SULIT

FACULTY OF COMPUTING
UTM Johor Bahru

UNIVERSITI TEKNOLOGI MALAYSIA
FINAL EXAMINATION SEMESTER 1 2023/2024

SUBJECT CODE	**: SECI 1013**
SUBJECT NAME	**: STRUCTURE DISCRETE**
SECTION	**: 1/2/3/4/5/6/7/8/9/15/16**
TIME	**:**
DATE/DAY	**:**
VENUES	**:**

INSTRUCTIONS:

- Answer all questions in the answer booklet provided.
- All calculation in 3 decimal places

(Please Write Your Lecturer Name And Section In Your Answer Booklet)

Name	
I/C No.	
Year / Course	
Section	
Lecturer Name	

This question paper consists of **_Five_ (5)** printed pages excluding this page.

Question 1 **[15 Marks]**

a) Nineteen students are in an elevator. Prove that at least three of them were born on the same day of the week. (5 Marks)

b) A bag contains 25 balls such as 10 balls are red, 7 are white and 8 are blue. What is the minimum number of balls that must be picked up from the bag blind folded (without replacing any of it) to be assured of picking at least one ball of each colour? (5 Marks)

c) In a quiz taken by 70 students, the scores range from 60 to 88. At leaser how many students have the same score? (5 Marks)

Question 2 **[15 Marks]**

You are conducting a study on the choice of university among Sijil Pelajaran Malaysia (SPM) leavers in Malaysia. Your data includes a sample of 500 students who have recently enrolled in universities across the country. Specifically, you are interested in whether these students chose to study in private universities or local public universities. The data you collected is as follows:

- 175 students chose private universities.
- 325 students chose local public universities

a) Calculate the probability that a randomly selected student from your sample chose to study in a private university. (1 Mark)

b) Determine the probability that a randomly selected student from your sample chose to study in a local public university. (1 Mark)

c) Are these two events mutually exclusive? Explain your reasoning. (3 Marks)

Now, let's consider additional factors that may influence the choice of university. You have gathered the following information:

- Among the students who chose private universities, 60% majored in business- related fields, while the rest majored in other disciplines.
- Among the students who chose local public universities, 40% majored in business-related fields, while the rest majored in other disciplines.
- 70% of the students who majored in business-related fields chose private universities.

d) Calculate the probability that a student chosen at random for the following :

i. Majored in a business-related field and chose a private university (3 Marks)

ii. Majored in a business-related field (3 Marks)

iii. Majored in a business-related field but chosen a local public university (4 Marks)

Question 3 **[31 Marks]**

Suppose Amina needs to spread a message among friends. Because of a restriction in the flow of communications, her 6 friends can only talk to specified friend as in Table 1:

Table 1

Friends	Can Talk to
Heidi	Nadia
Nadia	Heidi, Adam
Ali	Faiz, Bara,Adam
Faiz	Bara, Ali
Amina	Heidi, Faiz
Bara	Faiz, Ali
Adam	Heidi, Nadia,Ali

a) Draw a directed graph to represent the flow of communications for Amina and her friends. (4 Marks)

b) If Amina initiates the message and a continuous path is created, it there a path that will possible the message delivered to everybody exactly once? If so, execute the path flow of the communication. (4 Marks)

c) What theorem in graph theory implemented to solved problem in (b) (2 Marks)

Towns on a mountainous island are linked by railway lines as shown Figure 1. The distances (in kilometres) between stations are shown on the map

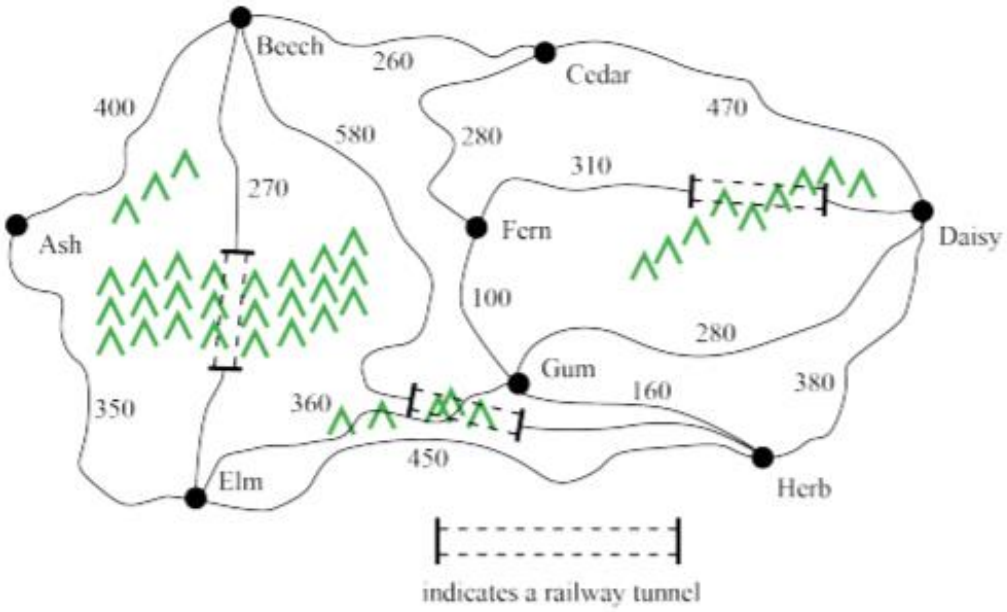

Figure 1

a) Construct a graph for the network of the railway system. Label the stations with the first letter and show the distances on the lines. (3 Marks)

