INTI International University & Colleges

FINAL
Examination Paper

(COVER PAGE)

Session	:	**APRIL 2019**
Programme	:	Diploma In Information And Communication Technology (DICTN) Diploma in Information Technology (DITN)
Course	:	**MAT1104: Discrete Mathematics**
Date of Examination	:	31 July 2019, (Wednesday)
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 Dr Ch'ng Pei Cheng
Moderator	:	Mr. Cheng Siak Peng

This paper consists of ***5*** *printed pages, including the cover page*

DIPLOMA IN INFORMATION AND COMMUNICATION TECHNOLOGY PROGRAMME (DICTN)
DIPLOMA IN INFORMATION TECHNOLOGY PROGRAMME (DITN)
MAT1104: DISCRETE MATHEMATICS
FINAL EXAMINATION: APRIL 2019 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) Convert the following accordingly (show all your working clearly):

(i) 01101011 binary to denary (2 marks)

(ii) 213.6875 denary to octal (2 marks)

(iii) AE4.2B hexadecimal to octal (2 marks)

(b) Show how 37 - 55 would be evaluated in 8-bit register using two's complement method. Justify your answer. (5 marks)

(c) Rewrite each of the terms of the expression

$$FA6.3_{16} + 0.125_{10} - 36.1_{8}$$

in binary, and simplify the expression. Convert your final answer to hexadecimal. (6 marks)

(d) Find the 24-bit computer representations of the decimal number "–32.0625", assuming 8 bits are used for the characteristic, and the exponent bias is $2^7 - 1$. (5 marks)

(e) Perform the following calculation in BCD arithmetic:

2724 + 5348 (3 marks)

Question 2

(a) Show that $[\neg p \vee (p \wedge q)] \wedge \neg q \Leftrightarrow \neg(p \vee q)$ by using logical equivalence identities. (5 marks)

(b) Prove the Distributive law $x + yz = (x + y)(x + z)$ using truth-table. (5 marks)

(c) Find the sum-of-products expansion of the following Boolean function:
$f(x, y, z) = x(y + \bar{z}) + \bar{y}z$ (4 marks)

(d) Use a Karnaugh map to find the minimal sum for the following expression:
$F = \bar{a}bcd + \bar{a}b\bar{c}d + a\bar{b}c\bar{d} + abc\bar{d} + \bar{a}\bar{b}\bar{c}\bar{d} + \bar{a}\bar{b}c\bar{d} + \bar{a}bc\bar{d}$ (6 marks)

(e) Draw the logic circuit with inputs x, y, z and output F(x,y,z) which corresponds to the following Boolean expression:

$$F = x\bar{y}z + xy\bar{z} + x\bar{y}\bar{z}$$ (5 marks)

Question 3

(a) Determine the following sentences are propositions or not.

(i) 20-14=7 (1 mark)

(ii) Singapore is in Europe. (1 mark)

(iii) Ice floats in water. (1 mark)

(b) Prove that $\neg(p \vee q) \vee (\neg p \wedge q) \equiv \neg p$ using the laws of logical equivalences. (4 marks)

(c) Rewrite the following statements without using the conditional:

(i) If it is hot, he swims. (2 marks)

(ii) He swims if and only if the weather is hot. (2 marks)

(d) Show that $[(p \rightarrow q) \wedge \neg q] \rightarrow \neg p$ is a tautology. (8 marks)

(e) Prove that

$$1^2 + 3^2 + 5^2 + \cdots + (2n + 1)^2 = (n + 1)(2n + 1)(2n + 3)/3$$

whenever n is a nonnegative integer by using Mathematical Induction method.

(6 marks)

Question 4

(a) Let $A = \{1, 2, 3, 4\}$, $B = \{1, 3, 6\}$ and $C=\{x, y\}$. Find

(i) $|A|$ (cardinality of A) and $|B|$ (cardinality of B) (2 marks)

(ii) $A \cup B$ (1 mark)

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

(iv) $A - B$ (1 mark)

(v) $A \times C$ (2 marks)

(b) Let $f(x) = x^3 + 1$ and $g(x) = x + 2$. Find

(i) $f \circ g$ (2 marks)

(ii) $g \circ f$ (3 marks)

(iii) $f^{-1}(x)$ (3 marks)

(c) 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 $R_1 - R_2$, $R_2 - R_1$ and $R_1 \cap R_2$.

(6 marks)

Question 5

(a) Consider the following encoding function *e:*

e(0,0)=00000
e(1,0)=00111
e(0,1)=01110
e(1,1)=11111

(i) Find the minimum distance of *e*. (4 marks)

(ii) How many errors can it detect? (1 mark)

(b) Encrypt the message MATH using the RSA system with $n = 43 \cdot 59$ and $e = 5$. (9 marks)

(c) Find the length of a shortest path between *a* and *z* in the given weighted graph in Figure Q5(c). (5 marks)

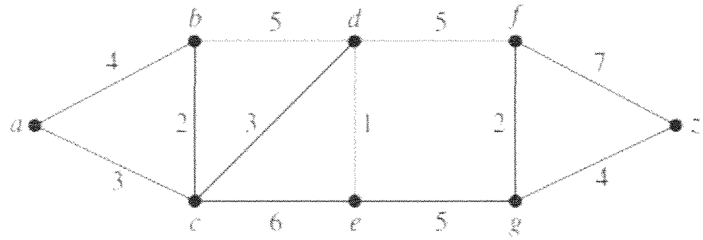

Figure Q5 (c)

(d) An undirected graph is shown in Figure Q 5(d). Find:

(i) The number of vertices (1 mark)

(ii) The number of edges (1 mark)

(iii) Degree of each vertices. Hence, verify handshaking theorem. (4 marks)

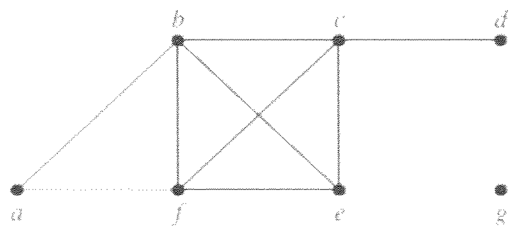

Figure Q5 (d)

~ **The End** ~