



FINAL ALTERNATIVE ASSESSMENT
Examination Paper

(COVER PAGE)

Session : January 2021

Programme : Diploma In Information Technology (DITN)
Diploma In Computer Science (DCS)

Course : **MAT1104: Discrete Mathematics**

Date of Examination : March 10, 2021 (Wednesday)

Time : 4.00 pm – 6.30 pm Reading Time : Nil

Duration : 2 Hours 30 Minutes

Note: 30 minutes is added into the duration of the examination to factor in any connectivity matters and for you to scan and upload your scripts.

Special Instructions :

Answer **ALL FOUR (4)** questions.

Materials permitted : Non-Programmable Calculator

Materials provided : Nil

Examiner(s) : **S.M. Elizabethrani Allappan**, Angeline Tan and Nurulanati Othman

Moderator : Ryan Tee Ah Ann

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

DIPLOMA IN INFORMATION TECHNOLOGY PROGRAMME (DITN)
 DIPLOMA IN COMPUTER SCIENCE PROGRAMME (DCS)
 MAT 1104: DISCRETE MATHEMATICS
 FINAL ALTERNATIVE ASSESSMENT: JANUARY 2021 SESSION

Instructions: This question paper consists of **FOUR (4)** questions. Answer **ALL** questions.

Question 1

- (a) Rewrite each of the terms of the following expressions in binary and simplify the expression. Convert the final answer into hexadecimal.

$$75.625_{10} - 100111.001_2 + 43.2_8 - 3C.4_{16} \quad (7 \text{ marks})$$

- (b) Find the 16-bit computer representations of the following integers:

(i) 1153 (2 marks)

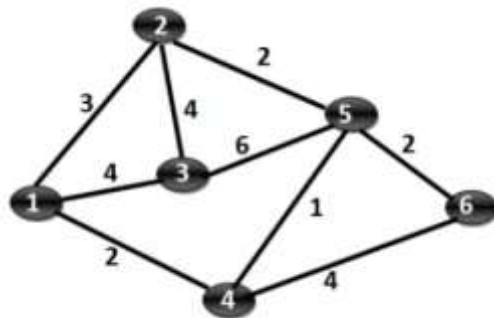
(ii) -425 (2 marks)

- (c) Find the 16-bit computer representations of the decimal number “- 0.253125”, assuming 8 bits are used for the characteristic, and the exponent bias is $2^7 - 1$. (5 marks)

- (d) Perform the following calculation in BCD arithmetic:

$$2746 + 3534 \quad (5 \text{ marks})$$

- (e) Use the Dijkstra’s algorithm to find the shortest path between the nodes 1 and 6 in the following weighted graph.



(4 marks)

(Total: 25 marks)

Question 2

- (a) Given a Boolean expression $F = \overline{(\bar{x} + z)(y + \bar{z})}$.
- (i) Simplify F using Boolean algebra and De Morgan's law. (3 marks)
 - (ii) Draw a logic circuit for the original expression F. (3 marks)
 - (iii) Draw the logic circuit for the simplified expression of F. (3 marks)
- (b) Find the Boolean expression for output G form the given table below. Then minimize it by using Karnaugh map.

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

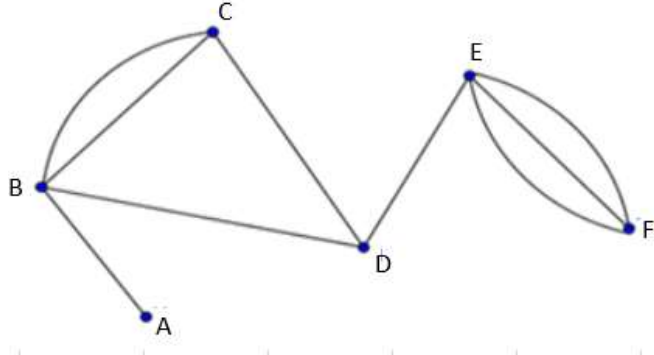
- (c) Find the sum-of-products expansion of the following Boolean function: (7 marks)
- $$f(a, b, c) = a(b + \bar{c}) + a\bar{b} + \bar{b}c.$$
- (3 marks)
- (d) By using Boolean algebra and De Morgan's laws show that

$$\overline{A\bar{B} \cdot (A + C)} + \overline{A\bar{B} \cdot A + \bar{B} + \bar{C}} = \bar{A} + B \quad (6 \text{ marks})$$

(Total: 25 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) Write down the degree of each vertex in the following graph. Hence, verify the Handshaking Theorem.



(4 marks)

- (c) Given $p=T$, $q=T$ and $r=F$, find the truth value of the proposition given below.

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

(5 marks)

- (d) Prove that $a + ar + ar^2 + \dots + ar^n = \frac{ar^{n+1} - a}{r - 1}$ (when $r \neq 1$) for all nonnegative integer n by using Mathematical Induction method. (7 marks)
- (e) Store decimal 0.546875 in 10 bits word using sign modulus format. (Show your working clearly) (2 marks)

(Total: 25 marks)

Question 4

- (a) In a certain community center, there are all-together 180 youths. Of these, 86 take up dancing, 84 sewing and 96 swimming, 32 of them take up dancing and sewing, 34 sewing and swimming and 44 swimming and dancing.

- (i) If each takes up at least one activity and x youths take up all three activities, express these facts in a Venn diagram by showing clearly the number in each separate region, in terms of x .

(4 marks)

(ii) Form an equation satisfied by x . Hence, find the value of x . (2 marks)

(iii) Find the number of youths who take up swimming and dancing but not sewing. (2 marks)

(b) Let set $A = \{2, 5, 7, 11\}$ and set $B = \{8, 15, 17, 121\}$, and a relation R from set A to set B be defined as $(a, b) \in R$ if a divides b .

(i) List the elements in set R . (2 marks)

(ii) List also the elements of the inverse of set R , namely R^{-1} . (1 mark)

(c) Encrypt the message LOAD using the RSA system with $n = 53 \cdot 61$ and $e = 17$. (9 marks)

(d) Consider the following (2,5) encoding function e :

$e(00) = 00000$

$e(01) = 00111$

$e(10) = 01110$

$e(11) = 11111$

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

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

(Total: 25 marks)

-The End-