DIPLOMA IN INFORMATION AND COMMUNICATION TECHNOLOGY PROGRAMME (DITN/DICT)
MAT1104: DISCRETE MATHEMATICS
FINAL EXAMINATION: JANUARY 2020 SESSION

Instruction: This paper consists of section A and B. Answer **ALL** questions in the answer booklet provided. All questions carry equal marks.

SECTION A: (50 marks)

Question 1

(a) Rewrite each of the terms of the expression

$$100100111.11_2 + 0.09375_{10} - 76.5_8$$

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

(b) If numbers are to be stored using 24 bit register in floating point format where 5 bits are allocated for the exponent in excess $2^{n-1}-1$ format, show how –55.828125 would be stored.

(5 marks)

(c) Show how 140 - 150 would be evaluated in 10-bit register using two's complement method. Justify your answer. (6 marks)

(d) Store decimal 0.546875 in 10 bits word using sign modulus format. (Show your working clearly) (3 marks)

(e) Use mathematical induction to prove that the following statement is true for all positives integers *k*.

$$\sum_{i=1}^{n}(2i-1)=n^2$$

(5 marks)

Question 2

(a) Determine each of the following sentences is proposition. If the sentence is a proposition, write its negation.

(i) There exist integers *x*, *y* such that $x + y = 9$. (2 marks)

(ii) Every prime number is even. (2 marks)

(b) Let p: You are absent.
q: You have a make up assignment to complete.

Show the conjunction, disjunction and conditional statement for p and q.
(3 marks)

(c) 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)

(d) A well known restaurant sells variety of chinese, indian and malay food. Of the 130 customers who visited the restaurant on a particular day,

75 ordered Chinese food,
62 ordered Indian food,
51 ordered Malay food,
21 ordered Chinese and Malay food,
23 ordered Chinese and Indian food,
27 ordered Indian and Malay food,

There were 10 customers who only had drinks on that day.

(i) Find the number of customer who ordered all the three types of food..
(2 marks)

(ii) Represent a Venn Diagram for the above information.
(3 marks)

(iii) How many customers ordered only 2 types of food?
(2 marks)

(e) In a beauty contest, three judges A, B and C register their votes as '0' or '1' through switches allocated to them. Contestants will be disqualified if two or more judges register '0' votes for them.Based on the truth table below, filled the output column with '0' for disqualified or '1' for qualified.

	Input		*Output*
A	**B**	**C**	**Z**
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

(i) Write an appropriate Boolean expression for the output 'disqualified' from the truth table. (2 marks)

(ii) Simplify the expression by using a Karnaugh map. (3 marks)

SECTION B (50 marks)

Question 1

(a) Let the function f, g be defined as follows:

$$f: R \to R, f(x) = 9x - 5$$
$$g: R \to R, g(x) = 6x + 1$$

Find

(i) $f \circ g$

(2 marks)

(ii) $g \circ f$

(2 marks)

(b) Given R = {(1, 2), (2, 1), (2, 2), (2, 4), (2, 5), (3, 1), (3, 5), (4, 5),(5, 5)}.

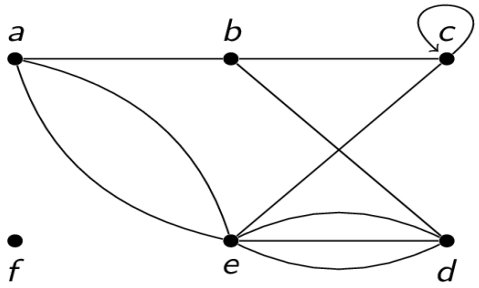
Draw a digraph that represents R. (4 marks)

Hence find R^{-1}. (1 mark)

(c) Prove using Boolean Algebra and De Morgan's Law that

$$\overline{A\overline{B}\cdot(A+C)}+\overline{A}B\cdot\overline{A+\overline{B}+\overline{C}}=\overline{A}+B$$ (4 marks)

(d) Consider the following graph. Find



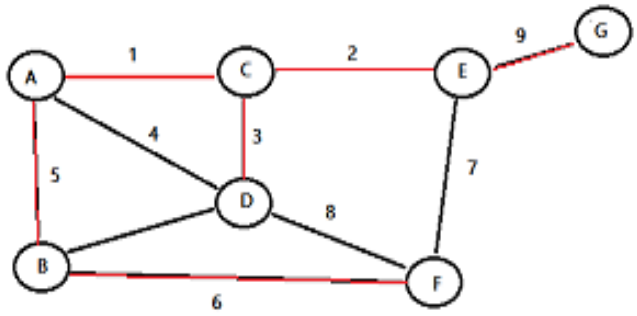
(i) the number of vertices. (1 mark)

(ii) the number of edges. (1 mark)

(iii) the degree of each vertex and verify the Handshaking Theorem. (4 marks)

(iv) the number of loops. (1 mark)

(e) Use the Dijkstra's algorithm to find the shortest path between the nodes ***A*** and *G* in the diagram shown below:



(5 marks)

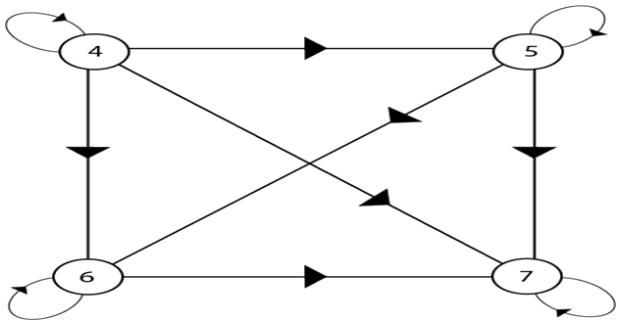
Question 2

(a) By expressing the decimal quantities 3245 and 578 in BCD, add them together and convert the BCD result to decimal. (5 marks)

(b) Let set $A = \{a, b, c\}$ and R is a relation on set A, where $R = \{(a, a), (b, b), (b, c), (c, c), (c, b)\}$. Determine if R is a reflexive, symmetric and antisymmetric relation on A.

(3 marks)

(c) (i) List the relation for R for the digraph given below. (2 marks)



(ii) Determine whether the relation is transitive? Give your reason.

(3 marks)

(d) Consider the (2, 8) encoding function e,

$e(00) = 00000000$
$e(01) = 10110100$
$e(10) = 01100010$
$e(11) = 11010111$

(i) Find the minimum distance of the encoding function. (3.5 marks)

(ii) How many errors will the encoding function detect? (1.5 marks)

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

(7 marks)

≈ The End ≈