**CHAPTER 4.7 : (DIJKSTRA'S SHORTEST PATH ALGORITHM)**
**QUESTION 1, 2**

Assignment 4

Question 1 (4.7)

| Iteration | S | N | L(a) | L(b) | L(c) | L(d) | L(e) | L(f) | L(g) | L(h) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | – | {a,b,c,d,e,f,g,h} | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | |
| 1 | {a} | {b,c,d,e,f,g,h} | 0 | 5 | 6 | ∞ | ∞ | ∞ | ∞ | ∞ | a |
| 2 | {a,b} | {c,d,e,f,g,h} | | 5 | 6 | 6 | ∞ | ∞ | ∞ | ∞ | |
| 3 | {a,b,d} | {c,e,f,g,h} | | | 6 | 6 | 10 | 13 | ∞ | ∞ | |
| 4 | {a,b,d,c} | {e,f,g,h} | | | 6 | | 8 | 13 | ∞ | ∞ | c |
| 5 | {a,b,d,c,e} | {f,g,h} | | | | | 8 | 13 | 11 | ∞ | e |
| 6 | {a,b,d,c,e,g} | {f,h} | | | | | | 13 | 11 | 12 | g |
| 7 | {a,b,d,c,e,g,h} | {f} | | | | | | | | 12 | h |

shortest path from a to h is a→c→e→g→h, with the weight of 12.

Question 2

a i)

| No | S | N | L(I) | L(A) | L(J) | L(K) | L(P) | L(S) | L(M) | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | – | {I,A,J,K,P,S,M} | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | |
| 1 | {I} | {A,J,K,P,S,M} | 0 | 1768 | ∞ | 2987 | 3899 | ∞ | ∞ | I |
| 2 | {I,A} | {J,K,P,S,M} | | 1768 | 5024 | 2987 | 3899 | ∞ | ∞ | |
| 3 | {I,A,K} | {J,P,S,M} | | | 5024 | 2987 | 3899 | ∞ | ∞ | |
| 4 | {I,A,K,P} | {J,S,M} | | | 5024 | | 3899 | 5253 | ∞ | P |
| 5 | {I,A,K,P,J} | {S,M} | | | 5024 | | | 5253 | ∞ | |
| 6 | {I,A,K,P,J,S} | {M} | | | | | | 5253 | 6479 | S |
| 7 | {I,A,K,P,J,S,M} | {} | | | | | | | 6479 | M |

I = Ipoh, A = Alor Setar, J = Johor Bahru, K = KL, P = Putrajaya, S = Seremban, M = Melaka

shortest route from Ipoh to Melaka is Ipoh → Putrajaya → Seremban → Melaka with distance of 6479.

a ii)

I = Ipoh, A = Alor Setar, J = Johor Bahru, K = KL, P = Putrajaya, S = Seremban, M = Melaka

| No. | S | N | L(I) | L(A) | L(J) | L(K) | L(P) | L(S) | L(M) | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | { } | {I, A, J, K, P, S, M} | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | |
| 1 | {A} | {I, J, K, P, S, M} | 1768 | 0 | 3256 | ∞ | ∞ | ∞ | ∞ | A |
| 2 | {A, I} | {J, K, P, S, M} | 1768 | | 3256 | 4755 | 5667 | ∞ | ∞ | |
| 3 | {A, I, J} | {K, P, S, M} | | | 3256 | 4755 | 5667 | 5257 | ∞ | J |
| 4 | {A, I, J, K} | {P, S, M} | | | | 4755 | 5667 | 5257 | ∞ | |
| 5 | {A, I, J, K, S} | {P, M} | | | | | 5667 | 5257 | 6483 | S |
| 6 | {A, I, J, K, S, P} | {M} | | | | | 5667 | | 6483 | |
| 7 | {A, I, J, K, S, P, M} | { } | | | | | | | 6483 | M |

Shortest route from Alor Setar to Melaka is Alor Setar → Johor Bahru → Seremban → Melaka, with the distance of 6483.

b) i) If consider shortest distance:

