SULIT

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

Faculty of Computing

UNIVERSITI TEKNOLOGI MALAYSIA
FINAL EXAMINATION SEMESTER I, 2014 / 2015

SUBJECT CODE	:	SCSI 1013 / SCI 1013
SUBJECT NAME	:	DISCRETE STRUCTURE
SECTION	:	ALL
TIME	:	9:00 AM – 12:00 NOON
DATE/DAY	:	10 / 01 / 2015 (SATURDAY)
VENUES	:	BK 1 - 6 (N 24)

INSTRUCTIONS :

ANSWER ALL QUESTIONS IN THE ANSWER BOOKLET

THIS PAPER CONTRIBUTE 40% OF COURSE ASSESSMENT

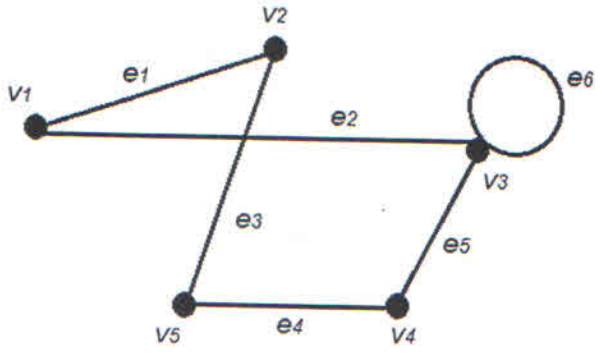
(Please Write Your Lecture Name And Section In Your Answer Booklet)

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

This questions paper consists of **NINE (9)** printed pages excluding this page.

Question 1 **[20 Marks]**

a) Given a graph (G) as shown in Figure 1.



G

Figure 1

i. Write a set of vertices and the set of edges, and give a table showing the edge-endpoint function. (4 marks)

ii. Find the incidence matrix of the graph. (3 marks)

b) Determine whether the graphs in Figure 2 (A and B) are isomorphic. If the graphs are isomorphic, find their adjacency matrices; otherwise, give an invariant that the graphs do not share. (5 marks)

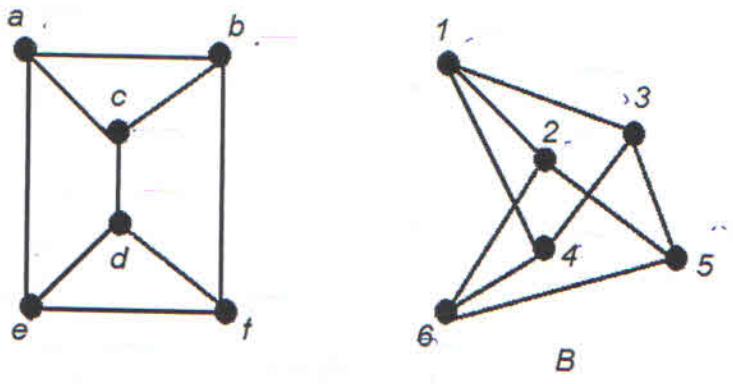


Figure 2

c) Determine whether the graphs in Figure 3 (C and D) has an Euler circuit or an Euler trail. If the graph has an Euler circuit or an Euler trail, exhibit one; otherwise, give an argument that shows there is no Euler circuit or Euler trail. (5 marks)

