UTM | **SCHOOL OF COMPUTING**
Faculty of Engineering

UNIVERSITI TEKNOLOGI MALAYSIA
FINAL EXAMINATION
SEMESTER I 2021/2022

SUBJECT CODE	: SCSI/SECI 1013
SUBJECT NAME	: DISCRETE STRUCTURE
YEAR/COURSE	:
TIME	: 3 HOURS
DATE	:
VENUE	:

INSTRUCTIONS TO THE STUDENTS:

1. Please answer ALL the questions in the answer sheet form.

2. Fill in your particular in the answer sheet.

3. A candidate who is suspected of cheating in examination is liable to disciplinary action including (but not limited to) suspension or expulsion from the university. All materials and/or devices which are found in violation of any examination rules and regulation will be confiscated.

NAME	-schema-
MATRIC NO.	
SECTION	
LECTURER	

(This question paper consists of 8 pages including this page)

QUESTION 1   15 MARKS

a)   There are four candidates for president of student Council. Amirul, Badrul, Chong and
     David. Suppose Amirul is three times as likely to be elected as Badrul. Badrul is twice
     times as likely as Chong, and Chong and David are equally likely to be elected.

     i.   What is the probability of being elected for each candidate?   (5 marks)

     ii.   Calculate the probabilities that Amirul or Chong being selected as president?

                                                                                  (3 marks)

b)   The probability that a randomly chosen male has pneumonia problem is 0.40. Smoking
     has substantial adverse effects on the immune system, both locally and throughout the
     body. Evidence from several studies confirms that smoking is significantly associated
     with the development of bacterial and viral pneumonia. 80% of males who have
     pneumonia problem are smokers. Whilst 30% of males that do not have pneumonia
     problem are smokers.

     i.   What is the probability that a male chosen do not have pneumonia problem?

                                                                                  (2 marks)

     ii.   Determine the probability that a selected male has a pneumonia problem given
           that he is a smoker.   (5 marks)

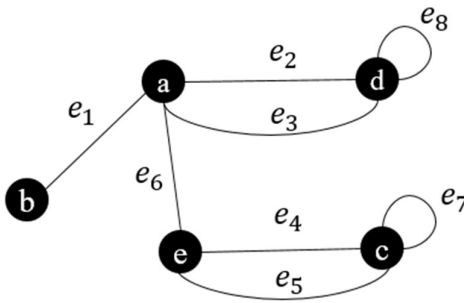**QUESTION 2**   **25 MARKS**

a)   Given the graph G as shown in **Figure 1**.

Figure 1: Graph G

i)   Write the features of **V**, **E** and edge-endpoints function, f.   (2 marks)

ii)   Find the degree of each vertex in the graph.   (1 mark)

iii)   Write the edge-endpoints function so that the graph produces the following shape (**Figure 2**). (Note: Redraw the graph and put label for edge in your answer sheet).
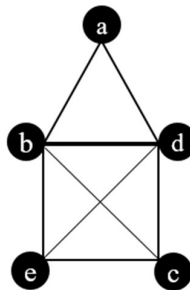

Figure 2

(2 marks)

b) For the following pair of graphs GLUCONEOGENESIS and GLYCOLYSIS, show that both graphs are isomorphic by
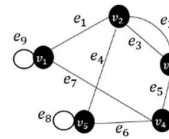
- Define the one-to-one and onto functions from the vertices of graph GLUCONEOGENESIS and the vertices of graph GLYCOLYSIS.
- Construct the adjacency matrix.

(10 marks)

b) Given the following graphs P and Q. Identify which of the graphs has Euler circuit or Euler trail and exhibit one. (7 marks)
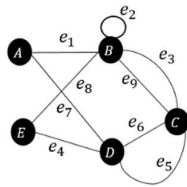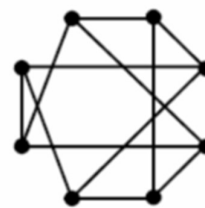

Graph P Graph Q

c) Identify which of the graphs (V or W) has Hamilton circuit. For the graph that contain Hamilton circuit, exhibit one. (Note: Redraw the graph and put label at each vertex in your answer sheet).

Graph V Graph W

(3 marks)

QUESTION 3   **25 MARKS**

a)   Multi-level marketing starts when a person recruits 4 members. Each member can either recruit 4 other members or choose not to recruit any members. Suppose that 2,000 members are actively doing the recruitments before the maximum level of recruitment is reached and no members can be approached twice. How many members have been recruited and how many members who did not do any recruitment?

(4 marks)

b)   A directory in computer memory contains both files and 3 subdirectories.
   i.   How many directories can be stored in that memory with the aim of having 15 empty files.   (2 marks)
   ii.   Determine the number of files with 3 subdirectories.   (1.5 marks)
   iii. Draw the rooted tree from Question c(i)   (1 mark)
   iv.   From tree in c(ii), identify and circle the proper ancestor of any final vertex. Justify your answer.   (1.5 marks)

c)   The mathematical expression $a + b * d - e/f$ is obtained using a rooted binary tree.

   i.   Draw a tree with the height of 2 to represent the inorder traversal.   (2 marks)
   ii.   Justify whether the rooted tree in c(i) is balanced or not.   (1 mark)
   iii. From tree in c(i), get the mathematical expression using the postorder traversal.

