CONFIDENTIAL

UTM UNIVERSITI TEKNOLOGI MALAYSIA
SCHOOL OF COMPUTING
Faculty of Engineering

UNIVERSITI TEKNOLOGI MALAYSIA

FINAL EXAMINATION

SEMESTER I 2020/2021

SUBJECT CODE	**: SCSI/SECI 1013**
SUBJECT NAME	**: DISCRETE STRUCTURE**
YEAR/COURSE	**: SCSI/SECI 1013**
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	
MATRIC NO.	
SECTION	
LECTURER	

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

QUESTION 1 **20 MARKS**

a) Let A and B are events in a sample space S and suppose that $P(A')=0.25$, $P(B)=0.7$, and $P(A' \cup B') = 0.45$. What is $P(A \cup B)$? (4 marks)

b) Four people have been exposed to Corona virus. Once exposed, a person has a 50-50 chance of actually becoming ill.

i. What is the probability that exactly one of the people becomes ill? (3 marks)

ii. What is the probability that none of the four people becomes ill? (2 marks)

c) A box contains 20 green balls and 25 red balls. Two balls are chosen at random, one after the other, without replacement?

i. What is the probability that both balls are red? (2 marks)

ii. What is the probability that the second ball is red but the first ball is not? (2 marks)

iii. What is the probability that the second ball is green? (3 marks)

d) A professor uses two proofreaders Ali and Hana to check a certain manuscript. Ali misses 9% of typographical errors and Hana misses 8%. Assume that the proofreaders work independently.

i. What is the probability that a randomly chosen typographical error will be missed by both proofreaders? (2 marks)

ii. If the manuscript contains 1000 typographical errors, what number can be expected to be missed? (2 marks)

QUESTION 2 **20 MARKS**

a) An airline has reviewed the flight schedule due to the COVID19 pandemic. The new flight connection that available in the west coast cities are only between Kuala Lumpur-Johor Bahru-Kuala Lumpur, Kuala Lumpur-Penang-Kuala Lumpur, Johor Bahru-Penang-Johor Bahru, Johor Bahru-Alor Star-Johor Bahru, Johor Bahru-Langkawi-Johor Bahru, Kuala Lumpur-Langkawi-Kuala Lumpur, Kuala Lumpur-Alor Star-Kuala Lumpur, and Penang-Langkawi-Penang.

i. Draw an undirected graph model representing this flight connection. Label all edges and vertices. (4 marks)

ii. Determine the degree of each of vertex in the graph (i). (2 marks)

iii. Is this graph (i) a simple graph? Justify your answer. (2 marks)

iv. The airline later introduces a special sightseeing trip that take off and land in Kuala Lumpur. Does this new route effect the answer in (iii) and why? (2 marks)

b) Ahmad buys a new house. The floor plan as shown in **Figure 1**.

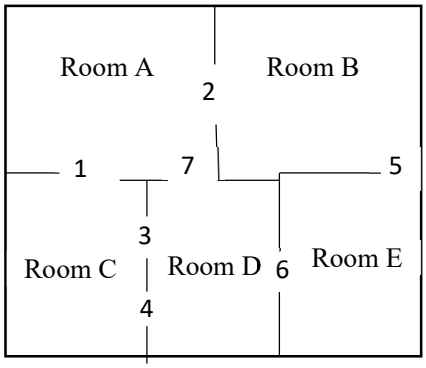
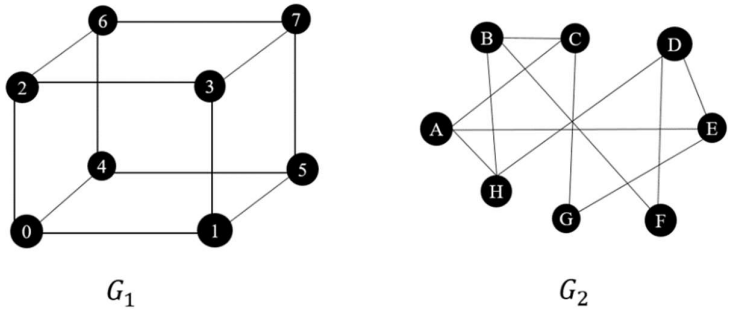


Figure 1

i. He wanted to give a tour for his friend. Is that possible for them to walk through every doorway (label as 1, 2, 3, 4, 5, 6, and 7) exactly once? If so, which room must they begin and end the tour? Explain. (2 marks)

ii. Is it possible to tour the house visiting each room (label as A, B, C, D, E) exactly once (not necessary using every doorway)? Explain. (2 marks)

c) Determine whether the pair of graphs ($G_1$and G_2) in **Figure 2** are isomorphic. If the graphs are isomorphic, give a vertex function that defines the isomorphic and their adjacency matrices. If they are not, give isomorphic invariant that they are not share. (6 marks)



G_1 G_2

Figure 2

QUESTION 3 **20 MARKS**

a) Either draw a full *m-ary* tree with 13 leaves and height 2 where *m* is a positive integer or show that no such tree exists. (2 marks)

b) The word 'SALUTE' is resulted from in-order traversal of a rooted binary tree.

i. Draw the tree with height of 2 that can represent the above traversal. (2½ marks)

ii. Using tree draw in (i) find the word resulted from the pre-order traversal. (2½ marks)

c) Draw two spanning trees from the graph in **Figure 3**. (3 marks)

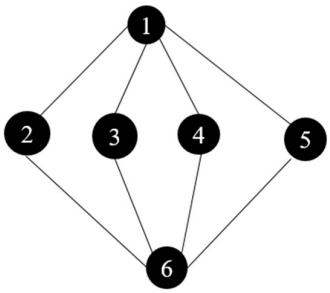


Figure 3

d) Data Communication company has offices A, B, C, D, E, F, G, and H. **Table 1** shows the cost, in Ringgit Malaysia (RM), of transmitting a piece of information from one of the offices to another along all existing direct links.

