Type: MCQ

Q1. Which one of the following grammar generates the Language L = $\{a^i b^j \mid i \neq j\}$? . (0.5)

1.S →AC | CB
C →aCb | a | b
A → aA | λ
B →Bb | λ

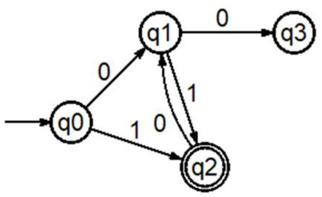
2. S →aS | Sb | a | b

3. S →AC | CB
C →aCB | λ
A →aA | λ
B →Bb | λ

4. ** S →AC | CB

C→ aCB | λ
A → aA | a
B →Bb | b

Q2. Language L given by the graph is . (0.5)



1. L = { x € {0, 1}* | x ends in 1 and does not contain substring 01}

2. ** L = { x € {0, 1}* | x ends in 1 and does not contain substring 00}

3. L = { x € {0, 1}* | x ends in 1 and contain substring 11}

4. L = { x € {0, 1}* | x ends in 1 and does not contain substring 10}

Q3. Determine the sum of minimum and maximum number of final states for a DFA having 'P' states. (0.5)

1. P
2. ** P+1
3. P-1
4. P+2

Q4. Predict the minimum number of states required in an Automaton to accept the following language.L = {w | w ends with 00} .(0.5)

1. 3
2. 2
3. 4
4. ** Cannot be said

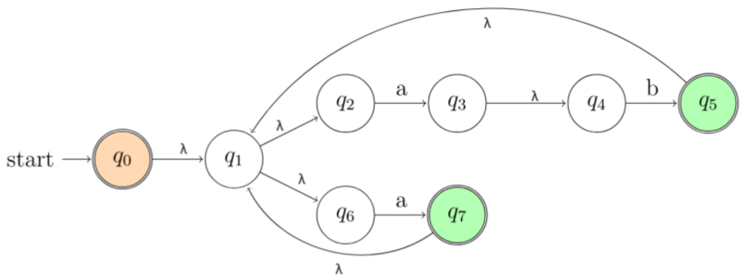
Q5. In the λ-NFA, M = ({q0, q1, q2, q3}, {a}, δ, q0, {q3}) where 'S' is given in the transition table below, what is the minimum length of string to reach to the final state?

	λ	a
q_0	$\{q_1\}$	∅
q_1	$\{q_2\}$	∅
q_2	∅	$\{q_2, q_3\}$
q_3	∅	∅

(0.5)

1. 0
2. 2
3. ** 1
4. 3

Q6. Given the λ-NFA. What are the states reachable when ‘a’ is read? (0.5)



1. {q0,q1,q2,q3,q4,q5,q6,q7}
2. ** {q1,q2,q3,q4,q6,q7}
3. {q1,q2,q3,q7}
4. {q3}

Q7. Which one of the following are NOT equivalent regular expressions? (0.5)

1. (01+10)* 01 and ((01)*+(10)*)*01
2. (01+10)(11)* and (01(11)*+10(11)*)
3. ((01)*+(10)*)* and ((01)*(10)*)*
4. **((01)*+(10)*)(11)* and (01(11)*+10(11)*)*

Q8. Identify the regular expression **(RE)** that accepts all base 3 numbers ’b’ such that b%3=1.

(0.5)

1. (0 + 1 + 2)* 0
2. ** (0 + 1 + 2)* 1
3. (0 + 1 + 2)* 2
4. (0 + 1 + 2)* 22

Q9. Identify the incorrect statement. For all regular languages:(0.5)

1. A corresponding regular expression can be obtained.
2. A left linear grammar can be written.
3. A nondeterministic automaton can be drawn.

