7 marks)

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(b) Find the Boolean expression for output G from the given table below. Then minimize it by using Karnaugh map. (6 marks)

x	y	z	G
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

(c) For the logic circuit in Figure Q2(c), determine the Boolean expression.

(4 marks)

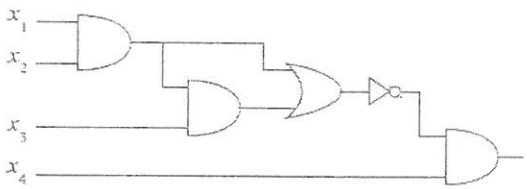

Figure Q 2(c)

(d) By using Boolean algebra and De Morgan's laws show that

$$\overline{A\bar{B}.(A+C)} + \bar{A}\,\bar{B}.\overline{(A+\bar{B}+\bar{C})} = \bar{A}+B$$

(8 marks)

Question 3

(a) Show that $[\neg p \vee (p \wedge q)] \wedge \neg q \Leftrightarrow \neg(p \vee q)$ by using logical equivalence identities. (7 marks)

(b) Let $p = F,\ q = T,\ r = T$. Find the truth value of the following Boolean expressions:

(i) $p \rightarrow (\neg r \leftrightarrow q \wedge p)$ (3 marks)

(ii) $\neg p \vee r \rightarrow q \wedge \neg r$ (3 marks)

(c) Let p be "Sam is rich" and q be "Sam is happy". Write each of the following in symbolic form.

(i) Sam is poor and happy. (1 mark)

(ii) Sam is neither poor nor happy. (1 mark)

(iii) Sam is rich if and only if he is happy. (2 marks)

(d) Prove that $a + ar + ar^2 + \cdots\cdots + ar^n = \frac{ar^{n+1}-a}{r-1}$ (when r≠1) for all nonnegative integer n by using Mathematical Induction method. (8 marks)

Question 4

(a) Let R_1 and R_2 be the relations on {1, 2, 3, 4} given by

$$R_1 = \{(1,1),(1,2),(3,4),(4,2)\}$$
$$R_2 = \{(1,1),(2,1),(2,2),(3,1),(4,4)\}.$$

(i) Represent each of the relations R_1 and R_2 in a form of zero-one matrix, labeled as M_{R_1} and M_{R_2}. (4 marks)

(ii) List the elements of $R_1 - R_2$, $R_2 - R_1$, $R_1 \cap R_2$ and $R_1 \cup R_2$. (8 marks)

(b) Simplify the following equation using Boolean algebra and De Morgan's theorems. Draw the logic circuit for the simplified equation.

$$X = \overline{(\overline{A}+C)(B+\overline{C})}$$ (2 marks)

(c) Draw a binary search tree for the given set of names in alphabetical order.
{MAHES, NORAH, DIWAGAR, DESMOND, REUBEN, SAMUEL, LEONARD}
(5 marks)

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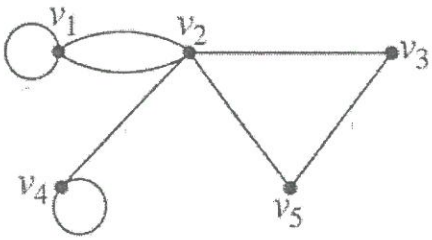
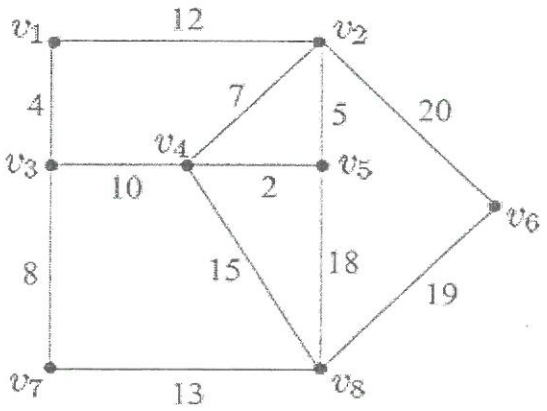
(d) Write down the degree of each vertex in the following graph. Hence verify the Handshaking Theorem.



(6 marks)

Question 5

(a) Use the Dijkstra's algorithm, find the shortest path between $v1$ to $v6$ in the following diagram.



(4 marks)

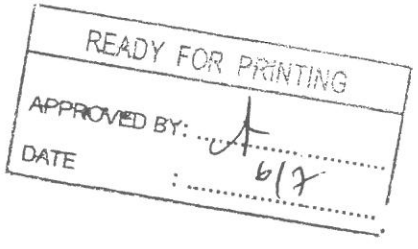
(b) Let the universal set
$\xi = \{2,3,5,7,11,13,17,19,23\}$,
$A = \{2,7,17\}$,
$B = \{2,3,13,23\}$ and
$C = \{2,11,17,19,23\}$

Find the elements of each of the set.

(i) $A \cap B$ (1 mark)

(ii) $C - B$ (1 mark)

(iii) $\overline{A \cap B \cap C}$ (2 marks)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(c) Construct a truth table for the following expression. Indicate whether the expression is a tautology, a contradiction, or contingent.

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

(6 marks)

(d) Consider the (2, 6) encoding function e,

$e(00) = 001101$
$e(01) = 011011$
$e(10) = 110011$
$e(11) = 111101$

(i) Find the minimum distance of the encoding function.

(4 marks)

(ii) How many errors will the encoding function detect? (2 marks)

(e) Find $f(2)$ and $f(3)$ if f is defined recursively by

$$f(k+1) = \frac{f(k-1)}{f(k)}.$$

for all integers $k \geq 1$, where $f(0) = -1$ and $f(1) = 2$. (4 marks)

~The End~

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