b) Determine the degrees of the vertices in the graph. (3 Marks)

c) It is possible to plan a trip that travels all sections of the railway line without travelling on any section of the line more than once. (You may have to visit towns more than once.). If so, determine the specific station to start and end the trip? Explain. (3 Marks)

d) The railway company decides to close one line to reduce the maintenance cost but the tourist still possible to travel all sections of the railway line once from any station and return back to the same station. Identify which line that can be closed? Explain

(2 Marks)

e) Determine the shortest route and the minimum total length of track to travel from Ash to Daisy using Dijkstra algorithm by completing Table 2. (10 Marks)

Table 2

S	N	L(A)	L(B)	L(C)	L(D)	L(E)	L(F)	L(G)	L(H)
{ }	{A,B,C,D,E,F,G,H,I,J,K,L}	0	∞	∞	∞	∞	∞	∞	∞

Question 4 **[21 Marks]**

(a) You are given the following description of a tree

" A rooted tree has a root node with three siblings. The left-most child of the root has three leaves, while the right-most child forms a subtree having an internal node with three children. The third node of the root is a binary subtree."

From the description above,

(i) Draw the tree. (4 Marks)

(ii) How many edges and vertices does the tree have? (2 Marks)

(iii) Is the tree a full 3-ary tree? Justify your answer. (2 Marks)

(iv) Is the tree balanced? Justify your answer. (2 Marks)

(b) For the following tree as shown in Figure 2

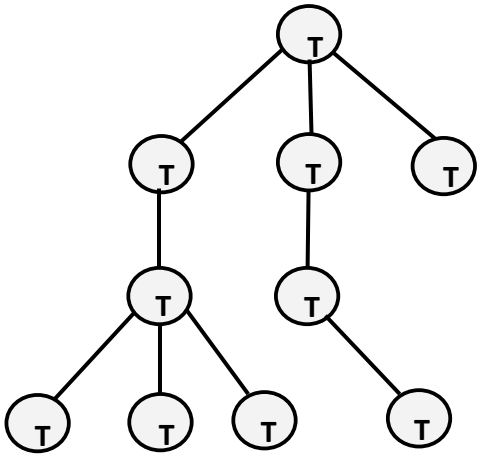

Figure 2

Find the order of the nodes visited by the following traversals

(i) Pre-order (2 Marks)

(ii) In-order (2 Marks)

(c) The undirected graph in Figure 3 depicts several locations in Peninsular Malaysia. The weight of the edges of the graph corresponds to the distance between the locations in kilometers. A Palestinian tourist visits Malaysia and would like to visit all the locations. As a travel guide (oddly with a CS degree), you are to advise him/her with the best route that would let him/her visit all the locations with the least distance traveled.

(i) List the edges in order of increasing size (1 Mark)

(ii) Use Kruskal's algorithm to find the minimum spanning tree to help the tourist to decide the best route. (8 Marks)

