UNIVERSITI TENAGA NASIONAL

College of Information Technology

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

FINAL EXAMINATION
SEMESTER I 2013/2014

DISCRETE STRUCTURES
(CSNB143)

September 2013

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 8 PRINTED PAGES INCLUDING THIS PAGE.

SECTION A: TRUE/FALSE (10 QUESTIONS, 10 MARKS)

Instruction: Indicate whether each of the following statements is True (T) or False (F)

1. A set should contain an ordered number of elements.

2. Explicit sequence is a sequence that depends on the previous value.

3. $p \rightarrow q$ is also called a conditional statement or implication.

4. In matrix addition, (A + B) + C = A + B (+ C).

5. Let A = {1, 3, 5, {2, 9}, 7 }, then {2, 9} is $\in$ A.

6. Connective OR is called conjunction for p and q.

7. A path that starts and ends at the same vertex is called a cycle.

8. A relation R on set A is called Partial Order if R is reflexive and antisymmetric.

9. A vertex with degree 0 is called an isolated vertex.

10. ${}_nP_r$ means the number of permutation of n objects taken r at a time.

SECTION B: PROBLEM-SOLVING (11 QUESTIONS, 90 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

(a) Let A = {ab, bb, bc}. In each of the following parts, indicate whether the string belongs to A*. (Note: Answer YES or NO)

i ababbbbbbc

[1 mark]

ii bbabbbbcbbc

[1 mark]

(b) Identify the first **FOUR(4)** values for sequence $\{a_n\}$ where a_n is:

(i) $n^2 - 1$; n = 1

[2 marks]

(ii) $(-1)^{n+1}$; n = 0

[2 marks]

Question 2

A class recently took a survey to determine where the city people obtained their news. Unfortunately some of the reports were damaged. Only the following are known.

88 people said they obtained their news from television

73 from local paper

46 from news magazine

34 obtained from television and local paper

16 from television and news magazine

12 from local paper and news magazine

Five were reported to use three media to obtain their news.

and 166 people were surveyed.

(a) How many people used none of the three media to obtain their news?

[4 marks]

(b) Convert the information given into Venn diagram.

[4 marks]

(c) How many obtained their news from a news magazine exclusively?

[2 marks]

Question 3

If possible, compute each of the following matrices. Show your calculation works.

$$A = \begin{pmatrix} 2 & 1 & 3 \\ 4 & 1 & -2 \end{pmatrix} \quad B = \begin{pmatrix} 0 & 1 \\ 1 & 2 \\ 2 & 3 \end{pmatrix} \quad C = \begin{pmatrix} 1 & -2 & 3 \\ 4 & 2 & 5 \\ 3 & 1 & 2 \end{pmatrix}$$

$$D = \begin{pmatrix} -3 & 2 \\ 4 & 1 \end{pmatrix} \quad E = \begin{pmatrix} 3 & 2 & -1 \\ 5 & 4 & -3 \\ 0 & 1 & 2 \end{pmatrix} \quad F = \begin{pmatrix} -2 & 3 \\ 4 & 5 \end{pmatrix}$$

(a) C + E

[2 marks]

(b) AB

[2 marks]

(c) EB + FA

[5 marks]

(d) $(AB)^T$

[2 marks]

Question 4

Write the negation of each of the following in English sentences.

(a) Jack did not eat fat, but he did eat broccoli.

[2 marks]

(b) Mary lost her lamb or the wolf ate the lamb.

[2 marks]

(c) If Tom stole a pie and ran away, then the three pigs do not have any supper.

[2 marks]

Question 5

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

(a) $1 + 3 + 5 + \ldots + (2n - 1) = n^2$

[6 marks]

(b) $4^n - 1$ is divisible by 3.

[5 marks]

Question 6

In a psychological experiment, a person must arrange a square, a cube, a circle, a triangle and a pentagon in a row. How many different arrangements are possible?

[2 marks]

Question 7

Suppose that an urn can contain 15 balls, of which eight are red and seven are black. In how many ways can five balls be chosen so that:

(a) All five are red?

[2 marks]

(b) All five are black?

[2 marks]

(c) Two are red and three are black?

[2 marks]

(d) Three are red and two are black?

[2 marks]

(e) At most three are black?

[4 marks]

Question 8

Find the transitive closure for M_R below using Warshall Algorithm, given $A = \{1, 2, 3, 4\}$.

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

[8 marks]

Question 9

Let $A = \{1, 2, 3, 4, 5, 6\}$ and given the permutation function as below. Compute:

$$p_1 = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 4 & 1 & 2 & 6 & 5 \end{pmatrix} \qquad p_3 = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 6 & 3 & 2 & 5 & 4 & 1 \end{pmatrix}$$

$$p_2 = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 3 & 1 & 5 & 4 & 6 \end{pmatrix}$$

(a) p_1^{-1}

[3 marks]

(b) $P_3 \circ P_2$

[3 marks]

(c) $p_1^{-1} \circ p_2^{-1}$

[3 marks]

Question 10

Consider the floor plan in Figure 1 below:

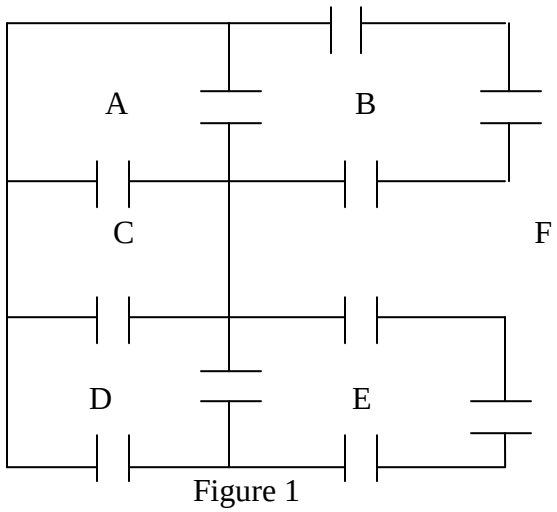

Figure 1

(a) Transfer the floor plan above into graph

[2 marks]

(b) Find the degree of each vertex

[3 marks]

(c) Determine if the graph above has Euler circuit or Euler path. State the path if there is Euler circuit or Euler path.

(i) Euler circuit

[1.5 marks]

(ii) Euler path

[1.5 marks]

Question 11

(a) Let A = {v1, v2, v3, v4, v5, v6, v7, v8, v9, v10} and T = {(v2, v3), (v2, v1), (v4, v5), (v4, v6), (v5, v8), (v6, v7), (v4, v2), (v7, v9), (v7, v10)}. Show that T is a rooted tree and identify its root.

[5 marks]

(b) List all the leaves based on answer in (a).

[2 marks]