Ipoh —(1h 30min, 1500, 3899)→ Putrajaya —(30min, 500, 1354)→ Seremban —(20min, 500, 1226)→ Melaka (distance: 6479, time: 2h 10min, cost: 2500)

If consider shortest time:

Ipoh → Putrajaya → Seremban → Melaka (distance: 6479, time: 2h 10 min, cost: 2500)

Ipoh —(1h, 1000, 2087)→ KL —(30min, 500, 1122)→ Putrajaya —(30min, 500, 1354)→ Seremban —(20min, 500, 1226)→ Melaka (distance: 6689, time: 2h 10min, cost: 2500)

If consider cheapest cost

Ipoh → Putrajaya → Seremban → Melaka (2500)

Ipoh → KL → Putrajaya → Seremban → Melaka (2500)

Final route: Ipoh → Putrajaya → Seremban → Melaka (shortest distance & time, cheapest way)

Final cost: 1500 + 500 + 500 = 2500

Final duration: 1h 30 min + 20 min + 20 min = 2h 10 min.

cost
distance

ii) Shortest distance:

Alor Setar —(1h 25min, 1500, 3256)→ Johor Bahru —(2h 10min, 3000, 2001)→ Seremban —(20min, 500, 1226)→ Melaka (distance: 6483, time: 3h 55 min, cost: 3900)

Shortest time:

Alor Setar —(25 min, 500, 1768)→ Ipoh —(1h 30min, 1500, 3899)→ Putrajaya —(20min, 500, 1354)→ Seremban —(20min, 500, 1226)→ Melaka (distance: 8247, time: 2h 35 min, cost: 3000)

Cheapest cost:

Alor Setar —500→ Ipoh —1500→ Putrajaya —500→ Seremban —500→ Melaka

Final route: Alor setar → Ipoh → Putrajaya → Seremban → Melaka (cheapest & take shortest time)

Final cost: 500 + 1500 + 500 + 500 = 3000

Final duration: 25mint 1h 30 min + 20min + 20 min = 2h 35 min

Final distance: 1768 + 3899 + 1354 + 1226 = 8247

cost
distance

c i) shortest distance:

Ipoh $\xrightarrow[3899]{4h\,30min\ 700}$ Putrajaya $\xrightarrow[1354]{2h\,30min\ 100}$ Seremban $\xrightarrow[1226]{2h\ 100}$ Melaka (distance: 6479, cost: 900, time: 9h)

shortest time:

Ipoh $\xrightarrow[3899]{4h\,30min\ 700}$ Putrajaya $\xrightarrow[1354]{2h\,30min\ 100}$ Seremban $\xrightarrow[1226]{2h\ 100}$ Melaka

cheapest cost:

Ipoh $\xrightarrow[2987]{4h\ 500}$ KL $\xrightarrow[1122]{2h\,30min\ 100}$ Putrajaya $\xrightarrow[1354]{2h\,30min\ 100}$ Seremban $\xrightarrow[1226]{2h\ 100}$ Melaka (distance: 6689, cost: 800, time: 11h)

Final route: Ipoh → Putrajaya → Seremban → Melaka (shortest distance & shortest time)

Final distance: 3899 + 1354 + 1226 = 6479

Final duration: 4h 30m + 2h 30m + 2h = 9h

Final cost: 700 + 100 + 100 = 900

ii) Shortest distance:

Alor Setar $\xrightarrow[3256]{2h\ 700}$ Johor Bahru $\xrightarrow[2001]{6h\,30min\ 1800}$ Seremban $\xrightarrow[1226]{2h\ 100}$ Melaka (distance: 6479, time: 13h 30min, cost: 1800)

shortest time:

Alor Setar $\xrightarrow[1768]{2h\,30min\ 100}$ Ipoh $\xrightarrow[3899]{4h\,30min\ 700}$ Putrajaya $\xrightarrow[1354]{2h\,30min\ 100}$ Seremban $\xrightarrow[1226]{2h\ 100}$ Melaka

(distance: 8247, time: 11h 30 min, cost: 1000)

cheapest cost:

Alor Setar $\xrightarrow[1768]{2h\,30min\ 100}$ Ipoh $\xrightarrow[2987]{4h\ 500}$ KL $\xrightarrow[1122]{2h\,30min\ 100}$ Putrajaya $\xrightarrow[1354]{2h\,30min\ 100}$ Seremban $\xrightarrow[1226]{2h\ 100}$ Melaka

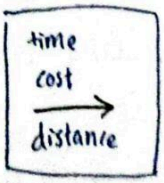
(distance: 8457, time: 13h 30min, cost: 900)

Final route: Alor Setar → Ipoh → Putrajaya → Seremban → Melaka (relatively cheaper & took shorter time)

distance: 1768 + 3899 + 1354 + 1226 = 8247

time: 2h 30min + 4h 30min + 2h 30min + 2h = 11h 30min

cost: 100 + 700 + 100 + 100 = 1000

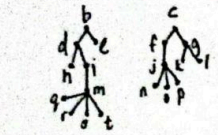


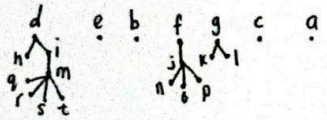
**CHAPTER 4.8 : (TREES)**
**QUESTION 1**

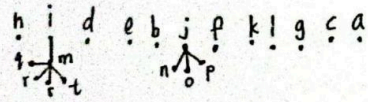
Chapter 4 (4.8) : Tree

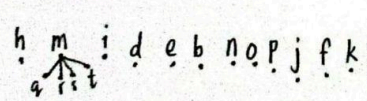
Question 1

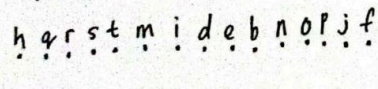
a. n, o, p
b. s, m, i, d, b, a
c. r, s, t
d. 11
e. h, i, j, k, l
f. m = 4
g. 5
h. post order : left right root



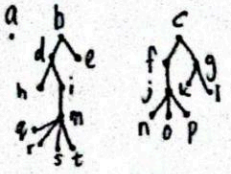


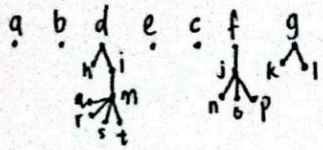


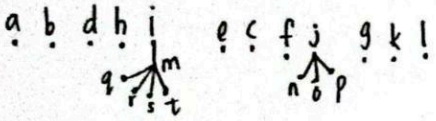


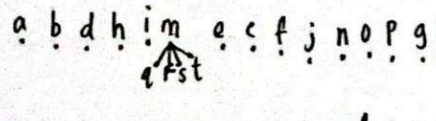


i. pre-order : root left right



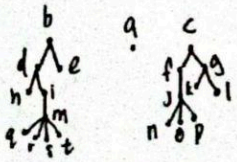


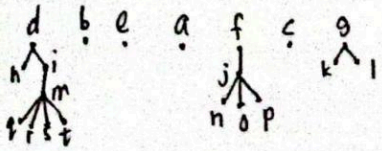


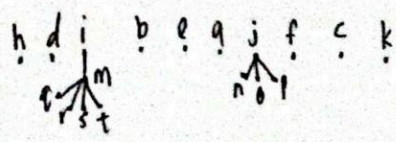


a b d h i m q r s t e c f j n o p g k l

j. inorder : left root right







h d m i b e a n j o p f c k g l

h d q r m s t i b e a n j o p f c k g l

**QUESTION 2 , 3**

## Question 2

send to 5 people or not sending = full 5-ary

$m = 5$

$i = 20000$ (those who sent)

