



FINAL
Examination Paper

(COVER PAGE)

Session : AUGUST 2017

Programme : Diploma In Information And Communication Technology (DICTN)

Course : MAT1104: Discrete Mathematics

Date of Examination : 7 December, 2017 (Thursday)

Time : 8:00 am – 10:00 am 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) : Nhivashni

Moderator : Mr. Cheng Siak Peng

This paper consists of 7 printed pages, including the cover page

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

Instruction: This 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 (present your working clearly).

- | | |
|---|-----------|
| (i) 1101001.01101 binary to octal and hexadecimal | (4 marks) |
| (ii) F32.A hexadecimal to decimal | (3 marks) |
| (iii) 568329 decimal to hexadecimal | (3 marks) |

(b) Find the 32-bit computer representation of 0.11001101×2^5 , assuming 8 bits are used for the characteristic and the exponent bias is $2^7 - 1$. (6 marks)

(c) Find the two's complement of -27 using 8-bit representation. (4 marks)

(d) Find the value of $215+8482$ using Binary Coded Decimal (BCD) arithmetic. (5 marks)

Question 2

(a) Derive the Boolean expression for the following circuit given that the inputs are $A = 0, B = 0$ and $C = 1$. (4 marks)

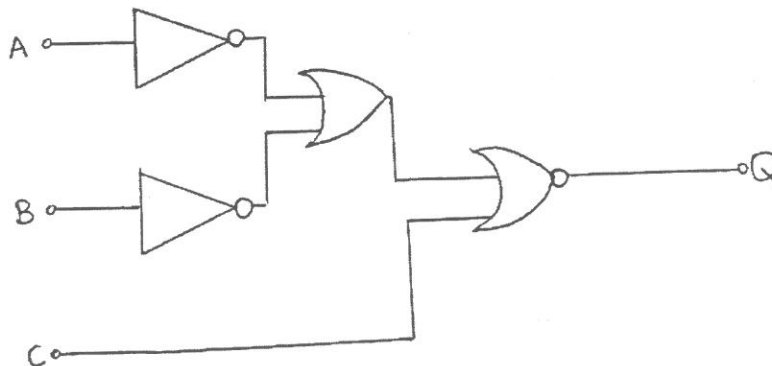


Figure 1

(b) Consider this logic circuit expression: $\overline{A \cdot B} + \overline{A + B + \overline{C}}$
 Draw a logic circuit for the circuit above without simplifying it. (4 marks)

(c) (i) Simplify the expression $A + A(B + C) + B(B + C)$ using De Morgan's Law and Boolean Rules. (4 marks)

(ii) Draw a logic circuit for the simplified expression in (i). (1 mark)

(d) Find the sum of products expansion of the following Boolean function:

$$f(a, b, c) = \overline{((a + \overline{b}) + c)} \quad (3 \text{ marks})$$

(e) Suppose there are three connecting wires to a system. The system will not work if all three wires are connected or if none of them are connected. ('1' denotes connection and '0' denotes that the wires are not connected.)

(i) Based on the truth table below, fill the output column with '0' if the system will not work and '1' if the system will work. (2 marks)

| Input (Wires) | | | Output(System Functioning) |
|---------------|---|---|----------------------------|
| A | B | C | |
| 0 | 0 | 0 | |
| 0 | 0 | 1 | |
| 0 | 1 | 0 | |
| 1 | 0 | 0 | |
| 1 | 0 | 1 | |
| 1 | 1 | 0 | |
| 0 | 1 | 1 | |
| 1 | 1 | 1 | |

(ii) Write an appropriate Boolean expression for the output 'system works' from the truth table. (2 marks)

(iii) Simplify the expression using a Karnaugh map. (5 marks)

Question 3

(a) A survey has been conducted on 600 students on their hobbies.

130 students like to play sports only

160 students like to watch television only

175 students like to read books only

90 students like to play sports and watch television

100 students like to watch television and read books

105 students like to read books and play sports

80 students like all three activities

Draw a Venn Diagram to represent the above information.

(4 marks)

Hence find the number of students who prefer

- | | | |
|-------|--|----------|
| (i) | One hobby only | (1 mark) |
| (ii) | Sports and reading but not watching television | (1 mark) |
| (iii) | Any two hobbies | (1 mark) |
| (iv) | Watching television or playing sports | (1 mark) |

(b) Represent the following statements using logical connectivities:

- | | | |
|------|---|-----------|
| (i) | If it is raining then I will take an umbrella. | (2 marks) |
| (ii) | She will access the email if and only if there are work emails. | (2 marks) |

(c) Determine whether the following sentences are propositions and if so, write its negation

- | | | |
|------|-------------------------------|-----------|
| (i) | $y - x = 8$. | (2 marks) |
| (ii) | Durian is the king of fruits. | (2 marks) |

(d) Let p : Independence day is a holiday.

q : We do not work on Independence Day.

Show the conjunction, disjunction and conditional statement for p and q (write in sentence as well as symbol form).