4. ** None of the mentioned

Q10. Which among the following cannot be accepted by a regular grammar? (0.5)

1. L is a set of numbers divisible by 2
2. ** L is a set of $0^n 1^n$
3. L is a set of string with odd number of 0
4. L is a set of binary complement

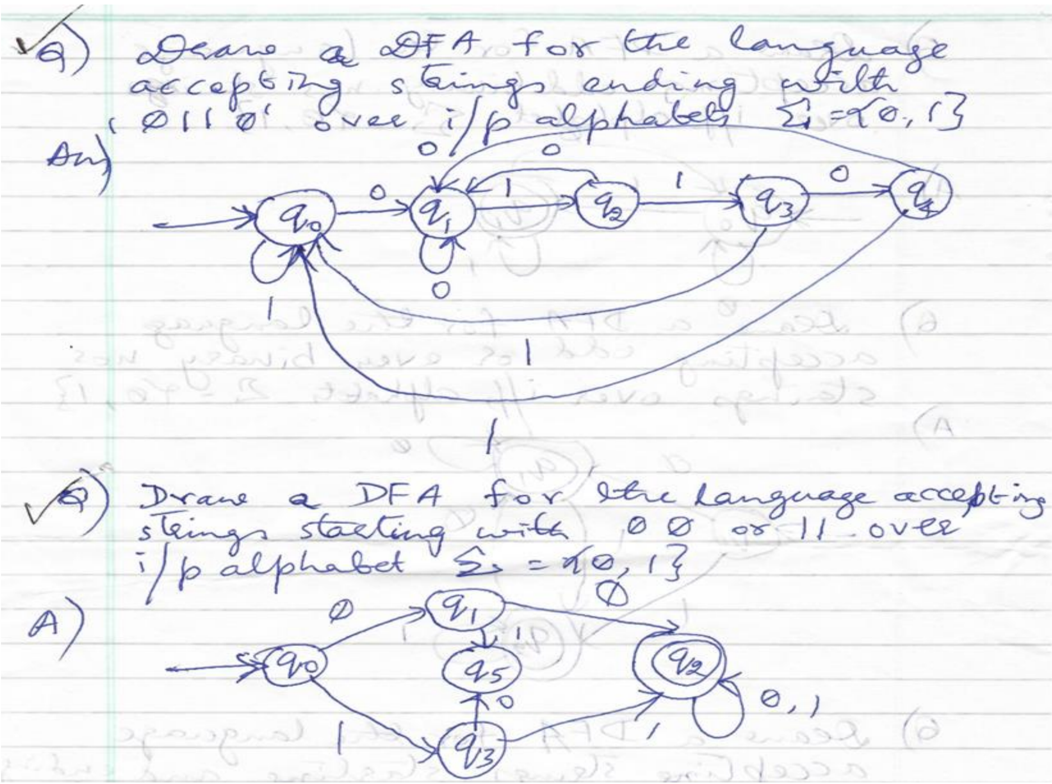
Type: DES

Q11. Apply the principles of DFA and draw the DFA with 5 states for the languagge accepting strings

i)ending with “0110” over the input alphabet ∑ ={0, 1} 1

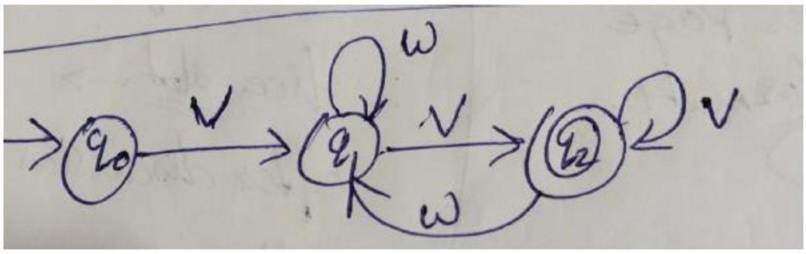
ii)starting with “00” or “11” over the input alphabet ∑ ={0, 1}. (3)

Solun: i) 1.5 M   ii) 1.5 M   Total -3 Marks



Q12. Show that the L={vwv:v,w € {a,b}*,|v|=2} is regular. (3)

Solu:



This the DFA .[Students can consider v as a or b, or a itself ,If corresponding DFA is drawn or Regular expression is given or Regular Grammar is given ,then full marks can be awarded]

Q0→VQ1

Q1→vQ2

Q1→wQ1

Q2→wQ1

Q2→vQ2

Qo→Intitial state ,Q2→Final State .

[Each steps 0.5 marks for grammar can be considered Or else if grammar is correct with less steps or correct Regular expression is given then also marks can be awarded.]