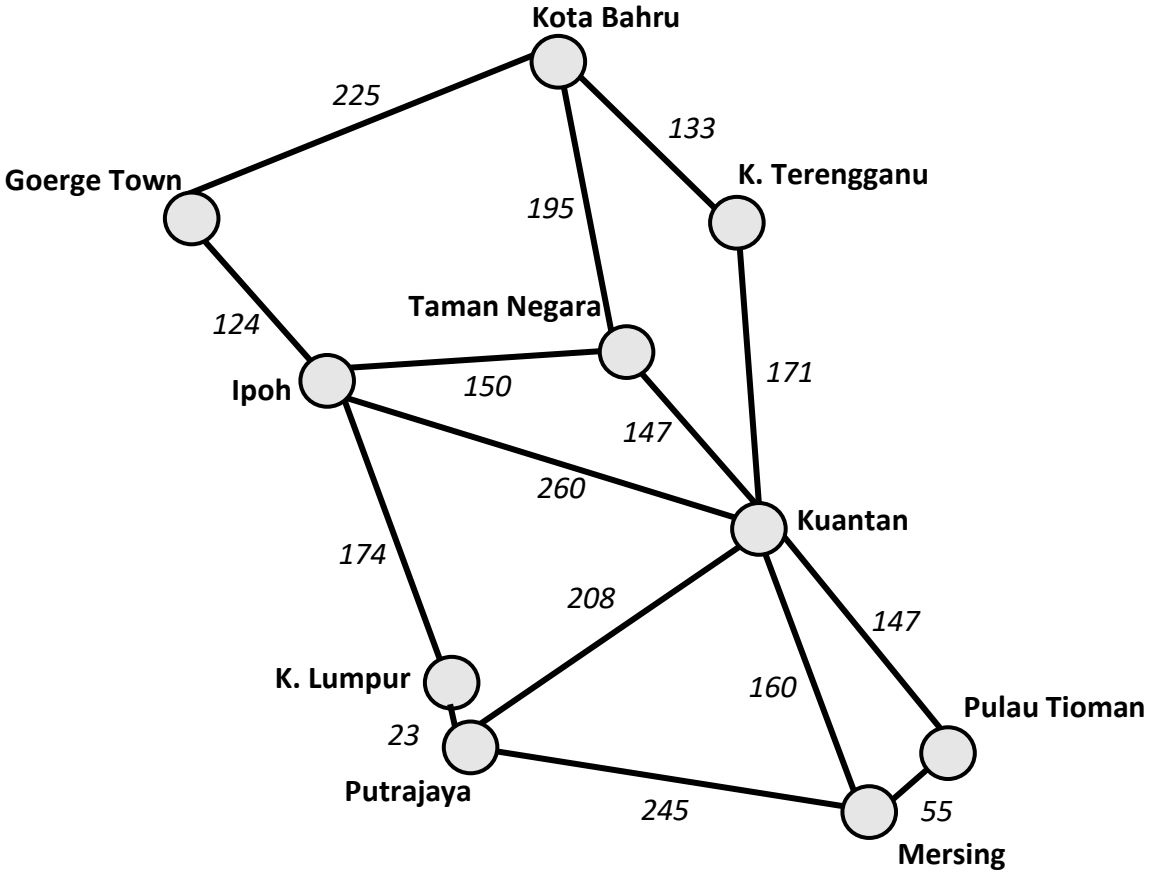

Figure 3

Question 5 **[18 Marks]**

a) Let N = {S, I, q_0, f_S, F) be the DFA such that S = {q_0, q_1, q_2, q_3, q_4}, I = {a, b}, F = {q_3}, q_2 = initial state and f_S is given by:

$$fs\ (q0, a) = q1,\ \ fs\ (q1, a) = q0,$$

$$fs\ (q2, a) = q1,\ fs\ (q3, a) = q4,$$

$$fs\ (q4, a) = q1,\ \ fs\ (q0, b) = q2,$$

$$fs\ (q1, b) = q3,\ \ fs\ (q2, b) = q0,$$

$$fs\ (q4, b) = q4,\ \ fs\ (q3, b) = q3,$$

Construct a state transition diagram of the DFA given the state transition function, fs above. (3 Marks)

b) Design a transition diagram for DFA that accept input contains string 1011. (5 Marks)

c) Based on the transition diagram in Figure 4

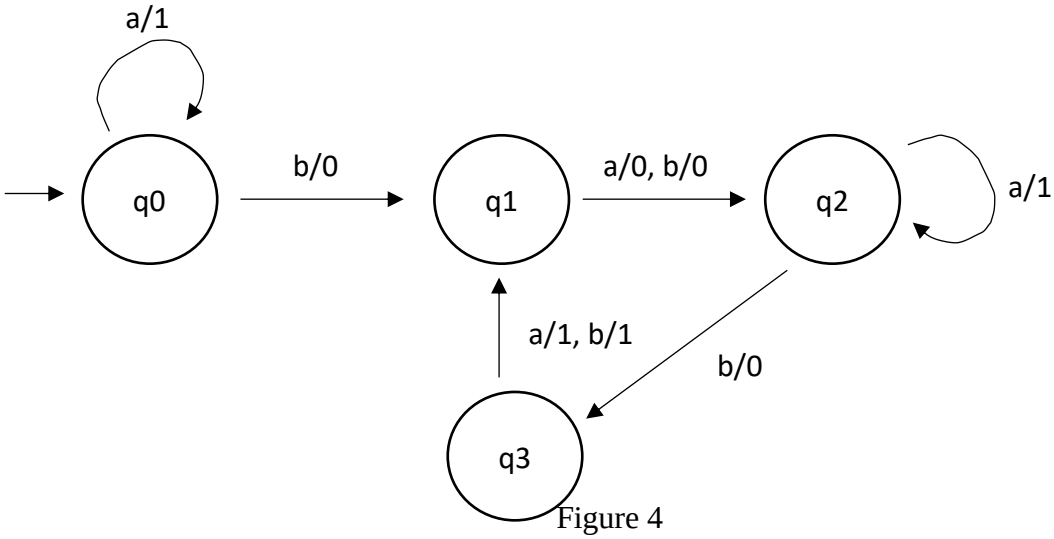

Figure 4

a. Find out all the information for Deterministic Finite Automaton, M = {S, I, O, q_0, f_s, f_o} and provide the transition table. (6 Marks)

b. Find the output string for the given input string.

i. abbbabaaab (2 Marks)

ii. bbbbaaabaa (2 Marks)