(2 marks)

d) Figure 3 represents a network of paths in a park. The number on each edge represents the length of the path in meters. The cost per meter is RM100. To gain as much profit, the contractor asked one of his staff to find the minimum network needed using Kruskal's algorithm.
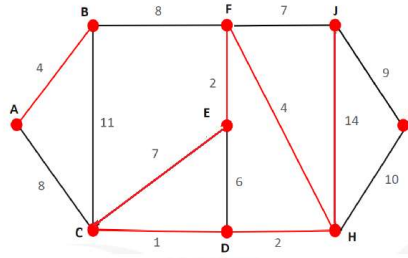

Figure 3

    i.   Explain why the staff's work which is highlighted in red is incorrect.   (1 mark)

    ii.   Help the staff to find the correct minimum network using Kruskal's algorithm and states its length and total cost.   (7 marks)

    iii.   Is there any possibiliy, more than one distint MST obtained for the Figure 3?. If yes, justify your answer and show the network.   (2 marks)

QUESTION 4   **10 MARKS**

Figure 4 below shows road connecting a few locations in Johor Bahru. The numbers represent the distance between each location. Tomorrow, you want to travel from location **A** to location **G** for work purposes.
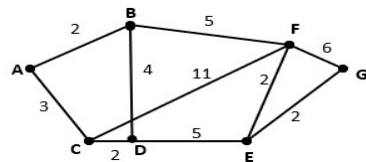

Figure 4

a) Find the shortest path from location **A** to **G** using Djikstra's Algorithm. Show your work by completing Table 1.   (8 marks)

b) State the shortest path and distance from location **A** to location **G**?   (2 marks)

QUESTION 5

a) Let $M = (\{q_0, q_1, q_2, q_3, q_4, q_5\}, \{x, y, z\}, q_0, f_s, \{q_2, q_5\})$ be the Deterministic Finite Automaton (DFA) with state transition function, f_s defined as follows:

$$f(q_0, x) = q_1 \qquad f(q_0, y) = q_2 \qquad f(q_0, z) = q_4$$

$$f(q_1, x) = q_1 \qquad f(q_1, y) = q_2 \qquad f(q_1, z) = q_2$$

$$f(q_2, x) = q_2 \qquad f(q_2, y) = q_3 \qquad f(q_2, z) = q_4$$

$$f(q_3, x) = q_5 \qquad f(q_3, y) = q_4 \qquad f(q_3, z) = q_4$$

$$f(q_4, x) = q_5 \qquad f(q_4, y) = q_0 \qquad f(q_4, z) = q_1$$

$$f(q_5, x) = q_5 \qquad f(q_5, y) = q_4 \qquad f(q_5, z) = q_0$$

i.   Draw the transition diagram for the machine, M.   (4 marks)

ii. What is the minimum length of strings that is accepted by the machine, M.   (1 mark)

iii. Give ONE example of strings in (ii).   (1 mark)

b) Consider the following Deterministic Finite Automaton (DFA) in **Figure 5**. Indicate whether the following strings are accepted or rejected.   (3 marks)

i.   000111
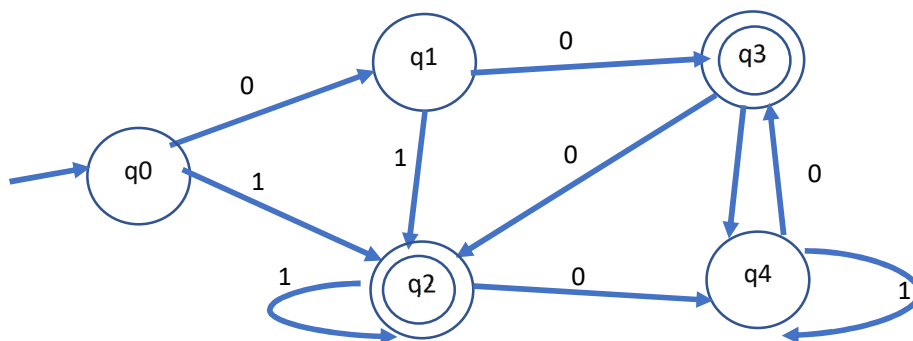
ii. 101010

iii. 110000

Figure 5

c) Suppose that a compiler recognized variable names according to the following rules:

- Numeric variable names had to begin with a letter, and then the letter could be followed by another letter or a digit or by nothing at all.
- String variable names had to begin with the symbol $ followed by a letter which could then be followed by another letter or a digit or by nothing at all.

Construct a deterministic finite automaton (DFA) that accepts all strings recognized by the compiler as variable names. Examples of accepted and rejected strings are shown in Table 2:

Table 2

Accepted Strings	Rejected Strings
$a	*a
a	$$a
ba2	a$
$c1a	1a

(6 marks)

QUESTION 6   10 MARKS

Consider a simple media player with four (4) buttons: *play*, *rewind*, *forward*, and *pause*. Press any of these buttons will change the state of the media player. Button *play* transfer the media player state from idle to playing state and the media start playing movie/music. The playing state will change to stop state if button *pause* is pressed. The *rewind* or *fast forward* button will change the stop state to the playing state and the media start playing movie/music.

a) Define the state, input and output to represent the media player as FSM.

b) Draw the state transition diagram.   (10 marks)