Table 1

From \ To	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
A	-	8	-	-	-	10	-	5
B	8	-	4	-	4	4	-	4
C	-	4	-	3	-	3	-	-
D	-	-	3	-	1	6	2	-
E	-	4	-	1	-	-	3	-
F	10	4	3	6	-	-	-	-
G	-	-	-	2	3	-	-	3
H	5	4	-	-	-	-	3	-

i. Construct a network using vertices A to H to represent the information in **Table 1**. (3 marks)

ii. A piece of information has to be passed from office A to all the other offices, either directly or by being passed on from office to office. Use Kruskal's algorithm to find the minimum total cost of passing the information to all the offices. (6 marks)

iii. Draw a network that produces the minimum total cost in (ii). (1 mark)

QUESTION 4 **10 MARKS**

A short road race has been organized by UTM for final year students. Students have to start at point A and use their own choice of route to reach endpoint J as quickly as possible. **Figure 4** shows the network of roads available and, for each road, the minimum completion time in seconds, for a student in UTM.

Mira, the best girl runner in UTM, is planning her strategy. Given that she can run each section in the minimum time, use Dijkstra's algorithm to find the route ***she should take. State her time for the race and draw the route***. Show all your workings for each iteration in a table.

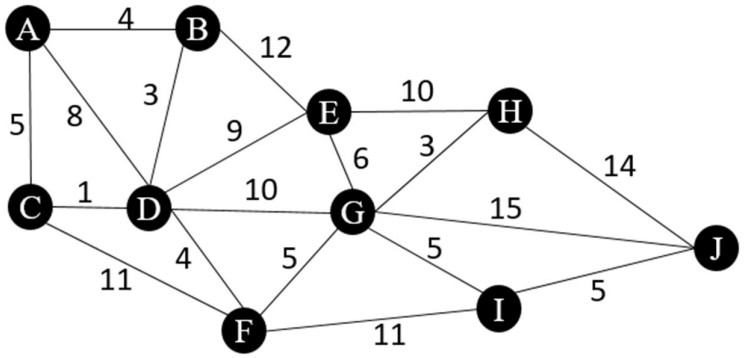


Figure 4

QUESTION 5 **15 MARKS**

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

$$f(q_0, a) = q_1 \qquad f(q_0, b) = q_0 \qquad f(q_0, n) = q_2$$

$$f(q_1, a) = q_2 \qquad f(q_1, b) = q_1 \qquad f(q_1, n) = q_1$$

$$f(q_2, a) = q_3 \qquad f(q_2, b) = q_2 \qquad f(q_2, n) = q_4$$

$$f(q_3, a) = q_1 \qquad f(q_3, b) = q_3 \qquad f(q_3, n) = q_4$$

$$f(q_4, a) = q_3 \qquad f(q_4, b) = q_5 \qquad f(q_4, n) = q_5$$

$$f(q_5, a) = q_4 \qquad f(q_5, b) = q_3 \qquad f(q_5, n) = q_5$$

a) Draw the transition diagram for the above machine. (5 marks)

b) Show the sequence of state transition for the input strings ***banana***. (2 marks)

c) Is the input string ***banana*** accepted by the DFA? Justify your answer. (2 marks)

d) Find ONE input strings that follow the given conditions and must accepted by machine *M*. (6 marks)

i. Length of strings is 4 and do not contains input *n*.

ii. Length of strings is 5 and do not contains input *b*.

iii. Length of strings is 3, start and end with the same input string (for example: *aba*).

You must show the sequence of state transition in each question.

QUESTION 6 **15 MARKS**

a) Let $h = \{S,\ I,\ O,\ q_o,\ f_s,\ f_o\}$ be the finite state machine (FSM) of equipment Y. **Figure 5** shows the transition diagram for the machine.

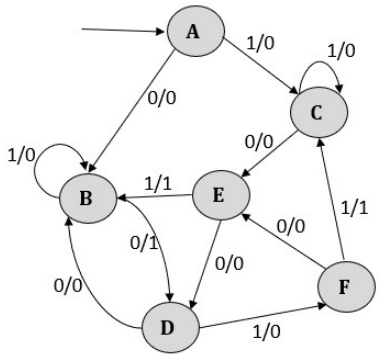


Figure 5

i. Construct the transition table with $q_o = A$ for the machine in **Figure 5**. (4 marks)

ii. What is the output string if the input string is **011100011**?
(Show the sequence of configurations and its output) (2 marks)

iii. Is the input string **11101010** accepted by the machine?
(Show the sequence of configurations and its output) (2 marks)

b) There is a 3-story elevator that can go to ground floor, floor 1 and floor 2; and there are buttons for each floor. The initial state is the ground floor. The inputs to the elevator are the buttons for the ground, first, and second floor. If the elevator is on floor 1 and the button for:

- Floor 1 is pressed, nothing happens, and the elevator remains on floor 1.
- Floor 2 is pressed; the elevator goes up until it has reached floor 2.
- Ground floor is pressed the elevator goes down until it has reached ground floor.

This situation also applies for elevator that is on floor 2 or ground floor. The FSM has three inputs which is for button ground floor is "0", button first is "1", and button second floor is "2". Design the FSM which controls the operation of an elevator in a 3-story building by shown the following:

i. Draw the FSM diagram. (5 marks)

ii. Write the transition table. (2 marks)