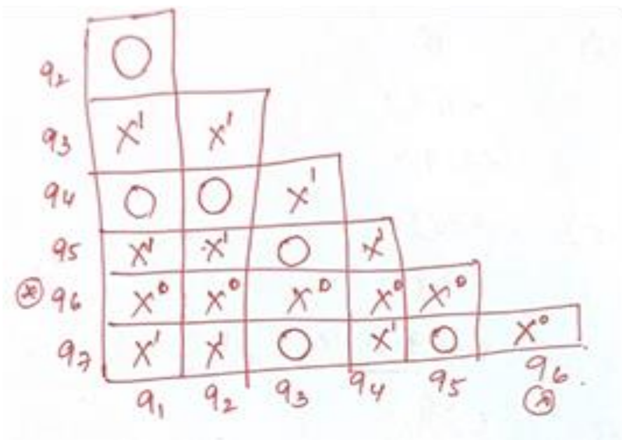
Q13. Reduce the Automaton given that q1 is the start state and q6 is the final state.

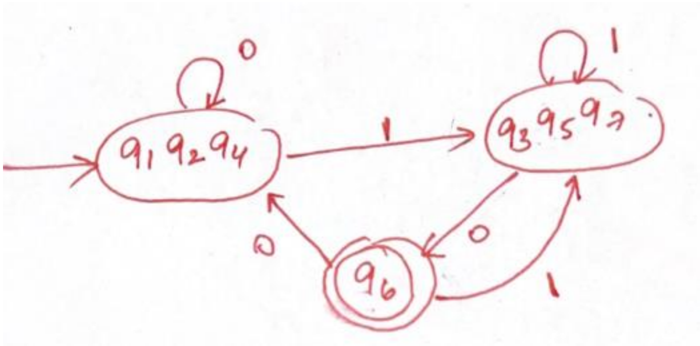
δ	0	1
q_1	q_2	q_3
q_2	q_4	q_5
q_3	q_6	q_7
q_4	q_4	q_5
q_5	q_6	q_7
q_6	q_4	q_5
q_7	q_6	q_7

. (3)

Solun:.

δ	0	1
q_1	q_2	q_3
q_2	q_4	q_5
q_3	q_6	q_7
q_4	q_4	q_5
q_5	q_6	q_7
q_6	q_4	q_5
q_7	q_6	q_7



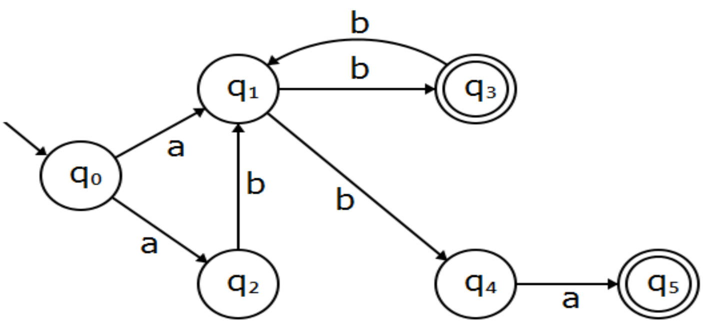


1 Mark for the table and marking final states.

1 Mark for distinguishable states

1 Mark for Minimized automata after merging states

Q14. For the NFA given in figure, Give the transition table for the equivalent DFA using Subset Construction Method



. (3)

Solun:

	a	b
$\rightarrow \{q_0\}$	$\{q_1, q_2\}$	$\emptyset$
$\{q_1, q_2\}$	$\emptyset$	$\{q_1, q_3, q_4\}$.
$\{q_1, q_3, q_4\}$	$\{q_5\}$	$\{q_3\ q_4\ q_1\}$
$\{q_5\}$	$\emptyset$	$\emptyset$
$\emptyset$	$\emptyset$	$\emptyset$

1 mark for the table generation. 2 mark for the transitions.

Q15. Find a left linear grammar for the language generated by the grammar given below where 'S' is the start symbol. Write all the steps.

S→0S |1A

A→0B |1C| λ

B→0S |1A | λ

C→0B |1C | λ . (4)

Solun:

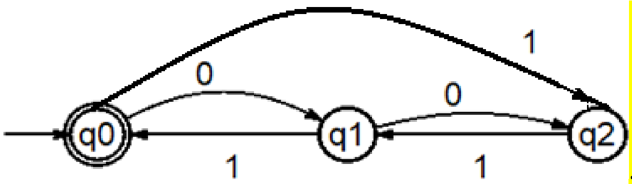
Step 1: Draw corresponding DFA

Step 2: Reverse DFA

Step 3: Obtain RLG from reversed DFA

Step 4: Obtain LLG from RLG

Q16. Derive a regular expression for the given generalised transition graph using reduction of states method



. (3)

Solun:

4 steps 0.5 each

Q17. Prove that the following language is not regular. L = { $a^{n!}$: n >=1} Σ ={a} .(3)

Solun: (String =1M ,Pumping Lemma =1M,Contracdiction =1M)

Use the Pumping Lemma. Assume for contradiction that L is a regular language. Since L is infinite. We can apply the Pumping Lemma. Let m be the integer in the Pumping Lemma. Pick a string w such that: w ∈ L , length |w|>=m, we pick $w = a^{m!}$

Write $a^{m!} = x\ y\ z$

From the Pumping Lemma
it must be that length $|x\ y| \le m, \quad |y| \ge 1$

$$xyz = a^{m!} = \overbrace{\underbrace{a\ldots a}_{x}\underbrace{a\ldots a}_{y}a\ldots a}^{m}\overbrace{a\ldots aa\ldots a}^{m!-m}$$

with z the part after y.

Thus: $y = a^k, \quad 1 \le k \le m$

$x\ y\ z = a^{m!} \qquad y = a^k, \quad 1 \le k \le m$

From the Pumping Lemma: $x\ y^2\ z \ \in\ L$

$$xy^2z = \overbrace{\underbrace{a\ldots a}_{x}\underbrace{a\ldots a}_{y}\underbrace{a\ldots a}_{y}a\ldots a}^{m+k}\overbrace{a\ldots aa\ldots a}^{m!-m} \in L$$

with z the part after the second y.

Thus: $a^{m!+k} \ \in L$

$x\,y\,z = a^{m!} \qquad y = a^k, \quad 1 \le k \le m$

From the Pumping Lemma: $x\,y^i\,z \ \in L$

$i = 0, 1, 2, \ldots$

Thus: $x\,y^2\,z \ \in L$

$a^{m!+k} \ \in L \qquad 1 \le k \le m$

Since: $L = \{a^{n!} : n \ge 0\}$

⇓

There must exist p such that:

$m! + k = p!$

However: $m!+k \le m!+m$ for $m > 1$

$$\le m!+m!$$
$$< m!m + m!$$
$$= m!(m+1)$$
$$= (m+1)!$$

$$m!+k < (m+1)!$$

$$m!+k \neq p! \quad \text{for any } p$$

$a^{m!+k} \in L \qquad 1 \le k \le m$

BUT: $L = \{a^{n!} : n \ge 0\}$

$$a^{m!+k} \notin L$$

CONTRADICTION!!!

Therefore: Our assumption that L is a regular language is not true.
Conclusion: L is not a regular language

Q18.(i) Show that the grammar is ambiguous. Consider string w= 0101011

S→ 0/01S1/0A1

A→1S/0AA1 . (2)

Solu: Two Leftmost Derivations:

Two Leftmost Derivations:

(1) S→01S1
→010A11

→0101S11

→0101011

(2) S→01S1
→0101S11
→0101011

There are two different leftmost derivative hence the language is ambiguous.

Q18.(ii) Find context free grammar for the following language with n ≥ 0 and m ≥ 0

i. L= $\{a^n b^m : 2n \le m \le 3n\}$. (2)

Solun:

n	m	$n \le m \le 2n$ condition	string
0	0	$a^0 b^0$	ε
1	1	$a^1 b^1$	ab
1	2	$a^1 b^2$	abb
2	2	$a^2 b^2$	aabb
2	3	$a^2 b^3$	aabbb

a — b
a — bb

$S \longrightarrow \varepsilon$
$S \longrightarrow aSb$
$S \longrightarrow aSbb$

$G = (V, \Sigma, R, S)$
$= (\{S, a, b\}, \{a, b\}, R, S)$ where $R = \{S \longrightarrow aSb \mid aSbb \mid \varepsilon\}$