UNIVERSITI TENAGA NASIONAL

College of Information Technology

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

FINAL EXAMINATION
SEMESTER I 2014/2015

DISCRETE STRUCTURES
(CSNB143)

September 2014

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** to 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 9 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. Power set is a set that contains all its subset as its element.

3. If the sequence is depending on the previous value, it is called Explicit Sequence

4. Boolean matrix is an *m x n* matrix where all of its entries are either 1 or 0 only.

5. The compound statement for AND is true if both statements are false.

6. If *p* and *q* are statements, the compound statement *if p then q* is denoted by $\underline{p \rightarrow q.}$

7. In a relation *R* that consists of set *A* and set *B*, the domain is the set of elements in *B* that are second elements of pairs in *R*.

8. A path in a graph is called an Euler path if it includes every edge exactly once.

9. A function *f*: A → B is said to be invertible if its reverse relation, f^{-1} is also a function.

10. Pigeonhole principle is a principle that ensures that data exists but there is no information to identify which or what data.

SECTION B: SUBJECTIVES QUESTION (13 QUESTIONS, 90 MARKS)

Instruction: Answer all questions.

Question 1

Let $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, $A = \{1, 2, 4, 6, 8\}$, $B=\{2, 4, 5, 9\}$, $C = \{x \mid x$ is a positive integer and $x^2 \leq 16$, and $D = \{7, 8\}$. Find the value for each of the operation below:

[5 marks]

(a) C'

(b) A'

(c) $A \cup A'$

(d) $A \cap A'$

(e) $A \oplus B$

Question 2

In a survey of 260 college students, the following data was obtained:

64 had taken a mathematics course,

94 had taken a computer science course,

58 had taken a business course,

28 had taken both a mathematics and a business course,

26 had taken both a mathematics and a computer science course,

22 had taken both computer science and business course, and

14 had taken all three types of courses.

Answer the following questions based on the above data. Show the complete working step until you arrive at your final answers.

(a) How many students were surveyed who had taken none of these three types of courses?

[4 marks]

(b) Of the students surveyed, how many had taken only a computer science course?

[2 marks]

(c) Convert the information in (a) into Venn diagram.

[4 marks]

Question 3

What is the value of a_7 in sequence $\{a_n\}$ if a_n is:

(a) $2n - 1$

[2 marks]

(b) $n^2 - 1$

[2 marks]

Question 4

Let A = {aa, bb, ab, ac}. Determine either strings below are valid strings in A*.

(a) aabbbb =

(b) bbacaaa =

(c) ababacbb =

(d) aaaaaaab =

[4 marks]

Question 5

Given matrices A, B, C, D, E and F as below:

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

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

Find:

(a) C + E

[2 marks]

(b) $(BC)^T$

[2 marks]

(c) A(C + E)

[3 marks]

(d) AC + AE

[5 marks]

Question 6

Given that *p*: Rina is studying, *q*: Rina is happy, *r*: Rina will succeed, *s*: Rina is watching Transformer. Write the symbols for each of the statement below:

(a) Rina study or Rina watch Transformer

[2 marks]

(b) If Rina study then Rina will succeed

[2 marks]

(c) If Rina is not happy then Rina watch Transformer and Rina will not succeed

[2 marks]

(d) Rina is happy if and only if Rina watch Transformer.

[2 marks]

Question 7

Using mathematical induction, prove that for $\forall n \geq 0$,

$$2 + 4 + 6 + \ldots\ldots + 2n = n(n+1) \text{ for all } n \geq 1.$$

[5 marks]

Question 8

How many orders that can be built from 6 numbers, 2, 3, 4, 5, 7 and 9, taken 3 at a time, to produce any number in hundreds. Assume that the repetition is not allowed.

(a) Without any condition.

[2 marks]

(b) Produce values less than 400.

[2 marks]

(c) Produce the even values.

[2 marks]

(d) Produce values that are the multiple of 5.

[2 marks]

(e) Produce the odd values

[2 marks]

Question 9

Let A = {a,b,c,d} and B = {1,2,3}. Determine whether the relation R from A to B is a function or not. If it is a function, then give its range.

(a) R = {(a,1), (b,2), (c,1), (d,2)}

[2 marks]

(b) R = {(a,1), (b,2), (a,2), (c,1), (d,2)}

[2 marks]

Question 10

Answer all questions based on the relation R diagraph in Figure 1 below.

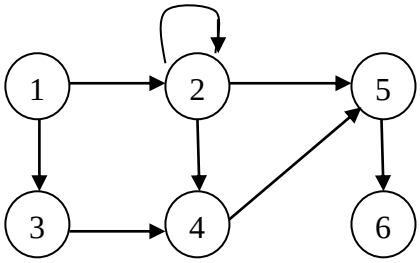

Figure 1

(a) Find R_2.

[5 marks]

(b) Draw the diagraph of R_2.

[5 marks]

Question 11

Let A = B = C = R be real numbers and let f: A → B, g: B → C are defined as $f(a) = 3 + a^2$ and g(b) = b(b + 2). Find:

a) $(g \circ f)(-2)$

[2 marks]

b) $(f \circ f)(x)$

[2 marks]

Question 12

Based on the graph in Figure 2:

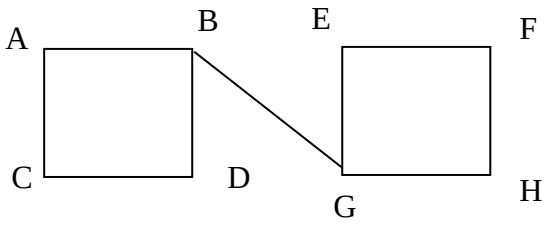

Figure 2

(a) Find the degree of each vertex.

[4 marks]

(b) Indicate whether there is a Hamilton cycle.

[1 mark]

(c) Indicate whether there is a Hamilton path.

[1 mark]

(d) Indicate whether there is a an Euler cycle.

[1 mark]

(e) Indicate whether there is an Euler path.

[1 mark]

Question 13

(a) Give the definition of Minimal Spanning Tree.

[1 mark]

(b) The graph in Figure 3 is weighted (in km) for each edge.

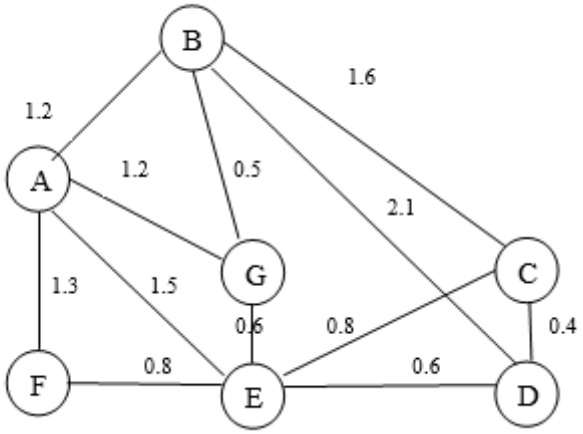

Figure 3

(i) Find The Minimal Spanning Tree from *E* using Prim approach.

[3 marks]

(ii) Based on (i), calculate the shortest distance of the tree.

[2 marks]

---End of questions---