$n = mi + 1$

$= 5(20000) + 1$

$= 100001$ (people receiving letters)

not sending $= 100001 - 20000$

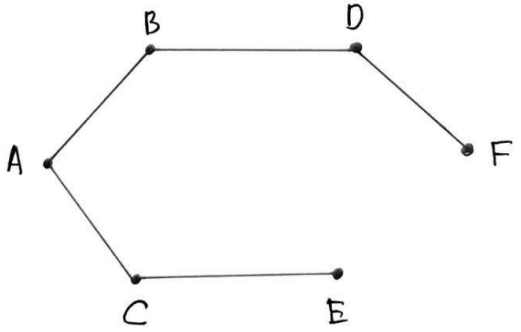
$= 80001$

∴ No. of people receiving letter = 100001

No. of people not sending the letter = 80001

## Question 3

ED 20 ✓(Chosen because it has least weightage of 20)
AC 20 ✓(Chosen because it has least weightage of 20 without forming cycle)
AB 40 ✓(Chosen because it has second least weightage of 40 without forming cycle)
DF 40 ✓(It has second least weightage of 40 without forming cycle)
CE 50 ✓(It has third least weightage of 50 without forming cycle, all vertices are connected)
BF 50
BC 50
BE 70
AD 80
CD 80
DE 80
EF 90
AF 100
AE 100
CF 100




Overall weight = 20+20+40+40+50

= 170

**CHAPTER 5 (5.1 & 5.2) : FINITE AUTOMATA**
**QUESTION 1**

Chapter 5 (5.1 & 5.2): Finite Automata

Question 1

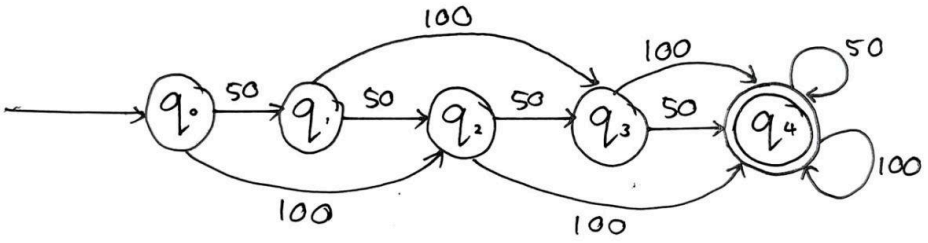
$I = \{50, 100\}$

$F = \{q_4\}$

$q_0$ = no coin accepted (2.00)
$q_1$ = accept 50 cents (1.50)
$q_2$ = accept 100 cents (1.00)
$q_3$ = accept 150 cents (0.50)
$q_4$ = accept ≥200 cents (0.00)

$S = \{q_0, q_1, q_2, q_3, q_4\}$

| $\delta s$ | 50 | 100 |
|---|---|---|
| $q_0$ | $q_1$ | $q_2$ |
| $q_1$ | $q_2$ | $q_3$ |
| $q_2$ | $q_3$ | $q_4$ |
| $q_3$ | $q_4$ | $q_4$ |
| $q_4$ | $q_4$ | $q_4$ |



**QUESTION 2**

ASSIGNMENT 4

Chapter 5: Question 2

2. (i)

| | $f_S$ | | $f_0$ | |
|---|---|---|---|---|
| | a | b | a | b |
| $q_0$ | $q_0$ | $q_1$ | 0 | 0 |
| $q_1$ | $q_2$ | $q_3$ | 1 | 1 |
| $q_2$ | $q_0$ | $q_1$ | 0 | 1 |
| $q_3$ | $q_2$ | $q_3$ | 1 | 0 |

(ii) (a) abbaaab

$q_0 \xrightarrow{0} q_0 \xrightarrow{0} q_1 \xrightarrow{1} q_3 \xrightarrow{1} q_2 \xrightarrow{0} q_0 \xrightarrow{0} q_0 \xrightarrow{0} q_1$

output string: 0011000

output : 0 (not accepted by M).

(b) bbbaababb

$q_0 \xrightarrow{0} q_1 \xrightarrow{1} q_3 \xrightarrow{0} q_1 \xrightarrow{1} q_2 \xrightarrow{0} q_0 \xrightarrow{0} q_1 \xrightarrow{1} q_1 \xrightarrow{1} q_1 \xrightarrow{1} q_3$

output string: 0101001111

output : 1 (accepted by M).