(3 marks)

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

- | | | |
|------|---|-----------|
| (i) | $q \leftrightarrow (p \wedge \neg r)$ | (3 marks) |
| (ii) | $\neg p \vee r \rightarrow q \wedge \neg r$ | (3 marks) |

Question 4

(a) Answer the following tree questions.

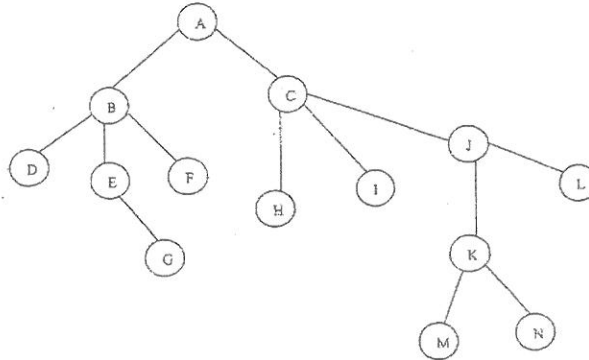


Figure 2

- (i) Find the parent of I (1 mark)
- (ii) Find the ancestors of G (1 mark)
- (iii) Find the children of C (1 mark)
- (iv) Find the descendants of J (1 mark)
- (v) Find the siblings of H (1 mark)
- (vi) Find all the leaves (2 marks)
- (vii) Draw the subtree rooted at J (2 marks)
- (viii) What is the height of this rooted tree (1 mark)

(b) Use the Dijkstra's algorithm to find the shortest path and its distance between the nodes A and G in the weighted graph in the figure below. (5 marks)

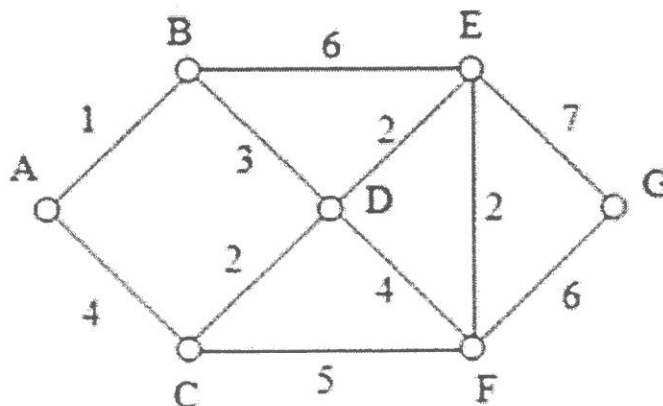


Figure 3

(c) Let $A = \{2,4,6,8\}$, $B = \{1,2,3,4,5,6\}$ and $C = \{3,5,7,9\}$ and the universal set is $U = \{1,2,3, \dots, 9\}$. Find

- (i) Cardinality of A and B, denoted as $|A|$ and $|B|$ (2 marks)
- (ii) $A \cup B$ and $B \cup C$ (2 marks)
- (iii) $A \cap C$ and $A \cap B$ (2 marks)
- (iv) $A - C$ and $B - C$ (2 marks)
- (v) $\overline{A \cap B}$ (2 marks)

Question 5

- (a) (i) List the relation for R in the digraph given below. (2 marks)

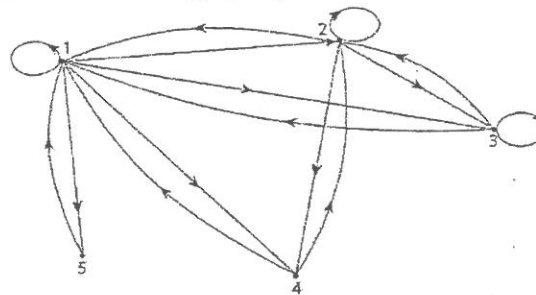


Figure 4

- (ii) Determine whether the relation is symmetric, anti-symmetric, and/or transitive? Give your reason. (6 marks)

(b) Consider the following (2,6) encoding function e :

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

- (i) Find the minimum distance of e . (4 marks)
- (ii) How many errors can e detect? (1 mark)

(c) Consider the following graph. Find

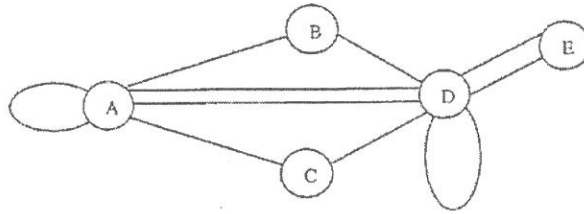


Figure 5

- | | | |
|-------|--|----------|
| (i) | Number of vertices | (1 mark) |
| (ii) | Number of edges | (1 mark) |
| (iii) | Degree of each vertex and verify the Handshaking Theorem | (3marks) |
| (iv) | The number of loops | (1 mark) |

(d) Draw the binary search tree for the given set of names in alphabetical order. (6 marks)
 { Ghajen , Calvin, Lee, Uma, Raymond, Afif, Bella }

~The End~