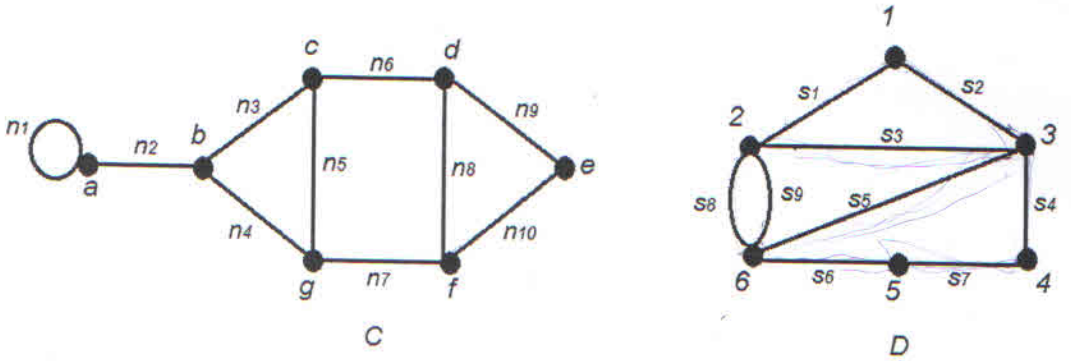


Figure 3

d) Determine whether the graphs in Figure 4 (E and F) has a Hamiltonian circuit. If yes, exhibit one. (3 marks)

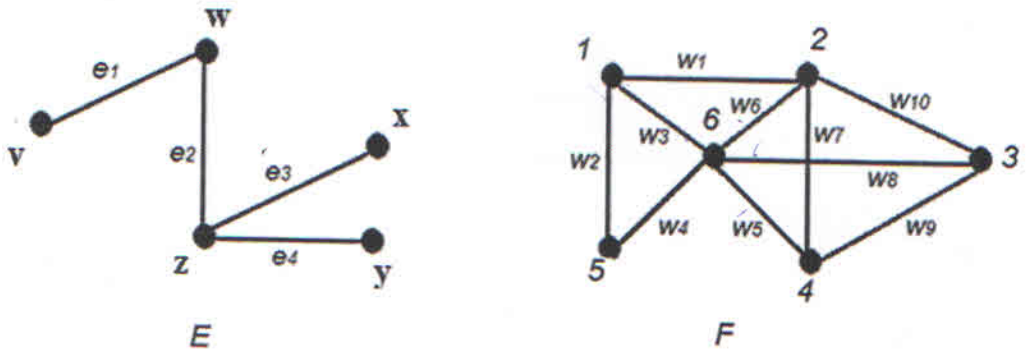


Figure 4

Question 2 **[10 Marks]**

Let G be a weighted graph, $G1$ as shown in Figure 5.

a) Based on Dijkstra's algorithm, complete Table 1 to construct the shortest path from node A to node F between the adjacent nodes of $G1$. (7 marks)

b) State the minimum distance and the shortest path from node A to node F. (3 marks)

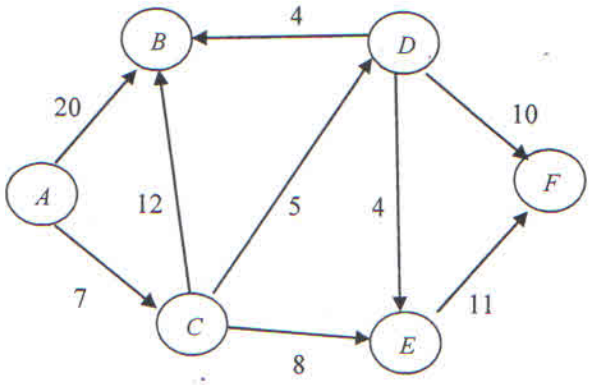


Figure 5 : *G*1

Table 1

Iteration	S	N	L(A)	L(B)	L(C)	L(D)	L(E)	L(F)
0	{ }	{A,B,C,D,E,F}	0	∞	∞	∞	∞	∞
1								
2								
3								
4								
5								

Question 3 **[20 Marks]**

a) Let $M = [S, I, q_0, f_s, F]$ be the Deterministic Finite Automata (DFA) machine as shown in Figure 6.

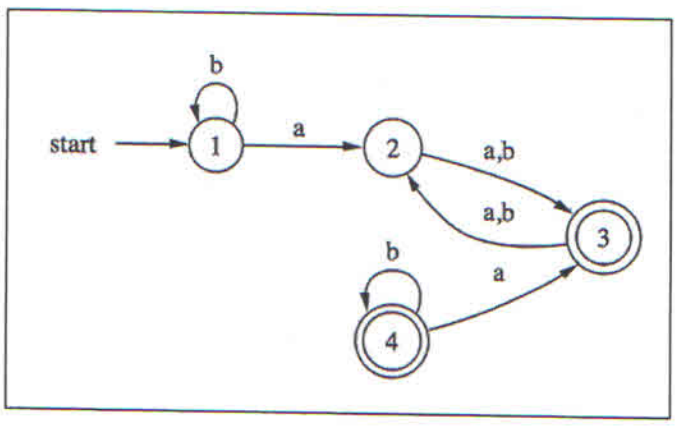


Figure 6: Transition diagram of *M*

i) List all the components of *M*. (6 marks)

ii) Write down a string of length four that *M* accept and a string of length four that it does not accept. Show the sequence of state transition of each string.

(5 marks)

b) Design a transition diagram of DFA that will accept the word '**banana**' whilst using only 3 states (i.e., *S*1, *S*2 and *S*3). (4 marks)

c) Construct the state transition table for the finite state machine (FSM) defined by the transition diagram shown in Figure 7. Then, find the output string for the input string 101011.

(5 marks)

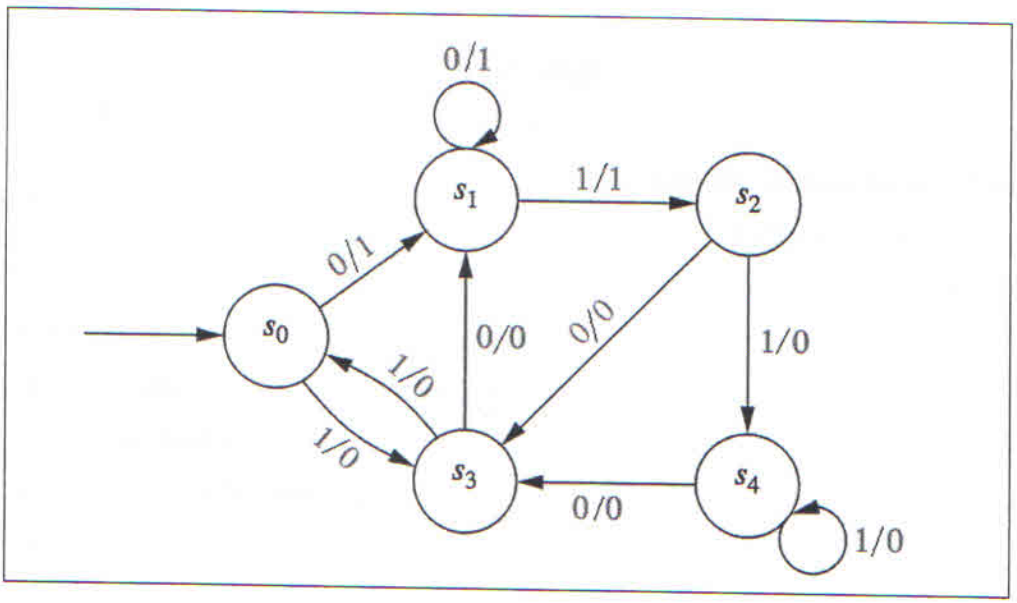


Figure 7

Question 4 **[10 Marks]**

SmartTAG, as shown in Figure 8, is an on-board unit vehicle-based device. It is used as an electronic toll collection system over long distances which the maximum range is about 15 metres. The smartTAG was first introduced in Malaysia in 1999 to complement Touch 'n Go, a card-based system.

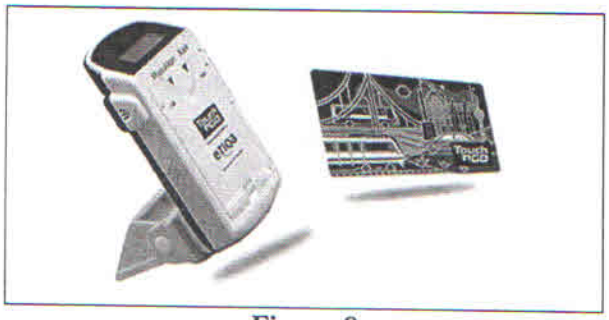


Figure 8

The smartTAG system works as follow:

- When a vehicle is approaching the barrier, the sensor senses the smartTAG.
- Balance in the Touch 'n Go card is checked.
- If the balance in the Touch 'n Go is insufficient, a message of 'Insufficient Balance' will be displayed and the barrier needs to remain in it current position.
- If the balance in the Touch 'n Go is sufficient, the barrier needs to raise the arm until it is at the top position.
- Once the arm is at the top position, it has to stay there until the vehicle has driven through the barrier.
- After the vehicle has driven through, the barrier needs to lower the arm until it reaches the bottom position.

Given that:

States

S_1 : idle / waiting for vehicle to approach the barrier

S_2 : checking the balance

S_3 : raising the arm barrier

S_4 : the arm barrier is raised at the top position and waiting for the vehicle to drive through

S_5 : lowering the arm barrier

Inputs

A : no vehicle approaching the barrier

B : sensor senses a vehicle is approaching

C : sufficient balance

D : insufficient balance

E : the arm barrier is not at the top position

F : the arm barrier is at the top position

G : vehicle has driven through the barrier

H : no vehicle has driven through the barrier

I : the arm barrier is not at the bottom position

J : the arm barrier is at the bottom position

Outputs

0 : nothing happened

1 : display 'insufficient balance' message

2 : raise the arm barrier

3 : lower the arm barrier

Construct the transition table in Table 2 below (complete the unshaded cells only).

Table 2

State	Input, f_s										Output, f_o									
	A	B	C	D	E	F	G	H	I	J	A	B	C	D	E	F	G	H	I	J
S_1																				
S_2																				
S_3																				
S_4																				
S_5																				

*Construct the table in your answer booklet.

Question 5

[20 Marks]

a) Three young graduates have formed a company. The three graduates, Alisha, Ben and Corey have a system to minimize friction. For all minor decisions they want to use a circuit that will determine when a majority of the three of them has voted for a proposal. Essentially, they want a box with three inputs (A,B,C) that will produce a 1(yes) at the output whenever two or more of the inputs are 1.

i) Draw a truth table to represent the above system.

(5 marks)

ii) Find the minterms expressions correspond to truth table obtain in (i)

(4 marks)

iii) Draw the logic circuit for the minterms expressions obtain in (ii)

(5marks)

b) Simplify this expression by using a karnaugh map

$$Y = A'B'C'D + A'B'CD + A'BC'D' + A'BCD' + A'BCD + AB'C'D + AB'CD' + AB'CD + ABC'D' + ABC'D$$

(6 marks)

Question 6

[10 Marks]

a) Could the following bit string have been received correctly if the last bit is a parity bit

i) 1000011

ii) 110111011100

(2 marks)

b) Suppose the encoding function is defined by $f: B^2 \rightarrow B^4$.

$f(00) = 0000$

$f(01) = 0101$

$f(10) = 1010$

$f(11) = 1101$

How many error the function will detect?

(5 marks)

c) A parity check matrix H is given as below and suppose the encoding function is defined as $f_H: B^3 \rightarrow B^6$.

$$H = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Find the following group code

i) $f(001)$

ii) $f(101)$

iii) $f(111)$

(3 marks)

Question 7

[10 Marks]

Consider the (2,5) encoding function $e : B^2 \rightarrow B^5$ define by

$e(00) = 00000$

$e(01) = 01110$

$e(10) = 10101$

$e(11) = 11011$

a) Define the set of code words in B^5, N

(2 marks)

b) Construct a table of left cosets for N in B^5 by completing Table 3. Place the coset leader at the beginning of each row.

(6 marks)

Table 3

Code Word / Coset leader	00000	01110	10101	11011
00000	00000	01110	10101	11011
00001	00001	01111	10100	11010
00010	00010	01100	10111	11001
00100	00100	01010	10001	11111
01000	01000	00110	11101	10011

c) Decode word 01101 relative to a maximum likelihood decoding function.

(2 marks)