**QUESTION 3**

Chapter 5: Question 3

3. (i) $S \rightarrow q_0, q_1, q_2$

$I \rightarrow a$

$q_0 \rightarrow q_0$

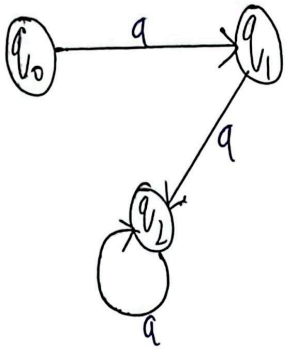
$f_S \rightarrow f_S(q_0, a) = q_1,\ f_S(q_1, a) = q_2,\ f_S(q_2, a) = q_2$

$F \rightarrow q_1$

(ii)

| | $f_S$ |
|---|---|
| | $a$ |
| $q_0$ | $q_1$ |
| $q_1$ | $q_2$ |
| $q_2$ | $q_2$ |

(iii)



**QUESTION 5**

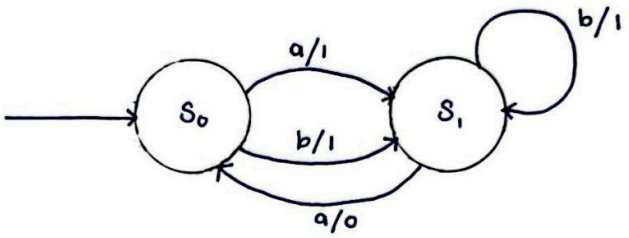
Question 5

$M = \{\{s_0, s_1\}, \{a,b\}, \{0,1\}, s_0, f_s, f_0\}$

i. Transition Table

| | $f_s$ | | $f_0$ | |
|---|---|---|---|---|
| | a | b | a | b |
| $s_0$ | $s_1$ | $s_1$ | 1 | 1 |
| $s_1$ | $s_0$ | $s_1$ | 0 | 1 |

ii Transition Diagram




iii. a) Input : abbab

$$s_0 \xrightarrow[1]{a} s_1 \xrightarrow[1]{b} s_1 \xrightarrow[1]{b} s_1 \xrightarrow[0]{a} s_0 \xrightarrow[1]{b} s_1$$

output string: 11101 output : 1 ∴ accepted

b) Input : bbaa

$$s_0 \xrightarrow[1]{b} s_1 \xrightarrow[1]{b} s_1 \xrightarrow[0]{a} s_0 \xrightarrow[1]{a} s_1$$

