UNIVERSITI TENAGA NASIONAL

College of Information Technology

BACHELOR OF COMPUTER SCIENCE (HONS)
BACHELOR OF INFORMATION TECHNOLOGY (HONS)

FINAL EXAMINATION
SEMESTER I 2015/2016

DISCRETE STRUCTURES
(CSNB143)

September 2015

Time allowed: 3 hours + 10 minutes for reading

INSTRUCTIONS TO CANDIDATES.

1. The total marks for this exam is 100 marks.
2. There are **TWO (2) SECTIONS** in this paper: Section A and Section B
3. Answer **ALL** questions in the answer booklet provided.

DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE INSTRUCTED TO DO SO.

THIS QUESTION PAPER CONSISTS OF 7 PRINTED PAGES INCLUDING THIS PAGE.

SECTION A: SHORT ANSWERS (5 QUESTIONS, 30 MARKS)

<u>Instruction</u>: Answer ALL the questions. You need to show all the required working steps to show how you arrive at the solutions.

Question 1

Given a Venn Diagram as in Figure 1, consist of **THREE (3)** disjoint sets X, Y and Z. The different areas in the Venn Diagram are labelled with A, B, C, D, E, F, G and H. Answer the following questions by **LISTING** the correct areas.

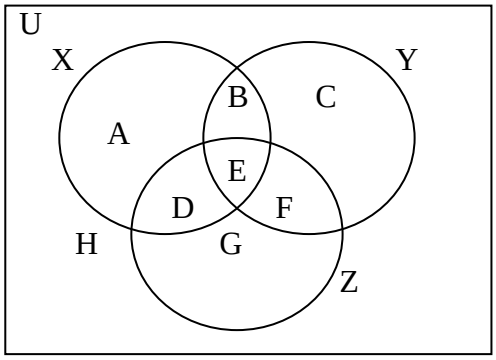


Figure 1

The area for

(a) $X \cap Y$

(b) $X - Z$

(c) $(A \cap C)'$

(d) Y'

(e) $U - (X \cap Y)$

[5 marks]

Question 2

Consider a matrix below and answer either YES or NO:

$$M_R = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 \end{pmatrix}$$

Is this matrix a

(a) square matrix?

(b) diagonal matrix?

(c) identity matrix?

(d) boolean matrix?

(e) zero matrix?

[5 marks]

Question 3

A student was given 15 questions in a test. Find the number of choices if he must answer 10 questions:

(a) from 15 questions.

[1 mark]

(b) where the first **FIVE (5)** questions are compulsory.

[2 marks]

(c) where the first **FIVE (5)** questions are from Section A (question 1 to 8), and another **FIVE (5)** questions are from Section B (question 9 to 15).

[2 marks]

(d) where at least **SIX (6)** question are from Section A (question 1 to 8).

[4 marks]

Question 4

If there are 30 people in one room, by using Pigeonhole Principle, show that at least **FIVE (5)** people were born in the same day.

[3 marks]

Question 5

Determine whether statements **~(p ∧ q)** and **~p ∨ ~q** are logically equivalent.

[8 marks]

SECTION B: STRUCTURAL QUESTIONS (6 QUESTIONS, 70 MARKS)

<u>Instruction</u>: Answer ALL the questions. You need to show all the required working steps to show how you arrive at the solutions.

Question 1

Using mathematical induction, prove that for $\forall n \geq 1$,

$2(3^0) + 2(3^1) + 2(3^2) + \ldots + 2(3^{n-1}) = 3^n - 1;\ n \geq 1$

[10 marks]

Question 2

Given set A = {a, b, c, d} and R is given in a diagraph as in Figure 2.

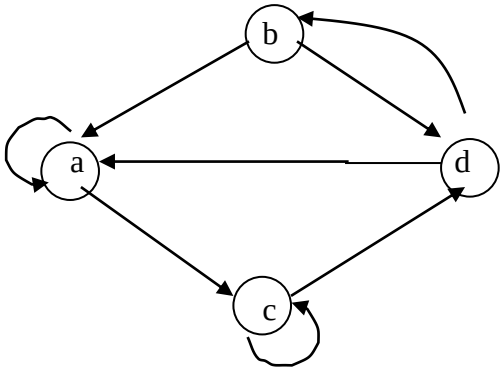


Figure 2

(a) Change the diagraph of R into:

(i) matrix, M_R

(ii) set, R

[2 marks]

(b) Find the in-degree and out-degree for each element.

[2 marks]

(c) Find the diagraph of R^{-1} and R complement.

[4 marks]

(d) Determine whether R is an equivalence relation or not. Give your reason.

[3 marks]

Question 3

Given a matrix M_R below, find the transitive closure by using Warshall Algorithm.

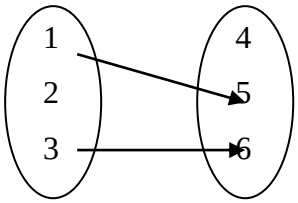
$$M_R = \begin{pmatrix} 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{pmatrix}$$

[9 marks]

Question 4

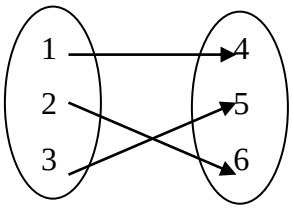
(a) Let A = {1, 2, 3} and B = {4, 5, 6}. Determine whether the relations R_1, R_2 and R_3 below is a function or not. Give your reason.

(i) R_1



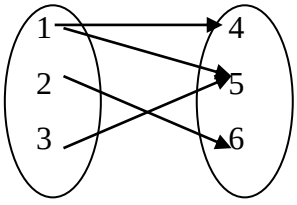
[2 marks]

(ii) R_2



[2 marks]

(iii) R_3



[2 marks]

(b) Let A = {1, 2, 3, 4, 5, 6}.

(i) Find the result of permutation function of (3, 5, 1, 4) ° (1, 3, 2, 6).

[4 marks]

(ii) Then, find its cycles.

[2 marks]

(iii) Then, find the product transposition.

[1 mark]

(iv) Identify either it is an odd or even permutation.

[1 mark]

Question 5

Figure 3 below is a Hasse Diagram, consist of vertices a, b, c, d, e, f, g, h and i.

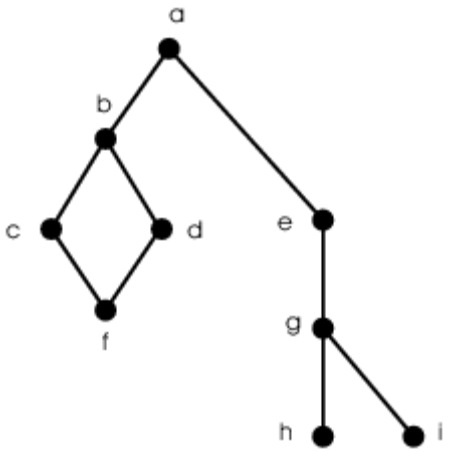


Figure 3

Find **SIX (6)** topological sorting for the Hasse Diagram.

[6 marks]

Question 6

A graph is given as in Figure 4 below.

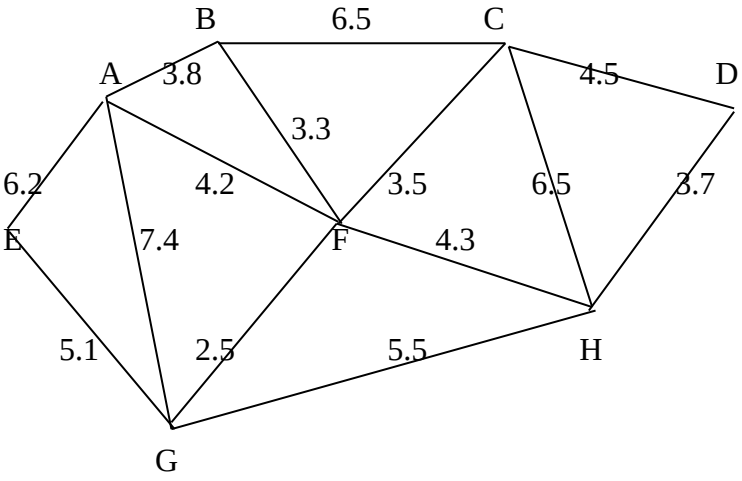


Figure 4

Answer the following questions.

(a) Find the degree of each vertex in the graph.

[2 marks]

(b) Does the graph have a Euler circuit or path? Give a circuit or path if there is any.

[6 marks]

(c) Identify a Hamilton cycle in the graph.

[3 marks]

(d) Find the Minimal Spanning Tree using Prim's approach starting from A and find the shortest distance needed to cover all the vertices.

[9 marks]

--- End of Questions---