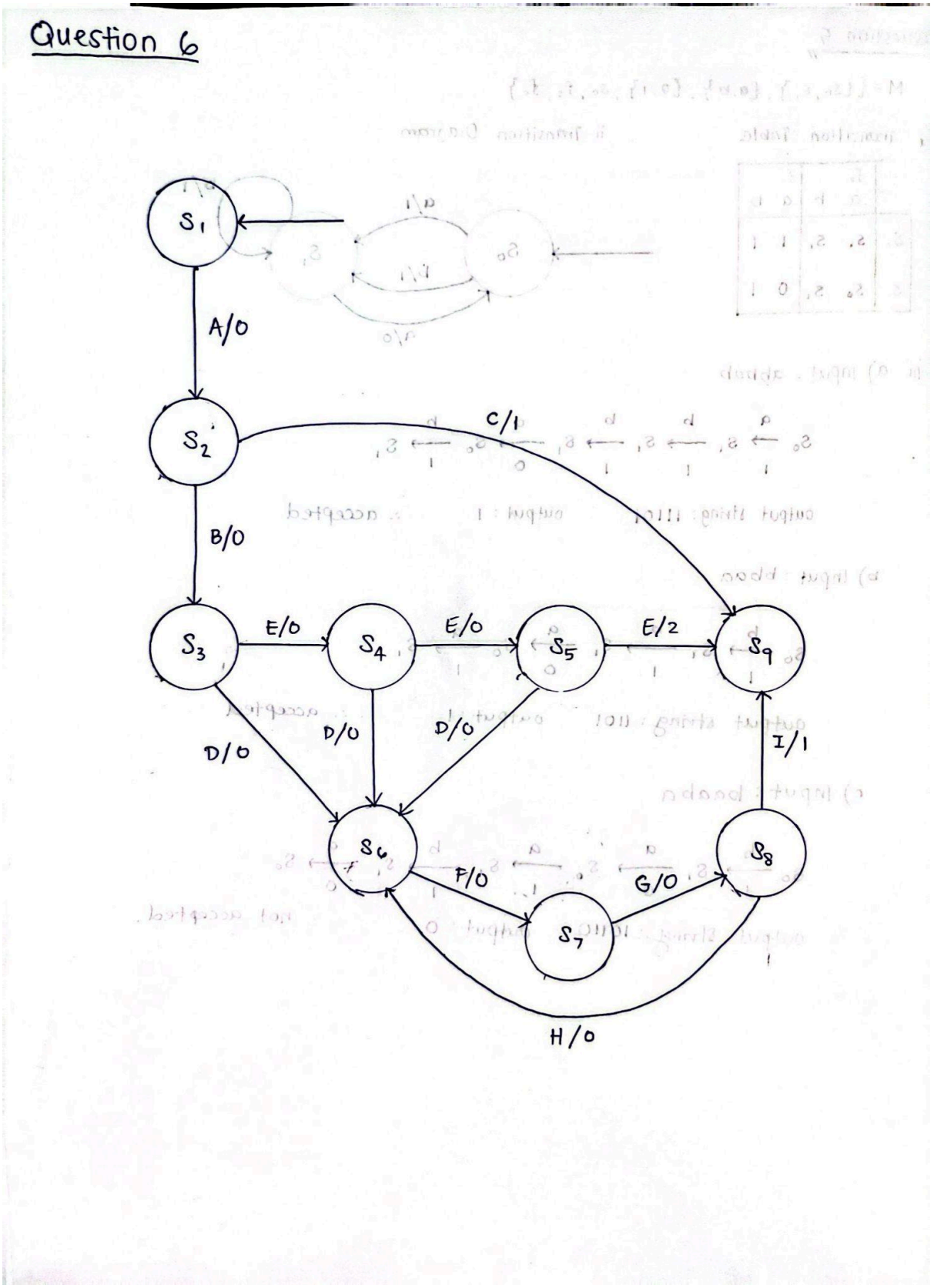
output string : 1101 output : 1 ∴ accepted

c) Input : baaba

$$s_0 \xrightarrow[1]{b} s_1 \xrightarrow[0]{a} s_0 \xrightarrow[1]{a} s_1 \xrightarrow[1]{b} s_1 \xrightarrow[0]{a} s_0$$

output string : 10110 output : 0 ∴ not accepted.

**QUESTION 6**


Question 6
S1
A/0
S2
C/1
B/0
S3
E/0
S4
E/0
S5
E/2
S9
D/0
D/0
D/0
I/1
S6
F/0
S7
G/0
S8
H/0

| | $f_s$ | | | | | | | | | $f_o$ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | I | A | B | C | D | E | F | G | H | I |
| $S_1$ | $S_2$ | - | - | - | - | - | - | - | - | 0 | - | - | - | - | - | - | - | - |
| $S_2$ | - | $S_3$ | $S_9$ | - | - | - | - | - | - | - | 0 | 1 | - | - | - | - | - | - |
| $S_3$ | - | - | - | $S_6$ | $S_4$ | - | - | - | - | - | - | - | 0 | 0 | - | - | - | - |
| $S_4$ | - | - | - | $S_6$ | $S_5$ | - | - | - | - | - | - | - | 0 | 0 | - | - | - | - |
| $S_5$ | - | - | - | $S_6$ | $S_9$ | - | - | - | - | - | - | - | 0 | 2 | - | - | - | - |
| $S_6$ | - | - | - | - | - | $S_7$ | - | - | - | - | - | - | - | - | 0 | - | - | - |
| $S_7$ | - | - | - | - | - | - | $S_8$ | - | - | - | - | - | - | - | - | 0 | - | - |
| $S_8$ | - | - | - | - | - | - | - | $S_6$ | $S_9$ | - | - | - | - | - | - | - | 0 | 1 |
| $S_9$ | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |