GATE Computer Science & IT

BASIC
THEORY OF COMPUTATION

ce Questions Booklet

ANALYSIS OF THEORY OF COMPUTATION GATE PAPER

Years	Marks
2015	5
2016	9
2017	10
2018	8
2019	5
2020	9
2021 Set-1	8
2021 Set-2	10

THEORY OF COMPUTATION FOR GATE SYLLABUS

- Chomsky classification of grammar.
- Regular languages
    - Regular expression
    - Regular grammar
    - Finite Automata (DFA/NFA)
    - Conversion from NFA to DFA
    - Minimization of DFA
    - Closure Properties
    - Mealy /Moore machine
    - Pumping Lemma for regular language
- Context free language
    - Properties
    - Context –free grammar
    - PDA (Push down-automata)
    - Chomsky Normal Form
    - Greibach Normal Form
    - CYK algorithm
    - Pumping Lemma for Context Free Language
- Turing Machine
    - TM Construction
    - Turing decidable Language (Recursive language)
    - Turing Machine recognizable(Recursively enumerable language)
    - Undecidable / decidable problem.
    - Countable / uncountable sets.
- Book Reference:
    - An Introduction to formal languages and automata by "PETER LINZ"
    - An introduction to Automata Theory, Language & computation by "Ullmann, Hopcraft&Motwani"

TABLE OF CONTENTS

REGULAR LANGUAGE

Type 0 = unrestricted grammar / Recur / Recursive enum. language

Type 1 = CSL

Type 2 = CFL

Type 3 = Regular

Q1. Consider the follwing grammar G:

```
S→aSa | aAa
A→Bb
B→c
```

The grammar G belongs to which type of Chomsky classification?

(A) Type 3

(B) Type 2 but not type 3

(C) Type 1 but not type 2

(D) Type 0 but not type 1

Ans(1): (B)

Given grammar

$S \rightarrow aSa \mid aAa$ → This production Rule CFL

$A \rightarrow Bb$

$B \rightarrow c$

$L = \{ a^n c b a^n, \ n \geq 1 \}$

Q2. Consider the following grammar G with start symbol S

```
S→a SC| T
T→bTd|R
dC→Cd
RC→Cr
R→∈
```

What is the highest type number that can be assigned to the following grammar?

(A)Type 0 (B) Type1

(C) Type2 (D) Type 3

Ans (2) (A)

$S \rightarrow aSC \mid T \rightarrow$ CFL

$T \rightarrow bTd \mid R \rightarrow$ CFL

$dC \rightarrow Cd \rightarrow$ CSL

$RC \rightarrow Cr \rightarrow$ CSL

$R \rightarrow \varepsilon \rightarrow$ RE

Type 0

unrestricted grammer

Q3. Consider the following grammar G with start symbol S

```
S→Aa,
A→Ba,
B→abc.
```

What is the highest type number that can be assigned to the following grammar?

(A) Type 0 (B) Type 1

(C) Type 2 (D) Type 3

Ans (3) Given Grammer,

(D)

$S \rightarrow Aa \rightarrow$ (Regular)

$A \rightarrow Ba \rightarrow$ (Regular)

$B \rightarrow abc. \rightarrow$ (Regular)

(Left Linear Regular grammer)

$L = \{abcaa\}$

Answer: D

String accepted.

$\boxed{abcaa}$

Q4. What is the highest type number that can be assigned to the following grammar?

```
S → aA | bB
A → aB | bC
B → aB | bB
C → aC | bC | λ
```

(A) Type 0
(B) Type 1
(C) Type 2
(D) Type 3

Ans (4)
(D)

$S \rightarrow aA \mid bB$ (Regular)
$A \rightarrow aB \mid bC$ (Regular)
$B \rightarrow aB \mid bB$ (Regular)
$C \rightarrow aC \mid bC \mid d.$ (Regular)

(Right Linear Regular Grammar)

Regular Expression :- $aa(a+b)^* + \cancel{ab(a+b)^*} + ba(a+b)^*$

$\cancel{a(a+b)^*} + \cancel{b(a+b)^*}$

$= ab(a+b)^*$

B → can be reached from start symbol But non-Terminate

$L = \{a, b, aba, abab, \ldots\}$

Regular Expression :- $ab(a+b)^*$

Ans: D

Q5. Consider the following grammar G with starting symbol S:

```
S → bTbb
T → bTbb | Acccb
A → aAc | λ
```

What is the highest type number that can be assigned to the following grammar?
(A) Type 0
(B) Type 1
(C) Type 2
(D) Type 3

Ans (5) (C)

$S \rightarrow bTbb \longrightarrow$ CFL

$T \rightarrow bTbb \mid Acccb \rightarrow$ CFL   Type (2)

$A \rightarrow aAc \mid d \rightarrow$ CFL

Regular X Expression :-

$\boxed{b^m a^n c^{n+3} b^{2m+1}}$

Ans: C

Q6. The following grammar

```
G = (N, T, P, S)
N = {S, A, B, C, D, E}
T = {a, b, c}
P : S → aAB
AB → CD
CD → CE
C → aC
C → b
bE → bc is
```

(A) is type 3

(B) is type 2 but not type 3

(C) is type 1 but not type 2

(D) is type 0 but not type 1

(6) Given Grammar,

Ans: (C)

$S \rightarrow aAB$

$AB \rightarrow CD \longrightarrow$ CSL.

$CD \rightarrow CE$ Type (1)

$C \rightarrow aC$

$C \rightarrow b$

$bE \rightarrow bc$ is

Ans :- Type (1) but not Type (2).

Ans: C

Q7. The following grammar

```
G = (N, T, P, S)
N = {S, A, B, C, D, E}
T = (a, b, c}
P : S → ABCD
BCD → DE
D → aD
D → a
E → bE
E → c is
```

(A) is type 3
(B) is type 2 but not type 3
(C) is type 1 but not type 2
(D) is type 0 but not type 1

Given Grammar,

Ans 7 (D)

S → ABCD

$\boxed{BCD \to DE}$ → $|BCD| \leq |DE|$
$3 \leq 2$ ∴ Not CSL

∴ Type 0 but not Type 1.

Ans: D

Q8. A grammar has the following productions:

S → aSSb | a | bSa

Which of the following sentences are in the language that is generated by this grammar?

(A) aaaaabb
(B) aabbaabb
(C) bbbaabbaa
(D) All of the answers above are correct

Ans (8) :- Given Productⁿ Rule,

(A)

$S \to aSSb \mid a \mid bSa.$

Deriving (A)

S

$aSSb$

$aSaSSb.$

$aaaaab.$ got.

Ans: A

Q9. Consider the grammar below, with start symbol S.

```
S → AS | SB | λ
A → Aa | a
B → Bb | b
```

Which of the following strings can't be generated by this grammar?

(A) a (B) abb (C) abba (D) aaabbb

Q9 Given Production Rules is:

Ans: C

$S \to AS \mid SB \mid \lambda$

$A \to Aa \mid a.$

$B \to Bb \mid b.$

To derive :-

(A) a can't be derived.

S
aAS
a

(B) abb can't be derived.

S
SB
ASB
↓ ↓ ↓
a d Bb
↓
a d bb ⇒ abb Derived

(C) abba Cant be derived.

(D) aaabbb Yes, can be derived.

S
AS
Aa S
Aaa S
aaa S
aaa SB
aaaSBb
aaaSBbb
aaaSBbb
↓
$\boxed{\text{aaabbb}}$ derived

Language = $\{a^m b^n,$ m,n≥

~~Grammar~~ !

Ans: C

Q10. Consider the following grammar G:

S→AB | aB   A→aab | λ   B→bbA

If the language accepted by G is L(G) then which of the following set of string is the subset of the L(G)?

(A) {bbaa, abb,bb}   (B) {bbaa, bba, abb}

(C) {aab, abb}   (D) None of these

(10) Language generat^n by given grammer is

L = { bb, bbaab, aabbb, aabbbaab,
abb, abbaab }.

(A) X as {bbaa} not in L

(B) X Same —— || ——

(C) X aab is not in L

(D) None of these

Q11. Consider the language L = {w : for some u ∈ Σ*, w = $u^R u$}.Which of the following strings belongs to L?

(i) aaabbb
(ii) abab
(iii) abba
(iv) λ

(A) (i) and (ii)
(B) (iii) only
(C) (iv) only
(D) (iii) and (iv)

(11) Check strings which are palindrome

(i) (A) aaabbb → Not pallindrome.

(ii) (B) abab $\xrightarrow{\text{Reverse}}$ baba Not Pallindrom

(iii) (C) abba $\xrightarrow{\text{Reverse}}$ abba Yes Pallindrom

(iv) (D) λ → Yes pallindrome.

(D) (iii) & (iv) are correct

Q12. Consider the grammar G:

```
S → AB
A → 0A1 | 2
B → 1B | 3A
```

Which of the following strings is in L(G)?

(A) 0211300021
(B) 021300211
(C) 00213021
(D) 0021113002111

	(12) $S \to AB$ $A \to 0A1 / 2$ $B \to 1B / 3A$ Language $= \{ 0^n 2 1^n (1^m + 3(0^i 2 1^i))$ where, $n, m, i \geq 0 \}$ When, $n=1,\ m=0,\ i=2$ option (B) matches.
Q13.	Identify in the list below a sentence of length 6 that is generated by the grammar $S \to (S)S \mid \lambda$ (A) ( ) ( ) ( ) (B)))) ((((C))) (( ) ((D)) (( ) ( ) (13) Given Product[n] Rule, $S \to (S)S / \lambda$ Now, To derive option (A) S $(S)S$ $(S)(S)S$ $(S)(S)(S)S \Rightarrow ()()()$ Derived $\lambda \quad \lambda \quad \lambda \quad \lambda$ Ans: A

Q14. Consider the following grammar G:

```
S → AB
A → 0A1 | 2
B → 1B | 3A
```

Which of the following strings are in L (G)?

i) 021300211 ii) 002111300211

iii) 00211100211 iv) 0021113002111

(A)i and ii (B)iii only

(C)iii and iv (D)i,ii and iv

(14) Given grammer,

$S \to AB.$

$A \to 0A1 / 2.$

$B \to 1B / 3A.$

Again, $L = \{ 0^n 2 1^n 1^m . 3 0^i 2 1^i$

where $n, m, i \geq 0$.

(i) when, $n=1$ $i=2$ $m=0$

021300211 ✓

(ii) when, $n=2$, $m=1$, $i=2$

002111300211

Ans: A

Q15. A grammar is described as follow:

```
S → aS
S → b
S → bA
A → bB
B → a
```

Which of the following strings cannot be derived from the above grammar?

(A) abba (B) abbb

(C) bba (D) aab

	15 Given Grammar :- $S \to aS$ $S \to b$ $S \to bA$ $A \to bB$ $B \to a$. $L = \cancel{(a^* + b)(ba + \lambda)}$ $L = (a^*b)(\lambda + ba)$ (A) abba ✓ generated. (B) abbb × cant be generated. (C) bba Yes can be generated. (D) aab. Yes. $\boxed{\text{Ans is (B)}}$
Q16.	Which of the following strings cannot be derived from the symbol S using the rules $S \to SS \mid aaa \mid aaaaa$? (A) aaaaaa (B) aaaaaaa (C) aaaaaaaa (D) aaaaaaaaa

Ans (16) Given Grammer :-

$S \to SS \mid aaa \mid aaaaa.$

$L = (aaa + aaaaa)(aaa + aaaaa)^{+}.$

Clearly $\left[L = a^{3n} a^{5m} \quad n, m \geq 1 \quad + a^{6} + a^{10} \right]$

a^{7} cant be generated.

$\boxed{\text{Hence (B) can be generated.}}$

Q17. Consider the grammar given below

```
S →xB | yA
A → x | xS | yAA
B → y | yS | xBB
```

Consider the following strings.

i. xxyyyxyxyxy

ii. yyxxyyxx

iii. yxxyxyxy

iv.xxyyxy

Which of the above strings are generated by the grammar?

(A) i and ii only

(B) ii , iii and iv only

(C) i, ii and iii only

(D) All the above

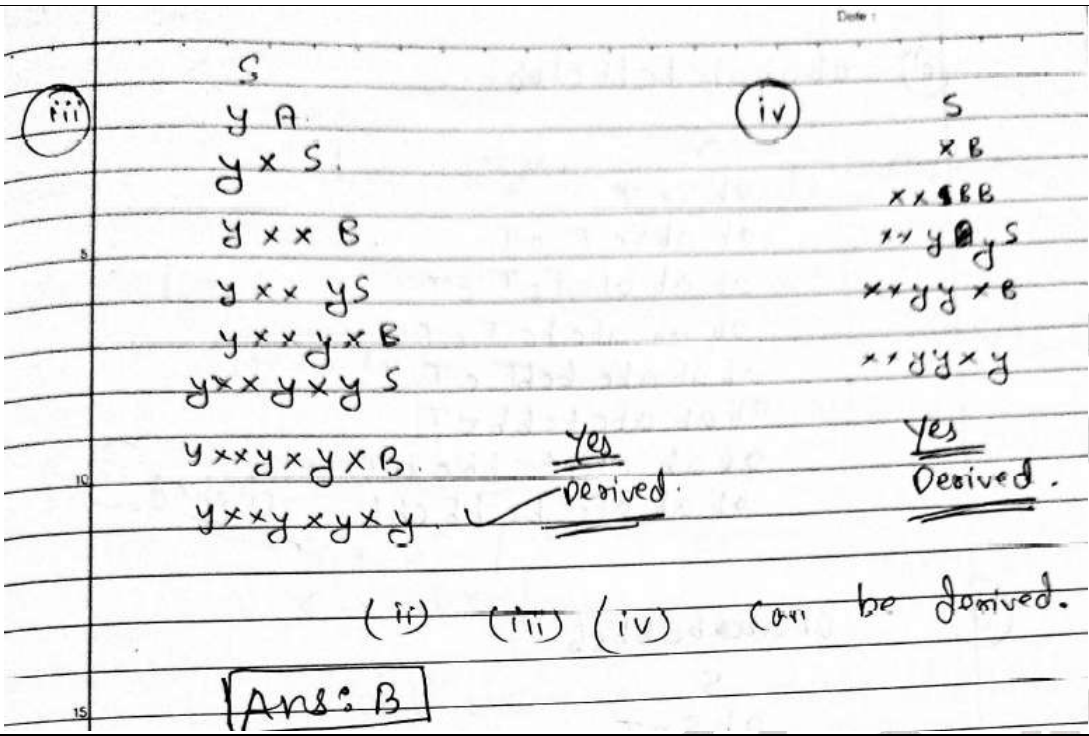
Ans:-
Q17- (i) xxyyy xy xy xy

S
x B
x x B B
x x y y S
x x y y y A.
x x y y y x S
x x y y y x y A
x x y y y x y x S
x x y y y x y x y A
x x y y y x y x y x S
x x y y y x y x y x y A

(This A can't generate $\wedge$)

$\therefore$ (i) cant be derived.

(ii) S
y A.
y y A A.
y y x A
y y x x S
y y x x y A   Yes can be derived.
y y x x y y A A.
y y x x y y x x



(iii) S

yA

yxS

yxxB

yxxyS

yxxyxB

yxxyxyS

yxxyxyxB

yxxyxyxy Yes Derived.

(iv) S

xB

xxBB

xxyBy S

xxyyxB

xxyyxy

Yes Derived.

(ii) (iii) (iv) can be derived.

Ans: B

Q18. Consider the following context-free grammar over the alphabet ∑ = {a, b, c} with S as the start symbol:

```
S ->abScT | abcT
T ->bT | b
```

Which of the following string is not generated by given grammar?

(A) ababcbbcbbb

(B) ababcbcb

(C) abababcbcbbcbb

(D) ababcbcbbcb

Q18 Given Grammer :-

$S \rightarrow abScT \mid abcT$

$T \rightarrow bT \mid b.$

(a) ab abc bb cb b b.

S

abScT

ab ab~~S~~c T cT

ab abc bTcT

ab abc bb cT

ab abc bbcbT

ab abc bbc bbT

ab abc bbc bbb.

Derived.

(b) ababcbcb.

S

abScT

ab abcTcT

ab abcbcb

Derived.

(c) abababc bc bbcbbb.

S

abScT

ab abScT cT

ab ab abcTcT cT

ab ab abc.bc TcT

ab ab abc bcbT cT

ab ab abc bcbbcT

ab ab abc bc bbcbT

ab ab abc bc bb cbb   derived.

(d) ababcabcbbcb.

S

abScT

ab abcTc T

ab abcbc T

ab abcbc.bT

ab abc bc bbT → Now T can't derive next terminal 'c'.

So (D) can't be derived from above grammar.

Q19. Consider the following grammar

S → XY | W
X → aXb | λ
Y → cY | λ
W → aWc | Z
Z → bZ | λ

What is the language generated by this grammar?

(A){ $a^ib^jc^k$ | i, j, k ≥ 0, and i = j = k }

(B){ $a^ib^jc^k$ | i, j, k ≥ 0, and i = j or i = k }

(C){ $a^ib^jc^k$ | i, j, k ≥ 0, and i = j or j = k }

(D){ $a^ib^jc^k$ | i, j, k ≥ 0, and i ≠ j or i ≠ k }

Ans:-

Q19 Given Grammer, $S \rightarrow XY / W$

$X \rightarrow aXb \mid \lambda.$

$Y \rightarrow cY \mid \lambda.$

$W \rightarrow aWc / Z.$

$Z \rightarrow bZ / \lambda.$

Solve $S \rightarrow XY.$ $S \rightarrow W$

$L_1 = a^n b^n c^m$ $L_2 = a^n b^m c^n$

$L = L_1 \cup L_2 = a^i b^j c^k$ and $[i=j$ or $i=k]$

$\boxed{\text{Ans: B}}$

Q20. Consider the following grammar

```
S → aSc | X
X → bXc | λ
```

What is the language generated by this grammar?

(A) $\{ a^i b^j c^k \mid i, j, k \geq 0, \text{ and } i + j = k \}$

(B) $\{ a^i b^j c^k \mid i, j, k \geq 0, \text{ and } i = j + k \}$

(C) $\{ a^i b^j c^k \mid i, j, k \geq 0, \text{ and } k = i - j \}$

(D) None of the above

Q20 Given Grammer,

$S \rightarrow aSc \mid X$

$X \rightarrow bXc \mid \lambda$

$L = a^n b^m c^m c^n$

$L = a^n b^m c^{n+m}, \quad n, m \geq 0.$

Hence, (i) $a^i b^j c^k$, where $k = i+j$

Ans: A

Q21. Consider the following language

```
S ->AX | Y C
A →aA |λ
C →cC | |λ
X →bXc | |λ
Y→aY b ||λ
L(G) is
```

(A) L(a*b*c*)

(B) $\{a^n b^n c^n \mid n >= 0\}$

(C) $\{a^i b^j c^k \mid i = j \text{ or } j = k\}$

(D) none of the above

Q21 Given Grammer,

$S \rightarrow AX \mid YC$

$A \rightarrow aA \mid \lambda$

$C \rightarrow cC \mid \lambda$

$X \rightarrow bXc \mid \lambda$

$Y \rightarrow aYb \mid \lambda$

$S \rightarrow AX$: $\boxed{L_1 = a^m b^n c^n}$

$S \rightarrow Yc$: $\boxed{L_2 = a^n b^n c^m}$

$L_1 \cup L_2 = a^i b^j c^k$

$\boxed{j = k \text{ or } i = j}$

$L(G) = ?$

C Correct.

Camlin

Q22. What is the language of the grammar with the following production rules?

S →ASb | c   A → a

(A) $\{a^n c b^n \mid n \in N\}$

(B) $\{xcb \mid x \in \{a\}^*\}$

(C) $\{acy \mid y \in \{b\}^*\}$

(D) All of the answers above are incorrect

Answer: D

Solution: S →ASb | c   A →a

$\Rightarrow$ S →aSb | c

$\Rightarrow L = \{a^n c b^n | n \geq 0\}$

If You take N = {0, 1, 2, 3 …} then option (a) will be correct. But it is not mention in the question N contains 0 or not. So, option D is correct.

Q23. Which language generates the grammar G given by the productions?

S → aSa | aBa   B → bB | b

(A) $L(G) = \{ a^n b^m a^n \mid n > 0, m > 0\}$.

(B) $L(G) = \{ a^n b^m a^n \mid n > 0, m < 0\}$.

(C) $L(G) = \{ ba^n b \mid n > 0, m > 0\}$.

(D) None of these

Q23 S → aSa | aBa.   B → bB | b

L = { aba , aabaa , abba , ---- }

$L = a^m b^n a^m , (m, n \geq 1)$

Option (A) .

Q24. Consider the following grammar G:

S → aSbb | λ

The language generated by the above grammar is:

(A) $L=\{a^n b^n : n \geq 0\}$

(B) $L=\{a^n b^{2n} : n \geq 0\}$

(C) $L=\{a^m b^n : n \geq 0\}$

(D) None

Q24

$S \to aSbb \mid \lambda$.

$L = \{\lambda, abb, aabbbb, aaabbbbbb, \ldots$

$L_2 \quad a^n b^{2n} \quad (n \geq 0)$

$\boxed{\text{Ans: B}}$

Q25. The language generated by the following grammar is:

S → 0S1 | C C → 1C0 | λ

(A) L1 = $\{0^n1^m0^m1^n \mid n, m \geq 0\}$

(B) L1 = $\{0^m1^{2n}0^n1^n \mid n, m \geq 0\}$

(C) L1 = $\{0^n1^m0^{2m}1^n \mid n, m \geq 0\}$

(D) L=$\{0^n1^n1^m0^m \mid n, m \geq 0\}$

Q25 A

$S \to 0S1 \mid C \qquad C \to 1C0 \mid \lambda$

$l = \{\lambda, 01, 0101, 001011, \ldots\}$

$\boxed{l = 0^n1^m0^m1^n, \quad n, m \geq 0}$

$\boxed{\text{option A.}}$

Q26. Consider the following grammar G with start symbol S over the alphabet Σ = {a, b}

S → aSaa | B

B → bB | λ

The language generated by G is

L1 = $\{a^nb^na^{2m} \mid n, m \geq 0\}$ L2 = $\{a^nb^{2m} \mid n, m \geq 0\}$

L3 = $\{a^nb^ma^{2n} \mid n, m \geq 0\}$ L4 = $\{a^nb^ma^{2m} \mid n, m \geq 0\}$

(A) L1 (B) L2

(C) L3 (D) L4

(26) Given Grammar,

C

$S \to aSaa \mid B$

$B \to bB \mid d.$

$L = \{ d, abaa, abbaa, aabaaaa, \ldots \}$

$\boxed{L = a^n b^m a^{2n}, \quad n, m \geq 0.}$

(C) L3 is correct.

Q27. Consider the following language:

$L = \{a^k b^{2k} \mid k >= 2\}$

Which of the following grammar generates L?

(A) $S \to aSbb \mid \lambda$

(B) $S \to aSbb \mid abb$

(C) $S \to aSbb \mid aabbbb$

(D) $S \to aX \mid bbY$ $\quad X \to aX \mid \lambda$ $\quad Y \to bbY \mid \lambda$

Answer: C

Solution: $L = \{a^k b^{2k} \mid k >= 2\} = \{aabbbb, aaabbbbbb \ldots\}$

(A) $S \to aSbb \mid \lambda$ $\quad \Rightarrow L = \{a^k b^{2k} \mid k >= 0\}$

(B) $S \to aSbb \mid abb$ $\quad \Rightarrow L = \{a^k b^{2k} \mid k >= 1\}$

(C) $S \to aSbb \mid aabbbb$ $\quad \Rightarrow L = \{a^k b^{2k} \mid k >= 2\}$

(D) $S \to aX \mid bbY$ $\quad X \to aX \mid \lambda$ $\quad Y \to bbY \mid \lambda$

$\Rightarrow L = aa^* + bb(bb)^*$

So, option C is correct.

Q28. Consider the following language:

$L = \{ab^n \mid n >= 0\} \cup \{(ba)^m \mid m > = 0\}$

(A) $S \to abS \mid baS \mid \lambda$

(B) $S \to aX \mid bY$ $\quad X \to bX \mid \lambda$ $\quad Y \to baY \mid \lambda$

(C) $S \to aX \mid baY$ $\quad X \to bX \mid \lambda$ $\quad Y \to baY \mid \lambda$

(D) None of the above

Answer: D

Solution:

Q28 $L = \{ab^n \mid n \geq 0\} \cup \{(ba)^m \mid m \geq 0\}$

$\{a, ab, abb \dots\} \cup \{\lambda, ba, baba \dots\}$

A) $S \to abS \mid baS \mid \lambda$

$L = \{abba \dots\}$ ✗

not part of language

B) $S \to aX \mid bY$

$X \to bX \mid \lambda$

$X \to baY \mid \lambda$

from $S \to aX$ from $S \to bY$

$\Rightarrow ab^* + b(ba)^*$ ✗

C) $S \to aX \mid baY$

$X \to bX \mid \lambda$

$Y \to baY \mid \lambda$

$\Rightarrow ab^* + (ba)^+$ ✗ $\because$ we need λ in L also

$\Rightarrow$ ans $\to$ D none of the above

Q29. Consider the Grammar G, with productions.

$S \to aA \mid \lambda$, $A \to bS$

Which of the following language are generated by G?

(A) $L = \{a^n b^n \mid n>0\}$

(B) $L = \{a^n b^m \mid n>0, b>0\}$

(C) $L = \{(ab)^n \mid n \geq 0\}$

(D) $L = \{(ab)^n \mid n>0$

(29) Given Grammer,

$S \to aA \mid \lambda$, $A \to bS$

$L = \{ \lambda, ab, abab, ababab, \dots \}$.

for ab,

Start symbol $S \to aA$

ab

S
aA
abS
$ab\lambda \Rightarrow ab$.

'λ'

$S \to \lambda$

abab

$S \to aA$
$\to abS$
$\to abaA$
$\to ababS$
$\to abab\lambda$
$\to abab$

So, $L = \{ (ab)^n \mid n \geq 0 \}$.

Ans (C) is Correct.

Q30. Which language generates the grammar G given by the productions

$S \to aSdd \mid A$

$A \to bAc \mid bc$

(A) $L(G) = \{ a^n b^m c^m d^{2n} \mid n \geq 0, m > 0\}$

(B) $L(G) = \{ a^m b^m c^n d^{2n} \mid n \geq 0, m > 0\}$

(C) $L(G) = \{a^i b^m c^m d^{2n} \mid i > 0, n \geq 0, m > 0\}$

(D) $L(G) = \{ a^n b^i c^j d^{2n} \mid n \geq 0, i > 0, j > 0\}$

	30 $S \to aSdd \mid A$ A $A \to bAc \mid bc$ $L = \{abcdd,\ abcbcdd,\ aabcdddd, \ldots$ $\boxed{L = a^n b^m c^m d^{2n},\ (n \geq 0,\ m \geq 1)}$ Option A is correct.
Q31.	Consider the following grammar G with start symbol S over the alphabet Σ = {a, b} `S → aXa	bXb	a	b` `X → aX	bX	λ` The language generated by G is (A) All strings that start and end with the same symbol. (B) All nonempty strings that start and end with the different symbol. (C) All nonempty strings that start and end with the same symbol. (D) None of the above.

Q31 — C

Given Grammer,

$S \rightarrow aXa \mid bXb \mid a \mid b$

$X \rightarrow aX \mid bX \mid \lambda.$

~~L = wTw^R~~, ~~where~~

Clearly, $L = a(a+b)^*a + b(a+b)^*b + a + b$

∴ All non empty strings that start and end with same symbol is gener by L.

$\boxed{\text{Answer: C}}$

Q32. The language generated by the following grammar is

```
S→ aB| bA
A→ a|aS|bAA
B→ b|bS|aBB
```

(A) Strings contain equal number of a's and equal number of b's.

(B)Strings contain odd number of a's and odd number of b's.

(C)Strings contain odd number of a's and even number of b's.

(D)Strings contain even number of a's and even number of b's.

Q32 — A

$S \rightarrow aB \mid bA,$

$A \rightarrow a \mid aS \mid bAA,$

$B \rightarrow b \mid bS \mid aBB.$

Clearly, when S chooses aB, then it searches for terminal b and when S choose

	-bA then it searches for terminal a By observation whenever these encounters 'a' then production forces to go for terminal 'b'. Hence, language generated by given grammer is string contain equal no. of a's and equal no. of b's. $\boxed{\text{Ans: A}}$
Q33.	Consider the following grammar $S \rightarrow 0S0 \mid 0S1 \mid 1S0 \mid 1S1 \mid 0$ What is the language generated by this grammar? (A){$w \in \{0, 1\}^*$ | the length of w is odd } (B){$w \in \{0, 1\}^*$ | the length of w is odd and the middle symbol is 0 } (C){$w \in \{0, 1\}^*$ | the length of w is odd and the middle symbol is 1 } (D){$w \in \{0, 1\}^*$ | w contains 0 in middle }

	Q33 B Consider Grammer :- $S \to 0S0 \mid 0S1 \mid 1S0 \mid 1S1 \mid 0.$ $L = \{0, 000, 001, 100, 101 \ldots\}$ clearly S terminates with '0' as middle and every time add's two terminals. Hence, length of string generated by grammer is $(2n+1, n \geq 0)$ and middle symbol is 0. ∴ Option (B), (the length of w is odd and middle symbol is 0) Camlin
Q34.	Consider the following grammar G with start symbol S over the alphabet Σ = {a, b} S → Aa | MS | SMA A → Aa | λ M → λ | MM | bMa | aMb The language generated by G is (A) All strings with more a's than b's. (B) All strings with one more a's than b's. (C) All strings with more b's than a's. (D) All strings with equal a's and b's.

Given grammer,

Q34.

$S \to Aa \mid MS \mid SMA$

$A \to Aa \mid \lambda.$

$M \to \lambda \mid MM \mid bMa \mid aMb.$

$L = \{ a, baa, aba, \ldots \}$

Language is a^+ (equal no. of a's and b's)

+ (equal no. of a's and b's) a^+ +

a^+ (equal no. of a's and b's) a^+.

Hence, Language accepted by given grammer is all strings with more a's than b's.

Ans A

Q35. How many of the following is/are true? _________

(i) baa $\in$ a*b*a*b*

(ii) b*a* $\cap$ a*b* = a* $\cup$ b*

(iii) a*b* $\cap$ c*d* = $\varnothing$

(iv) abcd $\in$ (a(cd)*b)*

35) (i) $baa \in a^*b^*a^*b^*$

Ans: 2

$b^1a^2 \Rightarrow baa$. True.

(ii) $b^*a^* \cap a^*b^* = a^* \cup b^*$.

I   II

Ist part :- All 'a' must come after (any no. of) 'b'.

IInd part :- All 'b' must come after (any no. of) 'a'

In Intersection both condition must be satisfy, and it is possible only when, either only any no. of 'a' comes or Any no. of 'b' comes.

Hence True. (ii) ✓

(iii) $a^*b^* \cap c^*d^* = \phi$.

false, as $\boxed{a^*b^* \cap c^*d^* = \lambda}$

(iv) $abcd \in (a(cd)^*b)^*$.

$(a(cd)^0b)(a(cd)^1b)$. $\Rightarrow$ abacdb

Hence, ~~Hence~~ Cant derived "abcd".

(iv) false. $\boxed{abcd \notin (a(cd)^*b)^*}$.

(i) & (ii) True. Ans :- (2)

Q36.	Determine whether the strings in the table belong to any of the languages described by the following regular expressions

RE	1001 belongs to the language (T/F)	110 belongs to the language (T/F)
10^*1^*		
$(10)^*+(1)^*$		
$(00)^*1^*(01)^*1$		
$(00)^*1^*(01)\ 1$		
$0^*(10+1)^*$		

(i) For 1001 : T, F, F, F, F

(ii) For 110 : F, F, F, F, T

(A) i only

(B) ii only

(C) Both i & ii

(D) Neither i nor ii

Q36

Ans: C

RE	(1001) belongs to lang. (T/F)	110 belongs to language (T/F)
10^*1^*	True $1^1 0^2 1^1 \Rightarrow 1001$	false 10 but not 110
$(10)^*+(1)^*$	1010 false 1001 ×	false 10 or 11 but not 110
$(00)^*1^*(01)^*1$	$(00)^0 1^1 (01)^1 \rightarrow$ false	false 1101 but not 110.
$(00)^*1^*(01)1$	$(00)^0 1^1 (01) 1 \rightarrow$ false.	False 11 or 1011 but 110.
$0^*(10+1)^*$	$(10)^1 (10)^1 \rightarrow$ false.	True (1)(10) can be derived

Can be deived

Q37.	Which of the following is not in the set of strings denoted by the regular expression R = (a* b c*)*?

(A) aabc

(B) bacd

(C) abcbc

(D) babbc

$(a^* b c^*)^*$

Q37

(a) $a^2 b^1 c^1 \Rightarrow aabc$

(b) bacd $\Rightarrow$ can't be derived as 'd' is not present and 'b' is compulsory between 'a' and 'c'.

(c) abcbc

$(a^1 b c^1)(a^0 b c^1) \Rightarrow abcbc$

(d) babbc

$(a^0 b c^0)^1 (a^1 b c^0)(a^0 b c^1)$ babbc.

$\boxed{\text{Ans (b)}}$

Q38. Which of the following strings are generated by the regular expression (ab)*.λ.(a+b+∅).ba?

(i) λ

(ii) aba

(iii) ababba

(iv) abababa

(A) ii, iii and iv only (B) ii and iv only

(C) i and ii only (D) All the above

38 $(abd)^*(a+b+\phi)\,ba$?

Ans: B

(A) $(abd)^0(\phi)\,ba = \phi$ but not d

So (A) can't be generated.

(B) aba. Yes

$(ab)^0(a)\,ba$

(C) ababba

$(ab)^2(b)\,ba \Rightarrow ababbba$ X

	(D) abababa $(ab)^2(a)(ba) \Rightarrow$ abababa ✓ Yes gen (B) & (D) generated. $\boxed{\text{Ans: (B)}}$
Q39.	Which of the following strings is a member of the language described by the regular expression: (a*ba*ba*ba*)* (A) bbbb (B)bbaaabb (C) bbaaabbbabb (D) bbabbbab

Q39. Regular Expression

$(a^*ba^*ba^*ba^*)^*$

(a) $(a^0ba^0ba^aba^a)(a^0ba^0ba^0ba^0)$

bbbb bb but desired bbbb

$\therefore$ (a) X cant be generated.

(b) bbaaabb.

$(a^0ba^0ba^3)(a^0ba^0ba^0ba^0)$

bbaaabbb but desired bbaaabb

$\therefore$ Cant be generated.

(c) bbaaa bbb abb.

$(a^0b\,a^0ba^3b)(a^0ba^0ba^0ba^0)(a^1ba^0ba^0ba^0)$.

bbaaabbbbabbb X Cant generate desired string

(d) bb abbb ab.

$(a^0ba^0ba^1b)(a^0ba^0ba^1b)$

bbabbbab Yes Generated.

Ans (D).

Q40. Someone has asserted that the following two regular expressions describe the same language: R1 = ((ab*a) + (ba*b))* and R2 = ((ab*a) + b*)*. Which of the following strings is contained in one of the languages but not in the other?

(A) ababab
(B) bbbbbb
(C) abba
(D) bbabba

Q (40) Given,

$R_1 = ((ab^*a) + (ba^*b))^*$

$R_2 = ((ab^*a) + b^*)^*$.

(A) R_1 is $((ab^1a))(bab)$ Yes Generated.
$= \underline{ababab}$.

R_2 is $(ab^1a)(b)(aba)$
$= abababa$ No not generated

Hence, ababab is the string which is generated by R_1 but not by R_2.

Ans is (A).

(B) b^6 generated by both R_1 & R_2

(C) abba generated by both R_1 & R_2

(D) bbabba generated by both R_1 & R_2.

Q41. The regular expression b*ab*ab*ab* represents the language

(A) $L = \{w : w \in \Sigma^*, n_a(w) = 3\}$

(B)$L = \{w : w \in \Sigma^* \; n_a(w) <= 3\}$

(C) $L = \{w : w \in \Sigma^* \; n_a(w) >= 3 \}$

(D) none

Ans 41 Given Expression :-

$b^*ab^*ab^*ab^*$

Clearly language accepts strings with exactly 3 a's.

(A) $L = \{ w : w \in \Sigma^* \; n_a(w) = 3 \}$

$\boxed{\text{Ans: A}}$

Q42. The regular expression b* + b*ab*+ b*ab*ab* represents the language

(A) $L = \{w : w \in \Sigma^*, n_a(w) = 2\}$

(B) $L = \{w : w \in \Sigma^* \; n_a(w) <= 2\}$

(C) $L = \{w : w \in \Sigma^* \; n_a(w) >= 2 \}$

(D) none

Ans 42 :- Given Expression :-

$b^* + b^*ab^* + b^*ab^*ab^*$

$\downarrow$ 0 a's $\quad$ $\downarrow$ 1 'a' $\quad$ $\downarrow$ exactly 2 a's.

$L = \{ w : w \in \Sigma^* \; n_a(w) <= 2 \}$

Ans :- (B) is correct.

Q43. Which of the following pair of regular expression is/are true?

I. $(01 + 0)^*0 \Leftrightarrow 0(10 + 0)^*$

II. $0(120)^*12 \Leftrightarrow 01(201)^*2$

III. $\phi^* \Leftrightarrow \lambda^*$

IV. $(0^*1^*)^* \Leftrightarrow (1^*0^*)^*$

(A) I, III and IV only

(B) II and III only

(C) II, III and IV only

(D) All the above

Ans 43 :- ① $(01+0)^* 0 \Leftrightarrow 0(10+0)^*$.

True, (Property of Regular expression)

② $0(120)^*12 \Leftrightarrow 01(201)^*2$.

True, Same Reason.

③ $\phi^* \Leftrightarrow \lambda^*$

As $\phi^* = \{\lambda\}$. True

$\lambda^* = \{\lambda\}$

④ $(0^*1^*)^* \Leftrightarrow (1^*0^*)^*$.

True, (By Property of Regular Exp)

$\boxed{\text{Ans: D}}$

Q44. Regular expression $r = (aa^*b)^* (aa^* + \lambda)$ is equivalent to:

(I) $(ab)^* (a+\lambda)$

(II) $a^*(ab)^*$

(III) $(b+ba)^*$

(IV) $(a+ab)^*$

(V) $(aa^*b)^*$

(A) IV and V

(B) I, II and III

(C) II, IV and V

(D) IV only

Q44 Given Regular Expression is

$r = (aa^*b)^* (aa^* + d)$

(i) $(ab)^*(a+d)$ false.

as 'aaa' accepted by r but not by (i)

(ii) $a^*(ab)^*$ false,

as "ab aaa" accepted by r but not by (ii)

(iii) $(b+ba)^*$ false baba does not generate by regular Expression.

(iv) $(a+ab)^*$ True.

(v) $(aa^*b^*)^*$ also not generate abaa String that end with a.

Answer: D

Q45. Identify the pairs of regular expressions that are equivalent (in that they describe the same sets of strings):

(I) (ab)+ (ab)*ab

(II) ab* (ab)*

(III) (a|b+) (a|(b)+)

(IV) a+* a+

(V) a*a (ba*a)* (a + ab)*a.

(A)I, II and III only

(B)I and III only

(C)I, III and V only

(D)All are equivalent

	Q45. (i) $(ab)^+ \Leftrightarrow (ab)^* ab$ True. As $\boxed{A^+ = A^* A}$ (ii) $ab^* \Leftrightarrow (ab)^*$ false LHS can generate abb but RHS cant. (iii) $(a+b)^+ \Leftrightarrow (a+(b)^+)$ Yes equivalent. (iv) $(a^+)^* \Leftrightarrow a^+$ false As 'λ' generated by LHS but not by RHS. Camlin (v) $a^*a(ba^*a)^* \Leftrightarrow (a+ab)^*a$ Yes equivalent. Ans :- (i), (iii), (v) are equivalent. $\boxed{\text{Answer: C}}$
Q46.	Match the regular expression with its description (1) (0∪1)*01(0∪1)* i. All strings which doesn't contain the substring 101. (2) 1*0* ii. Strings containing the substring 01. (3) (10∪0)*(1∪10)* iii. Strings of the form 111 . . . 000 . . ., that is, strings that begins with Zero or more ones followed by zero or more zeroes (4) 0*(1∪000*)*0* iv. All strings where each occurrence of 00 precedes all Occurrences of 11

	(A) 1-ii,2-iii,3-i,4-iv	(B) 1-ii,2-iii,3-iv,4-I
	(C) 1-iv,2-iii,3-ii,4-i	(D) 1-iii,2-ii,3-i,4-iv

Q46 Ans: B

Soln: (1) $(0\cup1)^* \underline{01}(0\cup1)^*$ → (ii) Strings containing substrings 01.

(2) 1^*0^* → (iii) Strings of the form 111... 000..., that is, strings that begins with zero or more ones followed by zero or more zeroes.

(3) $(10\cup0)^*(1\cup10)^*$ → (iv) All strings where each occurence of 00 precedes all occurences of 11.

(4) $0^*(1\cup000^*)^*0^*$ → All string which doesn't contain the substring 101.

(B) 1-ii, 2-iii, 3-iv, 4-i.

Q47. How many of the following is/are true? __________

(i) (ab)*a = a(ba)*

(ii) (a∪ b)* b (a ∪ b)* = a* b (a ∪ b)*

(iii) [(a ∪ b)* b (a ∪ b)* ∪ (a ∪ b)* a (a ∪ b)*] = (a ∪ b)*

(iv) [(a ∪ b)* b (a ∪ b)* ∪ (a ∪ b)* a (a ∪ b)*] = $(a \cup b)^+$

(v) [(a ∪ b)* b a (a ∪ b)* ∪ a*b*] = (a ∪ b)*

Q7 (i) $(ab)^* a = a(ba)^*$

True, (Property of Regular expression)

(ii) $(a \cup b)^* b (a \cup b)^* = a^* b (a \cup b)^*$

$(a+b)^* b (a+b)^*$

$a^* b (a+b)^*$.

Yes Equivalent,

(ii) True.

(iii) $[(a \cup b)^* b (a \cup b)^* \cup (a \cup b)^* a (a \cup b)^*]$

$(a+b)^* b (a+b)^* + (a+b)^* a (a+b)^*$.

$\Rightarrow \quad (a+b)^* - \{\lambda\}$

or $\quad (a+b)^+$

$\therefore$ (iii) false.

(iv) $[(a \cup b)^* b (a \cup b)^* \cup (a \cup b)^* a (a \cup b)^*]$

	(iv) $[(a\cup b)^* b (a\cup b)^* \cup (a\cup b)^* a (a\cup b)^*]$ $= (a+b)^+$ True, (Proved above) (v) $((a\cup b)^* ba (a\cup b)^* \cup a^*b^*)$ $(a+b)^* ba (a+b)^* + a^*b^*$. $L = \{\lambda, a, b, ab, ba, \ldots\}$ $L = (a+b)^*$. Hence (i) (ii) (iv) & (v) are correct. $\boxed{\text{Ans is (4).}}$
Q48.	**[MSQ]** Which of the following regular expressions are equivalent to the regular expression $R = (bba + aab + ab + b + a)^+ + \lambda$ (A) $(a^*b^*)^*$ (B) $(a^*b^*)^+ + \lambda$ (C) $(a + b + aa)^*$ (D) $(a + b)^*$

Q48 $R = (bba + aab + ab + b + a)^{+} + d.$

* clearly, $R = (a+b)^{*}$.

$\therefore$ (d) is correct.

* $(a+b)^{*} \Leftrightarrow (a^{*}b^{*})^{*}$

$\therefore$ (a) is correct.

* $(a^{*}b^{*})^{*} \Leftrightarrow (a^{*}b^{*})^{+} + d$

$\therefore$ (b) is correct

* $(a^{*}b^{*})^{*} \Leftrightarrow (a+b+aa)^{*}$

$\therefore$ (c) is correct.

Hence all (A), (B), (C), (D) are Correct .

Q49. **[MSQ]**

Which of the following regular expression is equivalent to given regular expression:

ε+1*(011) *(1*(011) *) *

(A) (1+011) *

(B) (1*(011) *)

(C) (1+(011) *) *

(D) (1011) *

Answer: A, C

Explanation: We know that ε + RR*= ε + R*R= ε + R+= R*.

So, ε + 1*(011) *(1*(011) *) * = (1*(011)*)* = (1 + 011)*.

It is also equivalent to (1 + (011)*)*.

Q50. If r and s are regular expressions, write $r \leq s$ to mean that the language of strings matching r is contained in the language of strings matching s. Then which of the following is/ are true?

(i) $r^*|s^* \leq (r|s)^*$

(ii) $(r|s)^* \leq r^*|s^*$

(iii) $(r^*s^*)^* \leq (r|s)^*$

(iv) $(r|s)^* \leq (r^*s^*)^*$

(v) $(rs|r)^*r \leq r(sr|r)^*$

(A) i, ii, iii only (B) i, iii, iv only

(C) ii, iii, iv only (D) All except ii

Q50 (i) $r^* + s^* \leq (r+s)^*$

True, (as rsr is generated extra and many such strings generated by RHS but not by LHS).

(ii) $(r+s)^* \leq r^* + s^*$

false, Same reason as for (i).

	(iii) $(r^*s^*)^* \leq (r+s)^*$. as LHS, RHS are equivalent. ∴ both accepts same strings. (iv) $(r+s)^* \leq (r^*s^*)^*$ LHS, RHS equivalent. $(r+s)^* \Leftrightarrow (r^*s^*)^*$. (v) $(rs+r)^*r \leq r(sr+r)^*$ Again, LHS, RHS equivalent. Hence, only (ii) is false. $\boxed{\therefore \text{(d) All accept (ii)}}$
Q51.	Which of the following is true? (i) (01)*0 = 0(10)* (ii)(0+1)*0(0+1)*1(0+1) = (0+1)*01(0+1)* (iii) (0+1)*01(0+1)*+1*0* = (0+1)* (iv) (0(0+1)*1 + 1(0 + 01)*0)* = (01 + 10)* (A) i only (B) i and iii only (C) i, ii and iii only (D) All the above Q51 (i) $(01)^*0 = 0(10)^*$ True, (By RE Property) (ii) $(0+1)^*0(0+1)^*1(0+1) = (0+1)^*01(0+1)^*$ false. (as 01 is accepted by RHS but not by LHS). Camlin

(iii) $(0+1)^* 01 (0+1)^* + 1^*0^* = (0+1)^*$

$L = \{ \varepsilon, 0, 1, 00, 01, 10, 11 \ldots \}$

$L = (0+1)^*$ True.

(iv) $(0(0+1)^*1 + 1(0+01)^*0)^* = (01+10)^*$.

as "1000" accepted by LHS but not by RHS.

Ans :- (b) i & iii only.

Q52. Consider the following four regular expressions over the alphabet {a, b}:

E1 = (ab + a*b*b*)*

E2 = ((ab)* (a*b*b*)*)*

E3 = (a + b)*

E4 = a(a + b)*

Which of the following statements is true?

(A) L(E2) = L(E3)

(B) L(E3) = L(E4)

(C) L(E1) = L(E4)

(D) L(E2) = L(E4)

	(52) $E1 = (ab + a^* b^* b^*)^*$. $E2 = ((ab)^* (a^* b^* b^*)^*)^*$ Clearly E1 and E2 are equal as $(a+b)^* = (a^* b^*)^*$. $E3 = (a+b)^*$ $E4 = a(a+b)^*$. $L(E3) \neq L(E4)$ as ('ε' accepted by E3 but not by E4.). Hence, $L(E2) = L(E3) = (a+b)^*$ Option (A) is correct
Q53.	What will be the regular expression for language L = {xwx : x, w ∈ {0, 1}*, |x|≤3}? (A) $(0+1)^3\ (0+1)^*(0+1)^3$ (B) $((0+1)+(0+1)^2+(0+1)^3)\ (0+1)^*\ ((0+1)+(0+1)^2+(0+1)^3)$ (C) $(\lambda + (0+1)+(0+1)^2+(0+1)^3)\ (0+1)^*(\lambda + (0+1)+(0+1)^2+(0+1)^3)$ (D) None of these Q53 $L = \{xwx : x, w \in (0,1)^*, \|x\| \le 3\}$. RE is given as. $\underbrace{[\lambda + (0+1) + (0+1)^2 + (0+1)^3]}_{X}\ \underbrace{(0+1)^*}_{w}\ \underbrace{[\lambda + (0+1) + (0+1)^2 + (0+1)^3]}_{X}$ Ans (C) is correct.

Q54. What will be the regular expression for the following language

$L1 = \{pwp: p, w \in \{0, 1\}^*, |p| = 7, k \in I^+\}$?

(A) $(0+1)^7 (0 + 1)^*(0+1)^7$

(B) $((0+1)+(0+1)^2+(0+1)^3 + \ldots +(0+1)^7) (0 + 1)^* ((0+1)+(0+1)^2+(0+1)^3+\ldots +(0+1)^7)$

(C) $(\lambda + (0+1)+(0+1)^2+(0+1)^3+\ldots +(0+1)^7) (0 + 1)^*(\lambda + (0+1)+(0+1)^2+(0+1)^3+\ldots +(0+1)^7)$

(D) Both a and b

Answer: None

Solution: $L1 = \{pwp: p, w \in \{0, 1\}^*, |p| = 7\}$

Both p should be same AND $|p| = 7$. So, it has 2^7 possibilities.

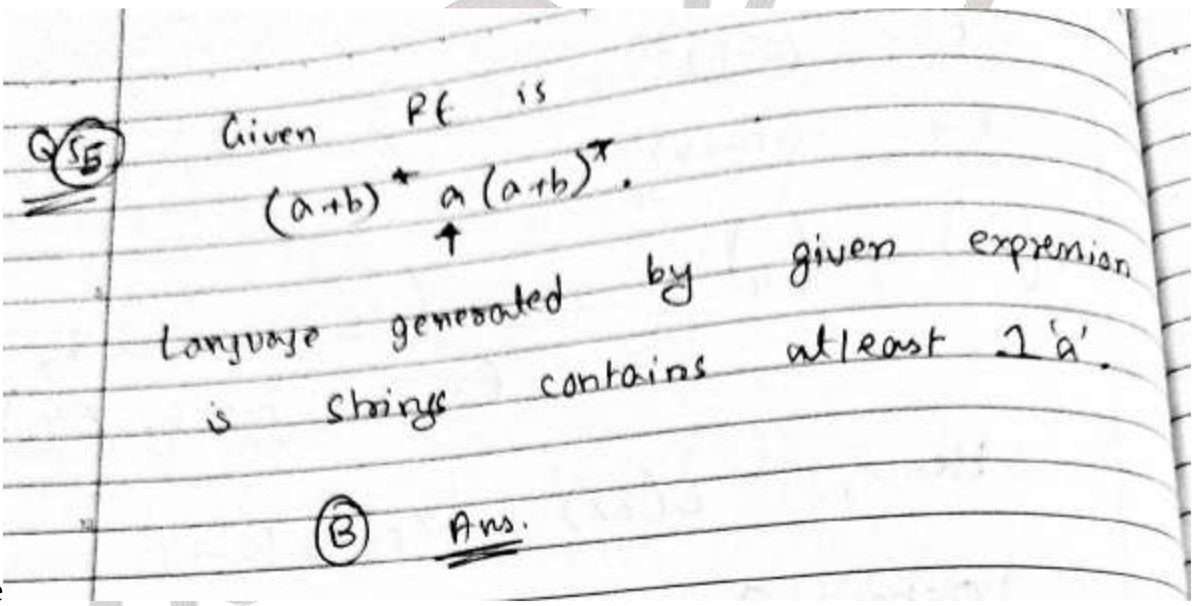
$L1 = 0^7 (0+1)^* 0^7 + 0^6 1(0+1)^* 0^6 1 + \ldots + 1^7 (0+1)^* 1^7$

Q55. The regular expression $(a + b)^*a(a + b)^*$ represents the language

(A) Contains exactly 1 a

(B) Contains at least 1 a

(C) Contains at most 1 a



(D) none

Q56. The regular expression $(b^*ab^*ab^*)^*$ represents the language

(A) $L = \{w : w \in \Sigma^*, n_a(w)$ is divisible of $2\}$

(B) every b is followed by at least one a

(C) $L = \{w : w \in \Sigma^* \; n_a(w) >= 2\}$

(D) None of these.

Q56 Given RE is $(b^* a b^* a b^*)^*$.

(A) $L = \{ w \mid w \in \Sigma^*, n_a(w)$ is divisibly by 2 $\}$.

Q57. Which of the following regular expressions generate all the strings with even Numbers of 0?

(i)1*(00)*1* (ii) 1*(010)*1*

(iii) (1*01*01*)* (iv) 1*(01*0)*1*

(A)iii and iv only (B)ii, iii and iv only

(C)iv only (D)iii only

Q57 (i) $1^*(00)^*1^*$ ("1010" contains even no. of 0's but cant be accepted by this)

(ii) $1^*(010)^*1^*$ ("0000" contains even no. of zeros but cant be accepted by this)

(iii) $(1^*01^*01^*)^*$ (Yes can accept all strings with even no. of 0.)

(iv) $1^*(01^*0)^*1^*$ ("001100" cant be accepted by this but contains even no. of zeros)

$\boxed{\text{Ans (D)}}$

Q58. Which of the following expression best describes the language L = {$\alpha \in \{0, 1\}^*$ | α contains 1's only}

(A) 1^* (B) 1^+

(C) $0 + 1^*$ (D) $1.(1)^+$

Q 58 L = { $\alpha \in (0,1)^*$ | α contains 1's only}.

Ans :- B 1^+.

Q59. Which of the following expression best describes the language
L = {$\alpha \in \{0, 1\}^*$ | α contains only 0's or only 1's}

(A) $0^* + 1^*$ (B) $(00^+) + (11^+)$

(C) $0^+ + 1^+$ (D) $0(0 + 1)^*1$

Q 59 L = { $\alpha \in (0,1)^*$ | α contains only 0's or only 1's }.

Ans :- C

$\underset{\text{only 0's}}{0^+} + \underset{\text{only 1's}}{1^+}$.

Q60. Let $\Sigma = \{0, 1\}$, and language over Σ, L = {$\alpha \in \Sigma^*$ | α contains odd number of 1's}. Which Of the following regular expression best describes the given language?

(A) $0^*(10^*10^*)^*10^*$ (B) $0^*1(11)^*\ 0^*$

(C) $0^*1^*0^*1^*0^*1$ (D) $1(11)^*$

Q60

$L = \{\alpha \in \Sigma^* \mid \alpha$ contains odd no. of 1's$\}$.

Ans :- RE is :-

$0^*\underbrace{(10^*10^*)}_{\text{even 1's}}{}^*10^*$

(even 1's + one '1') alw

returns odd no. of '1's.

Ans :- (A) is correct.

Q61. Let Σ = {0, 1}, and language over Σ,
L = {α∈Σ*| any two 0's in α are separated by three 1's}. Which of the following regular expression best describes the given language?

(A) $(01110)^*$
(B) $(01110)^* + 1^*$
(C) $1^*(01110)^* + 1^*$
(D) $1^*(0111)^*01^* +1^*$

Q61

$L = \{\alpha \in \Sigma^* \mid$ any two 0's in α are seperated by three 1's$\}$.

RE is $\boxed{1^*(0111)^*01^* + 1^*}$

Ans :- (D)

Q62. Let Σ = {0, 1}, and language overΣ, L = {α∈Σ*| α is a binary number divisible by 4}. Which of the following regular expression best describes the given language?

(A) $(0+1)^*00$
(B) $(0+1)^*0$
(C) $(0+1)^*\ 000$
(D) $(0+1)^*\ 100$

	Q(62) Answer: A Solution: $L = \{00, 100, 1000, 1100 ---\}$ So, its regular expression is $(0+1)^* 00$ ∴ Answer is A.
Q63.	Let $\Sigma = \{0, 1\}$, and language overΣ, $L = \{\alpha \in \Sigma^* \mid \alpha$ does not contain $11\}$. Which of the Following regular expression best describes the given language? (A) $0^*(10)^*$ (B) $0^*(10^+)^*(1+\varepsilon)$ (C) $(0^*10^*10^*)^*$ (D) $(0+10)^*$

	Ans 63 Given, $L = \{ \alpha \in \Sigma^* \mid \alpha$ does not contain 11 $\}$ (A) $0^*(10)^*$ As 101 must bel in L but (A) Rejects. So 'A', cant be ans. (B) $0^*(10^+)^*(1+\epsilon)$, Yes can be ans as all the strings which are part of L, generated by R.E and which are not part of L not generated by R.E. (C) $(0^*10^*10^*)^*$ can't be R.E as "11" is ~~accepted~~ generated by R.E but is not part of L. (D) $(0+10)^*$ as "101" part of L but can't be generated by R.E. ∴ D can't be Ans. Hence, Option (B) is correct.
Q64.	Which of the following regular expression generate all the strings with odd numbers of 1? (A) 0*10*(10*1)* (B) 0*10*(10*1)*0* (C) 0*10*(101)*0* (D) 0*(10*10*1)*0* Answer: None Solution:

	Q64 $L = \{\alpha \in \Sigma^* \mid n_1(\alpha) = \text{odd}\}$ a) $0^* 1 0^* (1 0^* 1)^*$ cannot create "101010" b) $0^* 1 0^* (1 0^* 1)^* 0^*$ cannot generate "101010101" c) $0^* 1 0^* (101)^* 0^*$ cannot generate "111" d) $0^* (1 0^* 1 0^* 1)^* 0^*$ cannot generate "1"
Q65.	Which of the following regular expressions define the same language? (1) $(ab)^*$ (2) $(aa^*b)^* a^*$ (3) a^*b^* (4) $a^* (aba^*)^*$ (A) 1 and 3 only (B) 2 and 4 only (C) 3 and 4 only (D) All define different languages

	R.E Ans (65) (1) $(ab)^* \Rightarrow L_1 = \{\lambda, ab, abab, ababab, \dots$ (2) $(aa^*b)^*a \Rightarrow L_2 = \{a, aba, aaba, ababa, \dots$ (3) $a^*b^* \Rightarrow L_3 = \{a, aa, aaa, ab, aab, aaabb$ (4) $a^*(aba^*)^* \Rightarrow L_4 = \{a, aba, aaba, ababa, \dots$ Clearly $\boxed{L_2 = L_4}$ Ans :- (B) 2 and 4 correct
Q66.	Consider the language defined by the regular expression $(a\|b)^*b^+$. Which of the following regular expression(s) also define that language? (1) $(a^*b^+) \| (b^*b^+)$ (2) $(ab \| bb)^* b^*$ (3) $(a \| b \| ba)^*b^+$ (A) (1) and (2) (B) (2) and (3) (C) Only (3) (D) Only (2)

	Ans: (66) Given, R.E is $(a+b)^* b$. (1) $a^* b^+ + b^* b^+$ can't be equivalent to above R.E as "abab" cant be generated by (1). (2) $(ab+bb)^* b^*$. Can't be equivalent to above R.E as "bab" cant be generated by (2). (3) $(a+b+ba)^* b^+$. Yes equivalent as $(a+b)^* \equiv (a+b+ab)^*$. Ans is (C) only (3).
Q67.	Which of the following defines a language different than the others? (A)The regular expression (a | b)* a b c (B) The regular expression (a* b*)* a b c (C)The regular expression (a | b) (a | b)* c (D)All are same

Ans (67) :-

R.E

(A) $(a+b)^* abc$

(B) $(a^*b^*)^* abc$ → Same as $\boxed{(a+b)^* \equiv (a^*b^*)^*}$

(C) $(a+b)(a+b)^* c$

Clearly, "ac" is generated by option (C) but not by "A" and "B".

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∴ option (C) is different.

Ans :- (C).

Q68. Which of the following statement is / are correct?

I. (a* b*) a b c ≡ (a | b)* a b c

II. (a*b*)*a b c ≡ (aa + ba + a*b + (bb)*a)* a b c

(A) I only

(B) II only

(C) Both I & II

(D) Neither I nor II

	68 (I) $(a^*b^*)\,abc \equiv (a+b)^*\,abc$ Clearly, abaabc is accepted by RHS but not by LHS. $\therefore$ (I) is false. (II) $(a^*b^*)^*\,abc = (aa + ba + a^*b + (bb)^*a)^*\,abc$ as, $(aa + ba + a^*b + (bb)^*a)^* \equiv (a+b)^* \equiv (a^*b^*)^*$. $\therefore$ (II) is correct. Ans :- (b) II only.
Q69.	What is the best description of languages denoted by the following regular expressionR = 0(0+1)*0? (A) strings of zeros and ones with zeros occurring more frequently than ones (B) strings from alphabet {0,1} which begin and end with a zero (C) strings from alphabet {0,1} which begin and end with a zero and have an even number of zeroes (D) strings from alphabet {0,1} which begin with one or more zeros, followed by zero or more 3ones, followed by a zero.

	Ans (69) :- $R = 0(0+1)^*0$ $L = \{00, 010, 000, 0010, 0110, 00000, \ldots\}$ clearly L accepts all strings which starts and ends with a '0'. ∴ Option (b) is correct.
Q70.	What is the best description of the languages denoted by the following regular expressionsR = $((11 + 0)^*)^*$ (A)strings from the alphabet {0,1} in which there are an even number of 1s (B) strings from the alphabet {0,1} in which ones always appear in pairs (C) strings from the alphabet {0,1} in which ones occur twice as frequently as zeros (D) strings from the alphabet {0,1} in which there are an even number of 1s and an odd number of zeroes. Ans (70) :- $R = ((11+0)^*)^*$. $L = \{\phi, 0, 11, 011, 110, 1100, 0011, \ldots\}$ L accepts all strings containing 1's, in pairs (one always appear in pairs). # Option A is false because "1010" contains even no. of 1's but not generated by R Ans :- (b).

Q71. Which of the following languages denoted by the regular expressions
R = 0*10*10*10*

(A) strings from the alphabet {0, 1} in which there are an odd number of 1s
(B) strings from the alphabet {0, 1} in which ones never appear together
(C) strings from the alphabet {0, 1} in which there are exactly three ones.
(D) strings from the alphabet {0, 1} in which there are exactly three ones or no ones

Ans (71):- $R = 0^*10^*10^*10^*$.

option (A) false as "11111" not in R

option (B) false as "111" appears in R

option (C) Yes, strings from the alphabet {0, 1} in which there are exactly three ones.

option (D) false, as "000" not in R which option D claims.

Ans:- option C is correct.

Q72. How many of the regular expression(s) which matches all strings of 0's and 1's that do not contain the substring 011? ____________

(1) $((011)0^*1^*)^*$
(2) $(0^*1)^+0^* + 1^*0^*$
(3) $(01|010|100|110)^*$
(4) $(0+1)^*0^*|1^*0^*$

	Ans 72 :- (1) $((011)\,0^*1^*)^*$ generates 011 → False (2) $(0+1)^*\,0^* + 1^*\,0\,1$ ↳ 0^*10^*1 → 011 → False (3) $(01 + 010 + 100 + 110)^*$ ↳ 01100 → False (4) $(0+1)^*\,0^* + 1^*\,0^*$ ↳ 011 → False So, all are false. Answer : 0
Q73.	How many strings of length less than 4 contains the language described by the regular expression $(a + d)^*b(a + bc)^*$?_______

73 Strings of length less than 4 in

$(a+d)^* b(a+bc)^*$.

length 1 :- * "b" $\rightarrow$ 1

length 2 :- * "ab"
* "db"
* "ba"

$\rightarrow$ 3

length 3 :- * "aab"
* "ddb"
* "adb"
* "dab"
* "aba"
* "dba"
* "bbc"
* "baa"

$\rightarrow$ 8

Total = 1+3+8 $\Rightarrow$ 12 Ans

$\boxed{\text{Answer : 12}}$

Or

Solution:

(a+d)*b(a+bc)*

string of length 1 = b =1

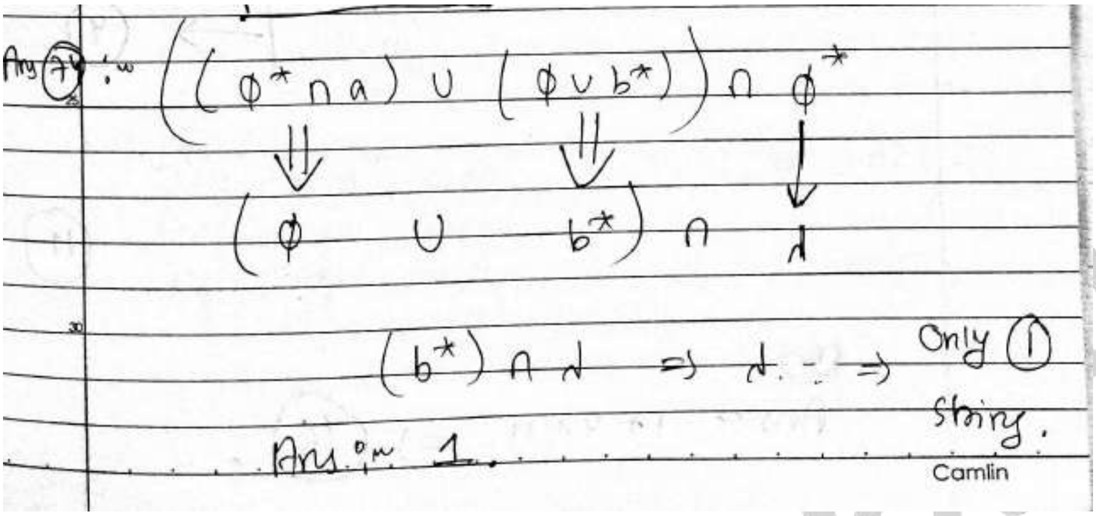
String of length 2= ab , db, ba = 3

String of length 3= aab, adb, ddb, dab, baa,bbc, aba , dba = 8

So number of string = 1+3+8=12

Answer: 12

Q74.	How many strings are there in the language defined by regular expression? ________((∅*∩ a) ∪ (∅∪ b*)) ∩ ∅*	



Ans (74) :- $((\phi^* \cap a) \cup (\phi \cup b^*)) \cap \phi^*$

$(\phi \cup b^*) \cap \lambda$

$(b^*) \cap \lambda \Rightarrow \lambda \Rightarrow$ Only (1) String.

Ans :- 1.

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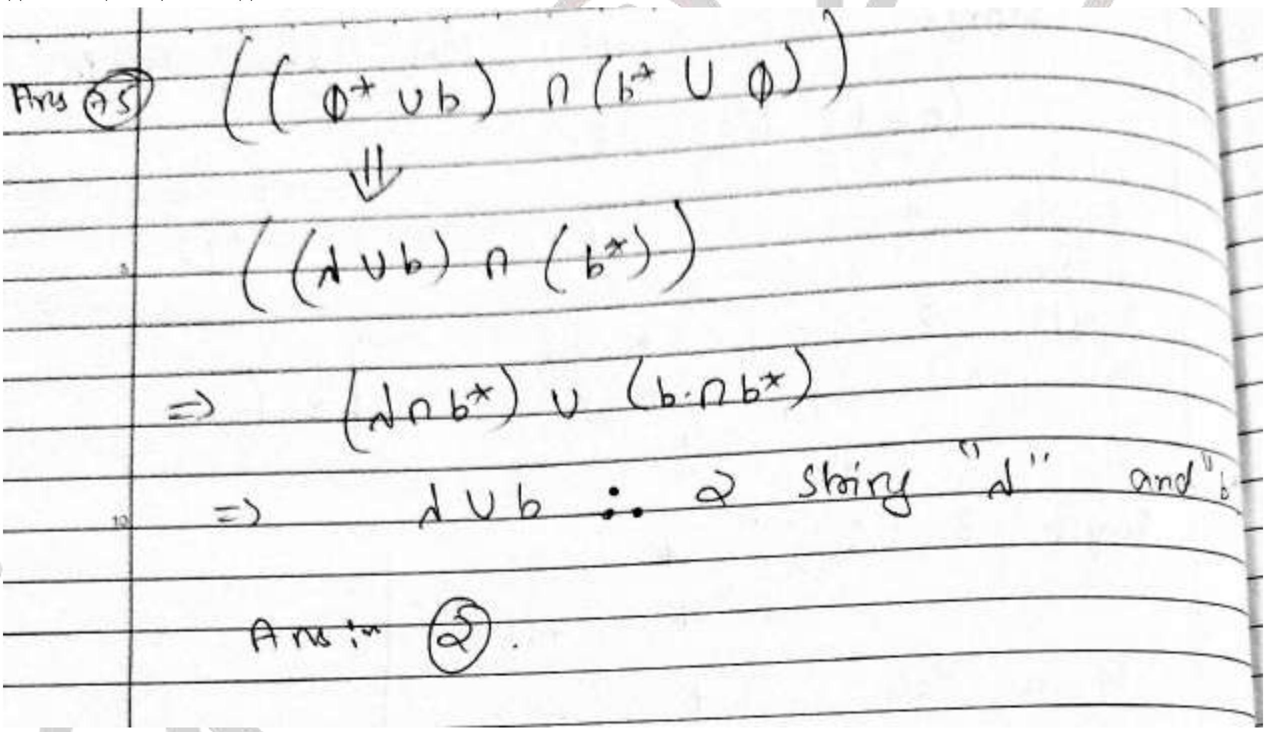
Answer: 1

Solution: ((∅*∩ a) ∪ (∅∪ b*)) ∩ ∅* = (∅ ∪ b*) ∩ λ = λ. So, the cardinality = 1.

Q75.	How many strings are there in the language defined by regular expression?__________ ((∅*∪ b) ∩ (b*∪∅))



Ans (75) $((\phi^* \cup b) \cap (b^* \cup \phi))$

$((\lambda \cup b) \cap (b^*))$

$\Rightarrow (\lambda \cap b^*) \cup (b \cap b^*)$

$\Rightarrow \lambda \cup b$ ∴ 2 String "λ" and "b"

Ans :- 2.

Answer: 2

Solution: ((∅*∪ b) ∩ (b*∪∅)) = {λ ∪ b} ∩ b* = {λ ∪ b}. So, the cardinality = 2.

Q76.	How many strings of length less than 5 contains the language described by the regular expression 0*1(0 + 1)* 01*? ____________

Ans 76) $0^*1(0+1)^*01^*$.

String of length 1 ⇒ 0

—"— 2 ⇒ "10" → 1

String of length 3 ⇒ "010", "100", "110", "101" → 4

String of length 4 ⇒ "0010", "0100", "0101", "0110", "1000", "1001", "1010", "1011", "1100", "1101", "1110"} → 11

Ans: 1 + 4 + 11 ⇒ 16.

Answer: 16

Solution: All the strings of length less than 5 generated by given regular expression are

{10, 010, 100, 110, 101, 0010, 0100, 0101, 0110, 1000, 1001, 1010, 1011, 1100, 1101, 1110}.

So, the total number of required strings = 16.

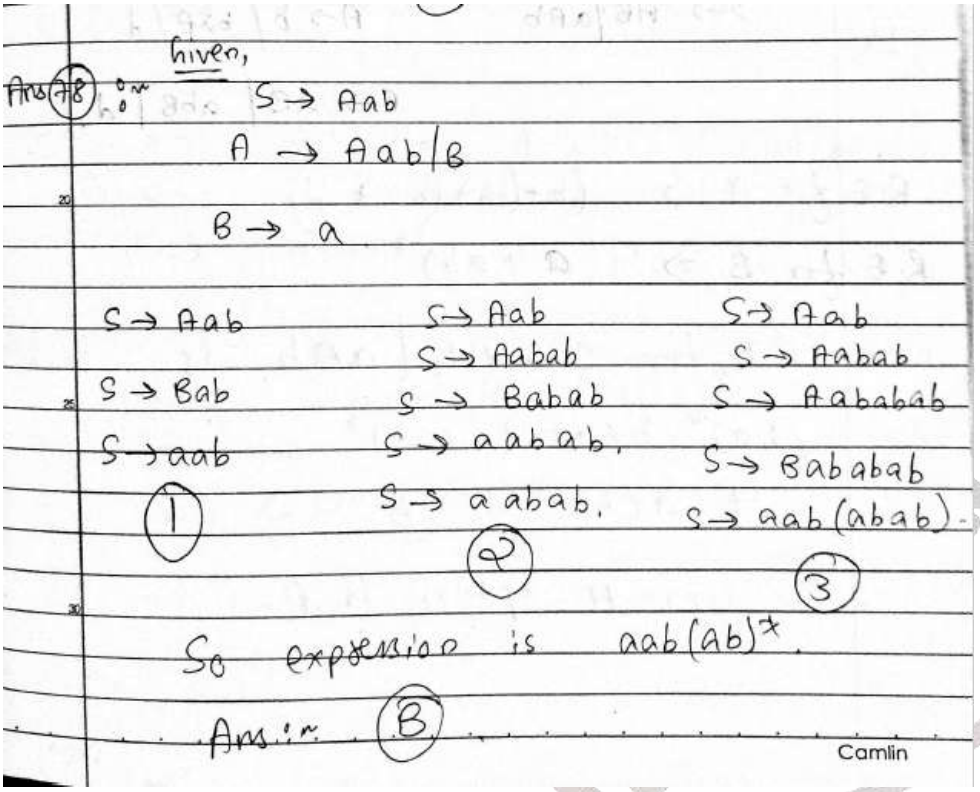
Q77. Let L be the language generated by regular expression ((a + b)*b(a + ab)*). How many strings of length less than four are there in L? ______

Answer: 11

Solution: Required number of strings of length less than four

$= (2^1 - 1) + (2^2 - 1) + (2^3 - 1) = 1 + 3 + 7 = 11$

Q78.	What is the regular expression for the language generated by the following grammar? S →Aab A→ Aab | B B → a (A) aab(ba)* (B) aab(ab)* (C) aa(ab)* (D) ab(ab)*


Ans (78) :- Given,
S → Aab
A → Aab/B
B → a

S → Aab
S → Bab
S → aab
(1)

S → Aab
S → Aabab
S → Babab
S → aabab,
S → aabab.
(2)

S → Aab
S → Aabab
S → Aababab
S → Bababab
S → aab(abab).
(3)

So expression is aab(ab)*.
Ans:- (B)

Solution:

S→Aab	S→Aab	S→Aab
S→Bab	S→Aabab	S→Aabab
S→aab --- (1)	S→Babab	S→Aababab
	S→aabab	S→Bababab
	S→aabab---(2)	S→aab(abab) ----(3)

So expression is: aab(ab)*

Answer: B

Q79.	Consider the following grammar G: S →AabB, A→ b | bA | λ, B → aB | aa | λ Which of the following regular expression is equivalent to the language generated by G? (A) b*abaa* (B) a*abb* (C) b*aba* (D) b^+aba^+

	Ans (79):- C Given Grammer, $S \to AabB$, $A \to b \mid bA \mid \lambda$, $B \to aB \mid aa \mid$ $B \to aB \mid aa \mid \lambda \Rightarrow a^*$ $A \to b \mid bA \mid \lambda \Rightarrow b^*$ $S \to AabB \Rightarrow b^*aba^*$ ∴ Answer is C.
Q80.	Consider the following grammar G: $S \to AB \mid aAb$ $\quad A \to b \mid baA \mid \lambda$ $\quad B \to aB \mid abB \mid \lambda$ Which of the following regular expression is equivalent to the language generated by G? (A) $(ba)^*(b + \lambda)(a + b)^*$ (B) $(ba)^*(b + \lambda)(a + ab)^*$ (C) $(ba)^*(b + \lambda)(a + ab)^* + a(b + ab)^*b$ (D) $a((ba)^*(b + \lambda))b + (ba)^*(b + \lambda)(a + ab)^*$

(80) $S \to AB \mid aAb$ $\quad A \to b \mid baA \mid d$

Answer: D

$B \to aB \mid abB \mid d.$

R.E for A $\Rightarrow (ba)^*(b + d)$

R.E for B $\Rightarrow (a + ab)^*$

Now, R.E for $S \to AB \mid aAb$, is

$(ba)^*(b+\lambda).(a+ab)^*$

$+ \; a(ba)^*(b+\lambda)b$

So, correct option is option D

Q81. Which of the following grammar generates the language generated by given regular expression R = a(a+b)*a + b(a+b)*b

(A) S → aSa | bSb | aS | bS | λ

(B) S → aAa | bAb $\quad$ A → aA | bA | λ

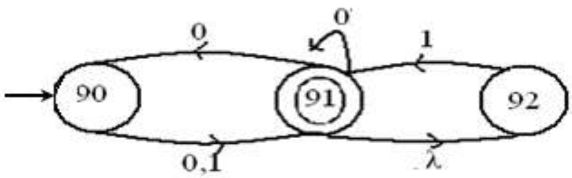
(C) S → aAa | bAb $\quad$ A → aA | bA | aAa | bAb| λ

(D) Both b & c

	Ans 81 :- Clearly, option (A) accepts d, but not (B) and (C). **Ans: D** Option — Regular Expression (A) S → aSa/bSb/aS/bS/d. ⟹ $(a+b)^*$. (B) S → aAa/ bAb A → aA/bA/d. ⟹ $a(a+b)^*a + b(a+b)^*b$. (C) S → aAa / bAb A → aA/ bA/aAa/bAb/d. ⟹ $a(a+b)^*a + b(a+b)^*b$. Ans:- Both (B) and (C). So, correct answer is (D)
Q82.	Which of the following grammar generates the language generated by given regular expression $R = aaa^+ + (ba+bb)^*a$ (A) $S \rightarrow aaX \mid Ya$ $X \rightarrow aX \mid \lambda$ $Y \rightarrow baYbbY \mid \lambda$ (B) $S \rightarrow aX \mid Ya$ $X \rightarrow aX \mid a$ $Y \rightarrow baY \mid bbY \mid \lambda$ (C) $S \rightarrow aaX \mid Ya$ $X \rightarrow aX \mid a$ $Y \rightarrow baY \mid bbY \mid \lambda$ (D) None of the above

	Ans:- (82) $R = aaa^+ + (ba+bb)^* a.$ for $(ba+bb)^* a$, $Y \rightarrow baY / bbY / \lambda$ — (1) for a^+, $X \rightarrow aX \mid a$ — (2) Now, for $R = aaa^+ + (ba+bb)^* a$, $S \rightarrow aaX \mid Ya$ $X \rightarrow aX \mid a$ $Y \rightarrow baY \mid bbY \mid \lambda$ ∴ Answer (C) is correct.
Q83.	Which of following Grammar generates the language $L(a^*a(a+ba)^*)$? (A) $S \rightarrow S_1 \mid S_2$, $S_1 \rightarrow aA$, $A \rightarrow aA \mid \lambda$, $S_2 \rightarrow aS_2 \mid baS_2 \mid \lambda$ (B) $S \rightarrow S_1S_2 \mid S_1$, $S_1 \rightarrow aA$, $A \rightarrow aA \mid \lambda$, $S_2 \rightarrow aS_2 \mid baS_2 \mid \lambda$ (C) $S \rightarrow S_1S_2 \mid a$, $S_1 \rightarrow aA$, $A \rightarrow aA \mid a$, $S_2 \rightarrow aS_2 \mid baS_2 \mid \lambda$ (D) Both B and C Answer: D Solution:

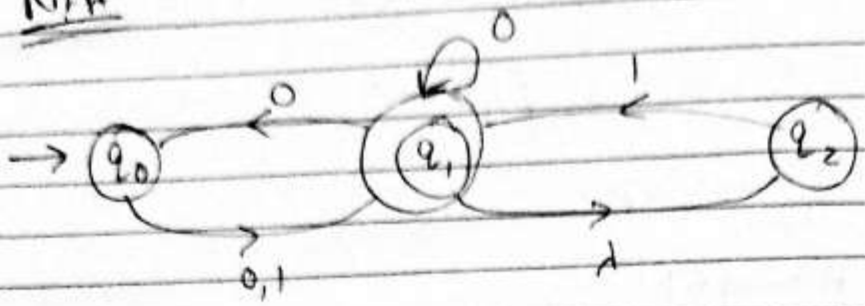
	(a) $S \to S_1 \mid S_2 \quad \Rightarrow aa^* + (a+ba)^*$ $= (a+ba)^* + a^+$ It is not equivalent to $aa^*(a+ba)^*$ because $[(a+ba)^* + a^+]$ ~~doesn't~~ generates 'ba' but $a^* a(a+ba)^*$ doesn't generate 'ba'. (b) $S_2 \to aS_2 \mid baS_2 \mid \lambda \quad \Rightarrow (a+ba)^*$ $A \to aA \mid \lambda \quad \Rightarrow a^*$ $S_1 \to aA \quad \Rightarrow aa^*$ $S \to S_1S_2 \mid S_1 \quad \Rightarrow aa^*(a+ba)^* + aa^*$ $= aa^*(a+ba)^*$ (c) $S \to S_1S_2 \mid a \quad \Rightarrow aa^*(a+ba)^* + a$ $= aa^*(a+ba)^*$ So, option (c) is also correct.
Q84.	Which of the following grammars is a right regular grammar with the same language as the regular expression $(a^* \cup b^*) \cap (a^*b^*)$? (A) $S \to AB \qquad A \to aA \mid \varepsilon \qquad B \to bB \mid \varepsilon$ (B) $S \to A \mid B \qquad A \to Aa \mid \varepsilon \qquad B \to Bb \mid \varepsilon$ (C) $S \to A \mid B \qquad A \to aA \mid a \qquad B \to Bb \mid a$ (D) $S \to A \mid B \qquad A \to aA \mid \varepsilon \qquad B \to bB \mid a$

<table>
<tr><td></td><td>Ans 84
Expression for Grammer.
$a^* \longrightarrow A \rightarrow aA / \varepsilon$
$b^* \longrightarrow B \rightarrow bB / \varepsilon$.
Now, $(a^* \cup b^*) \cap a^*b^* \Rightarrow a^* \cup b^*$.
$\therefore$ Grammer will be,
$S \rightarrow A | B \quad A \rightarrow aA / \varepsilon \quad B \rightarrow bB / \varepsilon$.
Ans:- D
Camlin</td></tr>
<tr><td>Q85.</td><td>Consider the following NFA


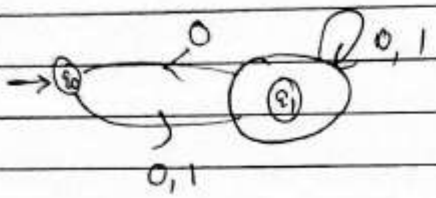
Which of the following string is not accepted by the following NFA?
(A) 00000000   (B) 01001
(C) 111110010   (D) None</td></tr>
</table>

Ans. 85

NFA



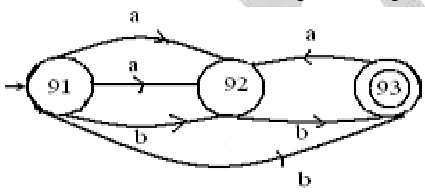
↓ Reduced NFA



Regular Expression is $(0+1)^+$

∴ Ans is D (as all strings accepted by NFA except λ).

Q86. Which of the following string is accepted by given NFA?



(A) aaabbbbbb (B) aababb

(C) abab (D) babaa

Answer: C

Solution:

(a) When we run given NFA for string 'aaabbbbbb' then we will reach on q2, which is a non-final state and there is no transition for 'a' from q2. So, NFA will not accept this string.

(b) When we run given NFA for string 'aababb' then we will reach on q2, which is a non-final state and there is no transition for 'a' from q2. So, NFA will not accept this string.

(c) When we run given DFA for string 'abab' then we will reach on q3, which is a final state. So, DFA will accept this string.

(d) When we run given NFA for string 'babaa' then we will reach on q2, which is a non-final state and there is no transition for 'a' from q2. So, NFA will not accept this string.

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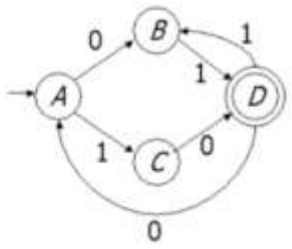
Q87. Consider the following DFA:



If the input is 011100101, which edge of the automaton is NOT traversed?

(A) CD (B) AC

(C) BC (D) BD

Answer: A

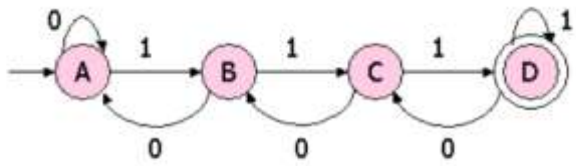
Solution:

If the input '011100101' is run on given DFA then following edge are traversed:

String	0	1	1	1	0	0	1	0	1
Edges	AB	BD	DB	BD	DA	AB	BD	DA	AC

CD is not traversed and BC is not an edges of given automaton.

Q88. Consider the following DFA:



If string S is accepted by this DFA, which of the following strings cannot be a suffix of S?

(A)111 (B) 111001

(C) 11011 (D) 0010111

Answer: B

Solution:

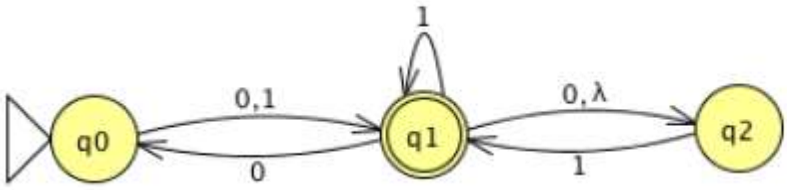
(A) Yes; because 111 is a suffix of 0111 and it is accepted by given DFA

(B) No; because after two zeroes we need two 1.

(C) Yes; because 11011 is a suffix of 011011 and it is accepted by given DFA.

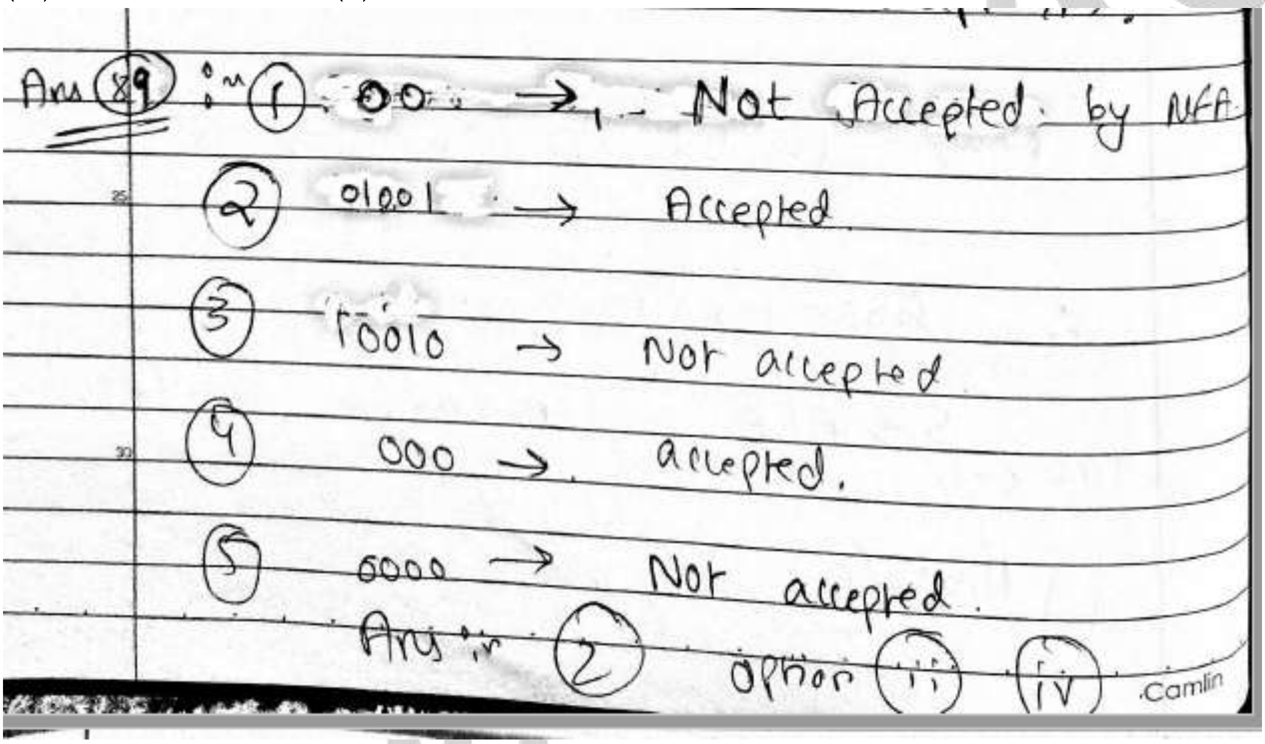
(D) Yes; because 0010111 is a suffix of 00010111and it is accepted by given DFA.

Q89. How many of the following strings are accepted by the NFA given below? ________



(i) 00 (ii) 01001 (iii) 10010

(iv) 000 (v) 0000


Ans (89) :- (1) 00 → Not Accepted by NFA

(2) 01001 → Accepted

(3) 10010 → Not accepted

(4) 000 → accepted.

(5) 0000 → Not accepted.

Ans :- (2) option (ii) (iv)

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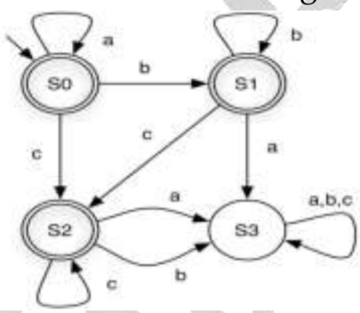
Q90. Which of the following strings is accepted by DFA given below?

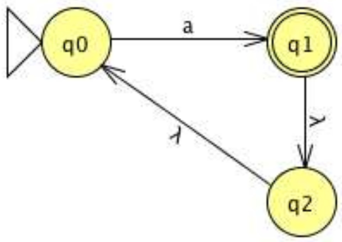


(A) aabbbcca (B) aabbbcccca

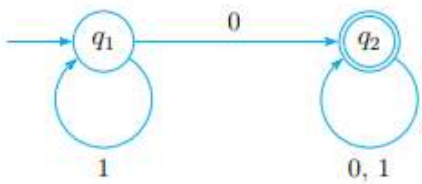
(C) abbbcccc (D)bccccabc

Solution: It accept the string that end with c and if c is occurred than after that no other alphabet occurred.

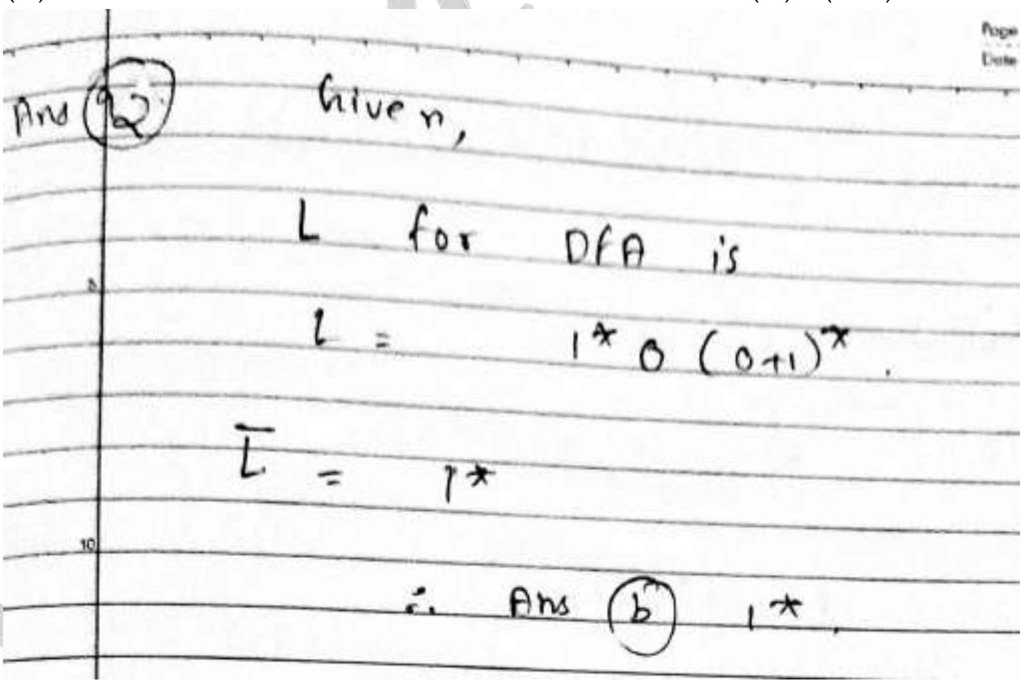
Answer: C

Q91.	What is the complement of the language accepted by the following NFA? (Σ = {a})  (A) Ø (B) {λ} (C) a* (D) a^+ Answer: B Solution: The language accepted by NFA is $\{a^k \mid k>0\}$. So, the complement of this language is {λ}.

Data for next two questions: Consider the following DFA D:



Q92.	Let the language accepted by G is L(D) then complement of L(D) is equivalent to (A) 1^+ (B) 1* (C) 1* + 0* (D) 1(0+1)*



Ans (92)

Given,

L for DFA is

$L = 1^* 0 (0+1)^*$.

$\bar{L} = 1^*$

$\therefore$ Ans (b) 1^*.

Q93. Let the language accepted by G is L(D) then reverse of L(D) is equivalent to

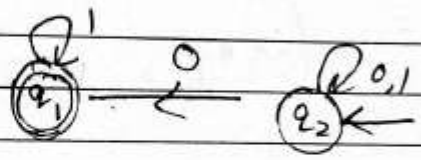
(A) 01*

(B) 1*0(0+1)*

(C) (0+1)*01*

(D) (0+1)* + 01*

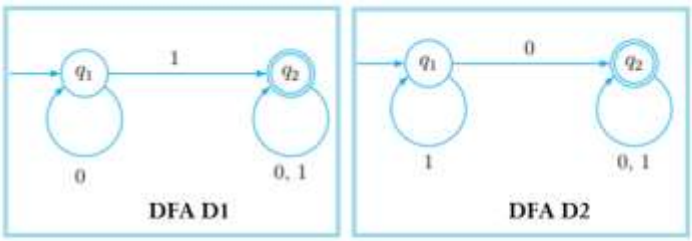
Ans (93) Reverse of L is



$L(D) = (0+1)^* 0 1^*$.

$\therefore$ Ans (C). $(0+1)^* 0 1^*$.

Data for next twenty questions: Consider the following two DFA's D1 and D2:



It is given the language accepted by D1 and D2 are L (D1) and L (D2), respectively.

Q94. **[MSQ]**

If L (D) = L(D1) ∪ L(D2), then which of the following regular expression is/are equivalent to L(D)?

(A) (0 + 1)*

(B) (01 + 10)(0 + 1)*

(C) (0*1 + 1*0) (0 + 1)*

(D) $(0 + 1)^+$

Ans (94) :- $L(D_1) = 0^*1(0+1)^*$

Ans: C, D

$L(D_2) = 1^*0(0+1)^*$

$L(D_1) + L(D_2) = 0^*1(0+1)^* + 1^*0(0+1)^*$

$= (0+1)^+$

Ans: (C) and (D) is correct.

Camlin

Q95. If L(D) = L(D1) ∩ L(D2), then the regular expression for L(D) is equivalent to

(A) ∅

(B) (01 + 10)(0 + 1)*

(C) (00*1 + 11*0)(0 + 1)*

(D) None of these

95 $L(D) = L(D_1) \cap L(D_2)$

$L(D_1) = 0^*1(0+1)^*$

$L(D_1) = \{1, 01, 001, 0010, 0011 \ldots\}$

$L(D_2) = 1^*0(0+1)^*$

$L(D_2) = \{0, 10, 110, 1110, 11011, \ldots, 01, 001, 0010, 0011, \ldots\}$

$L(D_1) \cap L(D_2) = (00^*1 + 11^*0)(0+1)^*$

Ans (C) is correct.

Q96.	If L(D) = L(D1) − L(D2), then the regular expression for L(D) is equivalent to (A) 1^* (B) 1^+ (C) $1(0 + 1)^*$ (D) None of these Answer: B Solution: L(D) = L(D1) − L(D2) = $L(D_1) \cap \overline{L(D_2)}$ = $0^*1(0 + 1)^* \cap \{1^*\} = 1^+$
Q97.	If L(D) = L(D1).L(D2), then the regular expression for L(D) is equivalent to (A) $0^*11^*0\ (0 + 1)^*$ (B) $0^*1(0+1)^*1^*0(0+1)^*$ (C) $(0 + 1)^*$ (D) $(0 + 1)^+$ Ans (97) $L(D_1) = 0^*1(0+1)^*$ $L(D_2) = 1^*0(0+1)^*$ $L(D_1).L(D_2) = 0^*1(0+1)^*1^*0(0+1)^*$ Ans (B) is Correct.
Q98.	If L(D) = $L(D1)^R.L(D2)^R$, then the regular expression for reverse of L(D) is (A) $(0 + 1)^*$ (B) $(0 + 1)^*1^*0(0 + 1)^*10^*$ (C) $0^*1(0 + 1)^*1^*0(0 + 1)^*$ (D) $(0 + 1)^*01^*(0 + 1)^*10^*$

98 $L(D) = L(D_1)^R \cdot L(D_2)^R$.

$L(D_1) = 0^*1(0+1)^*$.

$(L(D_1))^R = (0+1)^*10^*$.

$L(D_2) = 1^*0(0+1)^*$.

$L(D_2) = (0+1)^*01^*$.

$(L(D))' = 0^*1(0+1)^* \cdot 1^*0(0+1)^*$.

$(L(D))^R = (0+1)^*01^*(0+1)^*10^*$.

Ans (D) is correct.

Q99. If L(D) = L(D1) ∪ L(D2), then the regular expression for complement of L(D) is

(A) λ
(B) $0^+ + 1^+$
(C) $0^* + 1^*$
(D) 0^*1^*

99 $L(D) = L(D_1) \cup L(D_2)$.

To find : $\overline{L(D)} = ?$

Now, $L(D) = 0^*1(0+1)^* \cup 1^*0(0+1)^*$.

$= (0+1)^+$

$\therefore \overline{L(D)} = \lambda$ Ans (a) λ is correct.

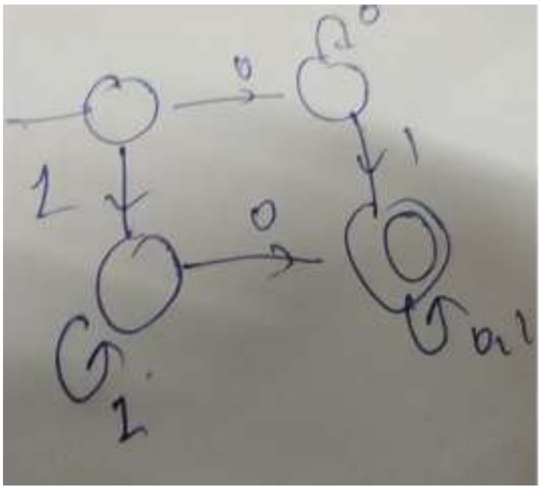
Camlin

Q100. If L(D) = L(D1) ∩ L(D2), then the regular expression for complement of L(D) is

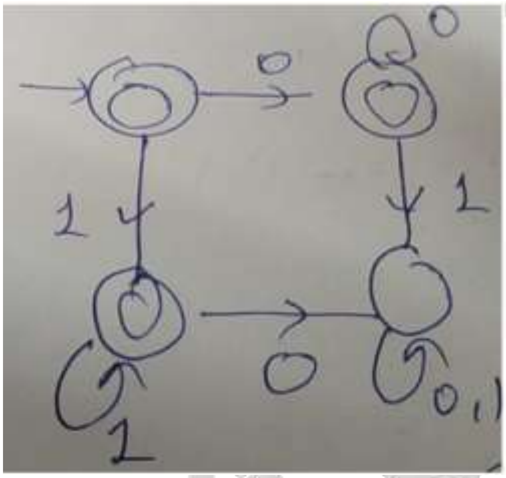
(A) λ
(B) $0^+ + 1^+$
(C) $0^* + 1^*$
(D) $(0^+1 + 1^+0)(0+1)^*$

Answer: C

Solution: The product automaton for D1 and D2 is shown below:



Now, the DFA for its complement is



The regular expression for complement of L(D) is $0^* + 1^*$. So, correct answer is C.

Q101. **[MSQ]**

If L(D) = L(D1)*∪ L(D2)*, then which of the following regular expression is/are equivalent to L(D)?

(A) $(01 + 10)^*$
(B) $(0 + 1)^*$
(C) $0^*1^*(0+1)^*$
(D) none of these

Ans (101) :- $L(D_1) = 0^*1(0+1)^*$.

$L(D_2) = 1^*0(0+1)^*$.

$(L(D_1))^* = (0^*1(0+1)^*)^*$

$(L(D_2))^* = (1^*0(0+1)^*)^*$.

$(L(D_1))^* \cup (L(D_2))^* = (0^*1(0+1)^*)^* + (1^*0(0+1)^*)^*$

(B) $= (0+1)^*$. option (B)

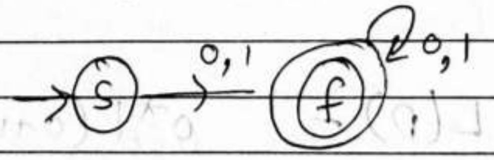
$\boxed{\text{Ans :- (B), (C)}}$ (C) $= 0^*1^*(0+1)^*$ option (C)

Q102. Minimum how many states are required to construct the DFA for L(D1) ∪ L(D2)? ____

102

Ans (2) As $L(D_1) \cup L(D_2) = (0+1)^+$

∴ DFA can be drawn as



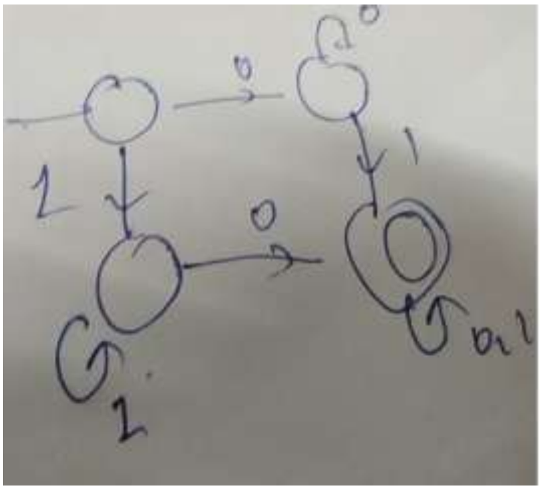
∴ minimal DFA has 2 states for the given L(D).

$\boxed{\text{Ans (2).}}$

Q103. Minimum how many states are required to construct the DFA for L(D1) ∩ L(D2)? ____

Answer: 4

Solution: The product automaton for D1 and D2 is shown below:

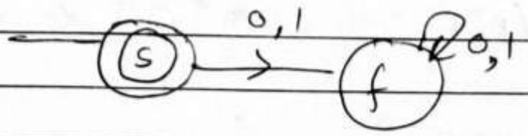


So, required number of states is 4.

Q104. Minimum how many states are required to construct the DFA for $\overline{L(D1)} \cap \overline{L(D2)}$? ____

Ans (104) :- As $\overline{L(D_1)} \cap \overline{L(D_2)} = \overline{L(D_1) \cup L(D_2)}$

∴ Complemented DFA of $L(D_1) \cup L(D_2)$



(making Non-final as final and vice versa in above fig.).

Ans :- minimal DFA has 2 states

Ans :- 2.

<table>
<tr><td>Q105.</td><td>Minimum how many states are required to construct the DFA for $\overline{L(D1)} \cup \overline{L(D2)}$? ____

Ans (105) :- As $\overline{L(D_1)} \cup \overline{L(D_2)} = \overline{L(D_1) \cap L(D_2)}$

Hence, Complemented DFA of $L(D_1) \cap L(D_2)$.

∴ Complemented DFA of fig. in Ans (103)

Ans :- 4 States.</td></tr>
<tr><td>Q106.</td><td>Minimum how many states are required to construct the DFA for $\overline{L(D1)}.\overline{L(D2)}$? ____

Ans (106) :- Now, $L(D_1) = 0^*1(0+1)^*$

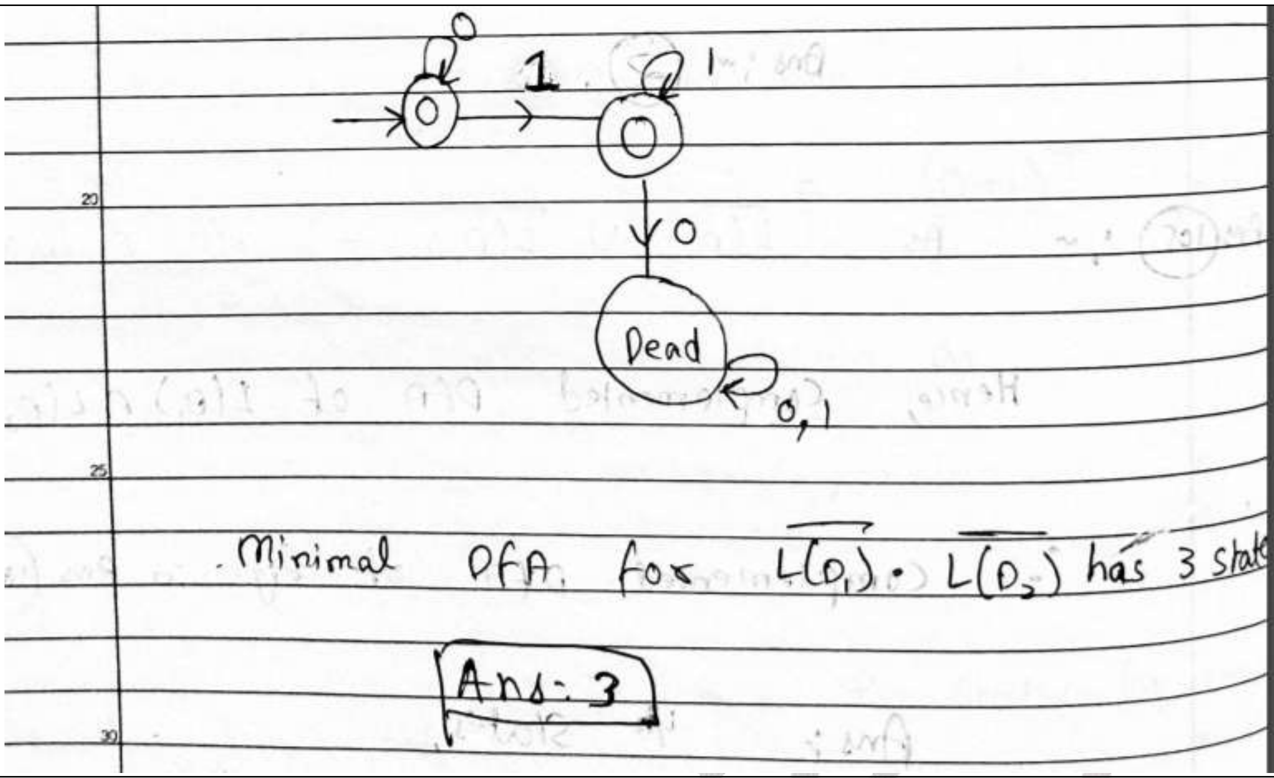
$\overline{L(D_1)} = 0^*$

Similarly,
$L(D_2) = 1^*0(0+1)^*$

$\overline{L(D_2)} = 1^*.$

$\overline{L(D_1)} . \overline{L(D_2)} = 0^*.1^*.$

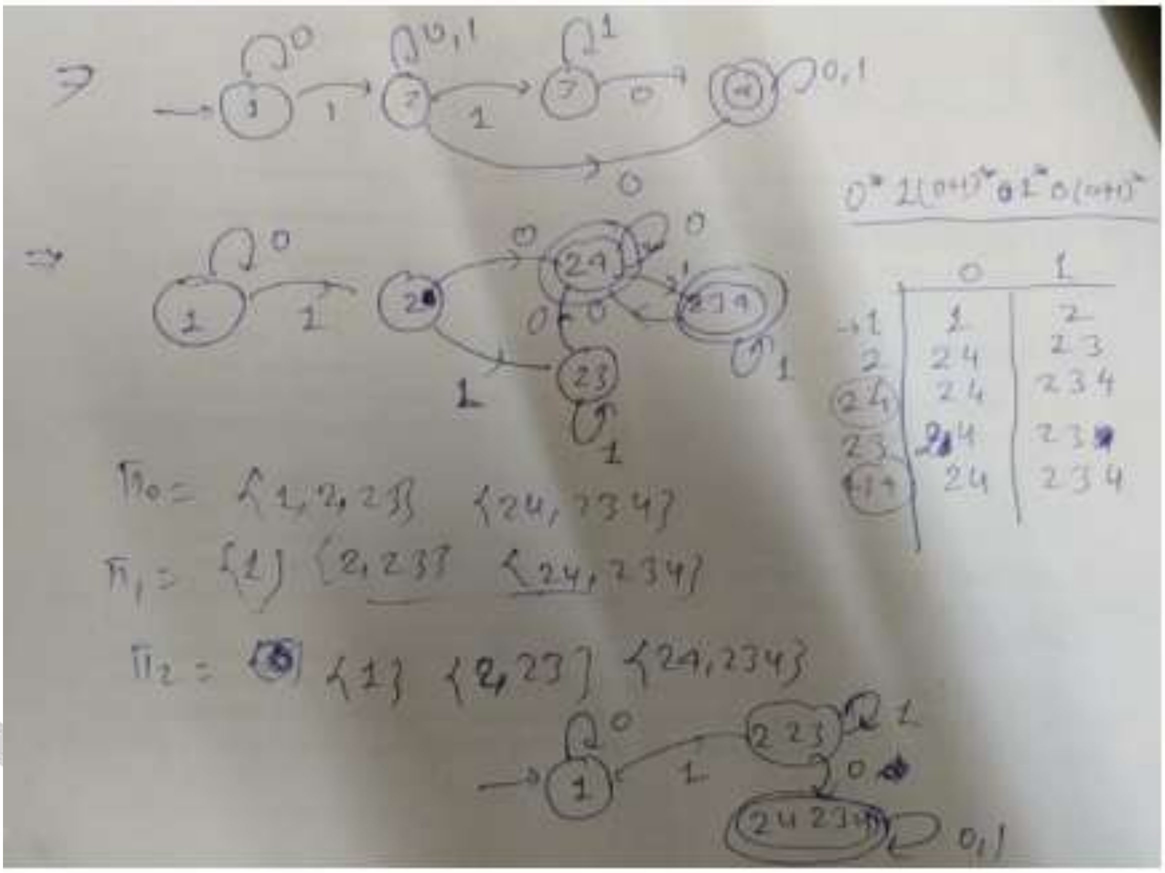
DFA can be constructed as</td></tr>
</table>



Q107. Minimum how many states are required to construct the DFA for L(D1) . L(D2)? ____

Answer: 3

Solution:



Q108.	**[MSQ]** Which of the following Grammars accept the language L(D1) ∪ L(D2)? (A) S → 0S | 1S | 0 | 1 (B) S → 0A | 1B, A → 0A | λ, B → 1B | λ (C) S → 0S1 | 1S0 | 0S | 1S | 0 | 1 (D) None of the above Ans 108 As, $L(D_1) = 0^* 1 (0+1)^*$ $L(D_2) = 1^* 0 (0+1)^*$. $L(D_1) \cup L(D_2) = (0+1)^+$. Grammer for $(0+1)^+$ is A $S \to 0S \mid 1S \mid 0 \mid 1$ Option A. Now, option C Also generates $(0+1)^+$. But option B generates. $0^+ + 1^+$. Hence, option A and C are correct.
Q109.	**[MSQ]** Which of the following Grammars accept the language L(D1) ∩ L(D2)? (A) S → 0X1A | 1Y0A, X → 0X | λ, Y → 1Y | λ, A → 0A | 1A | λ (B) S → XY, X → 0A1 | 1B0, A → 0A | λ, B→ 1B | λ, Y → 0Y | 1Y | λ (C) S → 0S | 1S | 0 | 1 (D) None of the above

Ans (109) :-

Ans: A, B

As $L(P_1) = 0^*1(0+1)^*$

$L(P_2) = 1^*0(0+1)^*$.

$L(P_1) \cap L(P_2) = (00^*1 + 11^*0)(0+1)^*$. — (R)

Now option (A),

$S \rightarrow 0X1A \mid 1Y0A$

$X \rightarrow 0X \mid \lambda \quad (X \rightarrow 0^*)$

$Y \rightarrow 1Y \mid \lambda \quad (y = 1^*)$

$A \rightarrow 0A \mid 1A \mid \lambda \quad A = (0+1)^*$

$\therefore S \rightarrow 0X1A \longrightarrow (S = 00^*1(0+1)^*)$

(+)

$S \rightarrow 1Y0A \longrightarrow 11^*0(0+1)^*)$

As grammer generates By option (A),

is same as (R)

$\therefore$ Option (A) is correct.

Date :

Now, option (B),

$S \to XY$, ~~$Y \to 0$~~

$X \to 0A1 \mid 1B0$ $\quad (X = 00^*1 \mid 11^*0)$

$A \to 0A \mid \lambda$ $\quad (A = 0^*)$

$B \to 1B \mid \lambda$ $\quad (B = 1^*)$

$Y \to 0Y \mid 1Y \mid \lambda$ $\quad (Y = (0+1)^*)$

$S \to XY$ $\quad (S = (00^*1 + 11^*0)(0+1)^*)$

Option (B) generates same grammer as (R)

$\therefore$ option (B) is correct.

Option (C) $S \to 0S \mid 1S \mid 0 \mid 1$.

$S = (0+1)^*$.

$\therefore$ option (C) is incorrect.

$\boxed{\text{Ans :- Option (A), (B)}}$

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Q110. **[MSQ]**

Which of the following Grammars accept the language $L(D1)^R \cup L(D2)^R$?

(A) $S \to 0S \mid 1S \mid 0 \mid 1$

(B) $S \to 0A \mid 1B$, $A \to 0A \mid \lambda$, $B \to 1B \mid \lambda$

(C) $S \to 0S1 \mid 1S0 \mid 0S \mid 1S \mid 0 \mid 1$

(D) None of the above

Ans 110 :- $L(D_1) = 0^*1(0+1)^*$.

$L(D_1)^R = (0+1)^*10^*$.

$L(D_2) = 1^*0(0+1)^*$.

$L(D_2)^R = (0+1)^*01^*$.

$L(D_1)^R \cup L(D_2)^R = (0+1)^*10^* + (0+1)^*01^*$

$= (0+1)^+$ — R

Option A $S \to 0S \mid 1S \mid 0 \mid 1$

$S = (0+1)^+$ same as R

	∴ option (A) is correct. option (B) $S \to 0A \mid 1B$ $A \to 0A \mid \lambda$ $B \to 1B \mid \lambda$ $S = 00^* + 11^*$ $A = 0^*$ $B = 1^*$ $S = 0^+ + 1^+$ Not as (R) ∴ option (B) is false. option (C) $S \to 0S1 \mid 1S0 \mid 0S \mid 1S \mid 0 \mid 1$ $S = (0+1)^+$ Same as (R) ∴ option (C) is correct. Ans :- option (A) & (C).
Q111.	**[MSQ]** Which of the following Grammars accept the language L(D1) . L(D2)? (A) $S \to AB, A \to X1Z,$ $X \to 0X \mid \lambda, B \to Y0Z,$ $Y \to 1Y \mid \lambda,$ $Z \to 0Z \mid 1Z \mid \lambda$ (B) $S \to 0S \mid 1S \mid 0 \mid 1$ (C) $S \to 0S1 \mid 1S0 \mid 0S \mid 1S \mid 0 \mid 1$ (D) None of the above

Ans (iii) :-

$$L(D_1) = 0^* 1 (0+1)^*$$

$$L(D_2) = 1^* 0 (0+1)^*.$$

$$L(D_1) \cdot L(D_2) = 0^* 1 (0+1)^* . 1^* 0 (0+1)^* \text{ — R}$$

$$= 0^* 1 (0+1)^* 0 (0+1)^*.$$

Option A

$S \to AB$

$$S = \overbrace{0^* 1 (0+1)^*}^{A} \cdot \overbrace{1^* 0 (0+1)^*}^{B}$$

$A \to X1Z$ $\quad (0^* 1 (0+1)^*)$

$X \to 0X \mid \lambda$ $\quad (X = 0^*)$

$B \to Y0Z$ $\quad (1^* 0 (0+1)^*)$

$Y \to 1Y \mid \lambda$ $\quad (Y = 1^*)$

$Z \to 0Z \mid 1Z \mid \lambda$ $\quad (Z = (0+1)^*)$

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	As option (A) generates same grammar as (R) ∴ option (A) is ✓ Option (B) and (C) generates $(0+1)^+$ ∴ Ans:- option (A).
Q112.	**[MSQ]** Which of the following Grammar(s) accept the language $\overline{L(D1)}.\overline{L(D2)}$? (A) $S \to 0S \mid 1S$ (B) $S \to \lambda$ (C) $S \to 0S \mid 1S \mid 0 \mid 1$ (D) $S \to XY$ $\quad X \to 0X \mid \lambda$ $\quad Y \to 1S \mid \lambda$

Ans (112) :- Given,

$$L(D_1) = 0^*1(0+1)^*.$$

$$\overline{L(D_1)} = 0^*.$$

$$L(D_2) = 1^*0(0+1)^*$$

$$\overline{L(D_2)} = 1^*.$$

$$\overline{L(D_1)} \cdot \overline{L(D_2)} = 0^*1^*. \quad \vdash R$$

option (A) generates $L = \{\ \}$.

option (B) false. (does not generate R

option (C) $(0+1)^*$ (does not generate R).

	✓ option (D), $S \to XY$ $X \to 0X \mid \lambda$ $(X = 0^*)$ $Y \to \epsilon \mid Y \mid \lambda$ $(Y = 1^*)$ $S = 0^*1^*$. Same as (R) Ans :- option (D) ✓
Q113.	Which of the following Grammar accepts the language $\overline{L(D1)} \cap \overline{L(D2)}$? (A) $S \to 0S \mid 1S$ (B) $S \to \lambda$ (C) $S \to 1S \mid 0S \mid 0 \mid 1$ (D) None of the above

Ans (113) Given,

$$L(D_1) = 0^*1(0+1)^*.$$

$$L(D_2) = 1^*0(0+1)^*$$

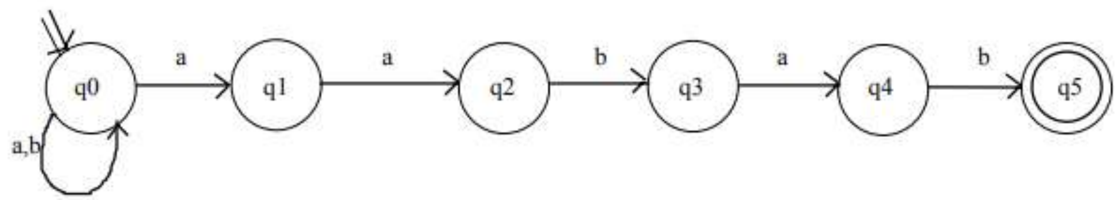
$$\overline{L(D_1)} \cap \overline{L(D_2)} = \overline{L(D_1) \cup L(D_2)}$$

$$= \overline{(0+1)^+}$$

$$= \lambda.$$

Option (B) $S \to \lambda$ correct.

Q114. Consider the following NFA M: :



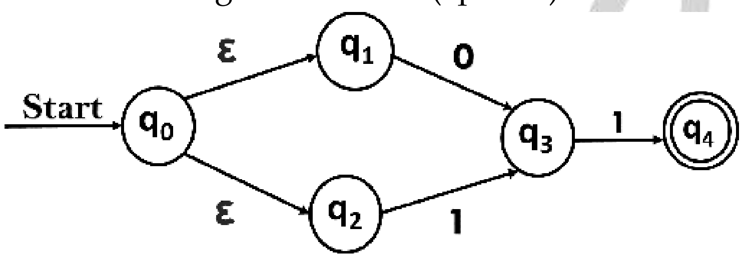
If the language accepted by M is L(M) then the regular expression for reverse of L(M) is

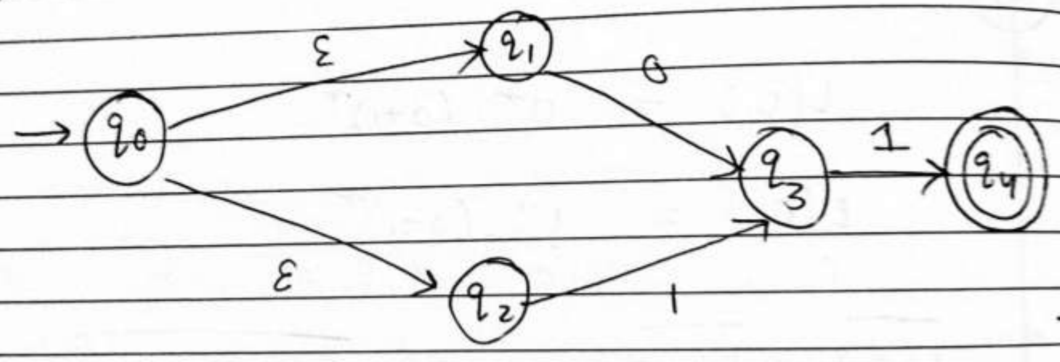
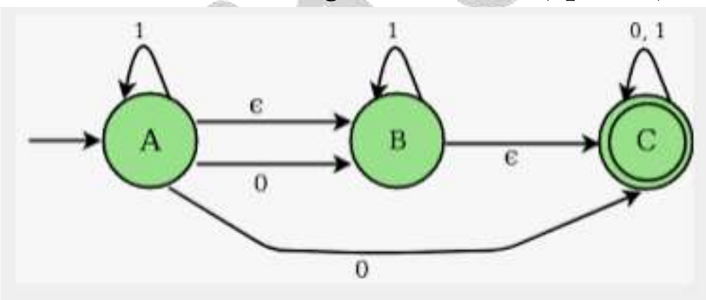
(A) (a + b)*{λ + a + aa + aab + aaba + aabbab}

(B) (aabab)(a + b)*

(C) babaa (a + b)*

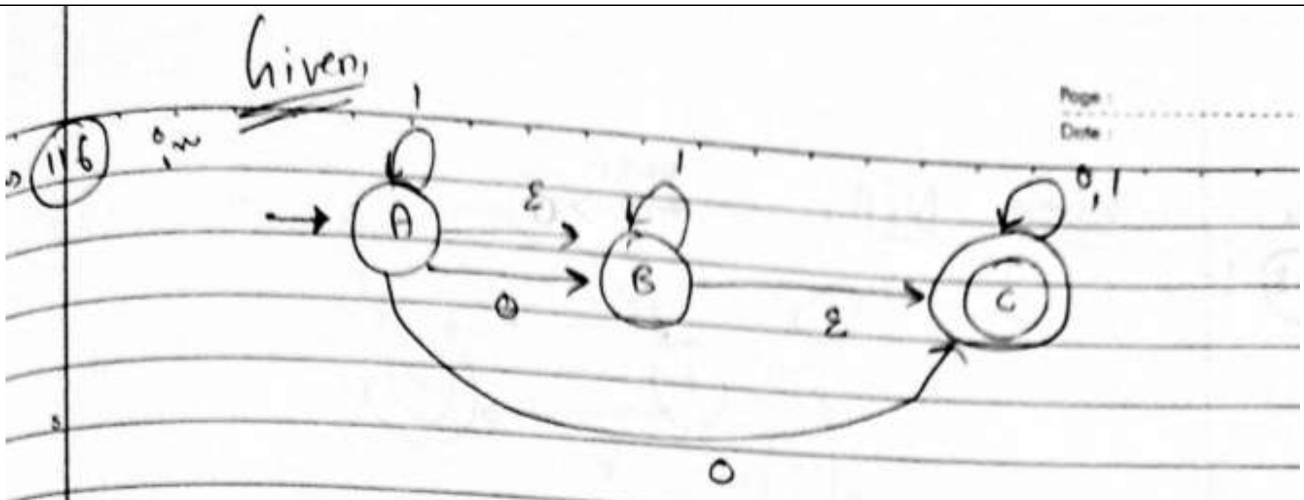
(D) None of the above

	Ans (114) Language of given NFA is $L(m) = (a+b)^* \; aabab.$ Now, $(L(m))^R = babaa\,(a+b)^*$ Ans:- option c is correct.
Q115.	**[MSQ]** Consider the following NFA with ∈ (epsilon): :  Which of the following statement is/are true? (A) $\in -$closure $\{q_0\} = \{q_0, \; q_1, q_2\}$ (B) $\in -$closure $\{q_1\} = \{q_1, q_2\}$ (C) $\in -$closure $\{q_2\} = \{q_0, q_2\}$ (D) $\in -$closure $\{q_3\} = \{q_3\}$

	Ans 115 Given NFA.  (A) ε- closure of $\{q_0\} = \{q_0, q_1, q_2\}$ ε- closure of $\{q_1\} = \{q_1\}$ ε- closure of $\{q_2\} = \{q_2\}$. (D) ε- closure of $q_3 = \{q_3\}$. Ans :- (A) & (D) are correct.
Q116.	**[MSQ]** Consider the following NFA with ∊ (epsilon):  Which of the following statement is/are true? (A) $\in -$closure $\{A\} = \{A,\ B, C\}$ (B) $\in -$closure $\{B\} = \{B,\ C\}$ (C) $\in -$closure $\{C\} = \{C\}$ (D) $\in -$closure $\{A\} = \{A, B\}$

Given,

116 :-



(A) ✶ ε – closure of $\{A\} = \{A, B, C\}$

As $\left(A \xrightarrow{\varepsilon} B \xrightarrow{\varepsilon} C\right)$

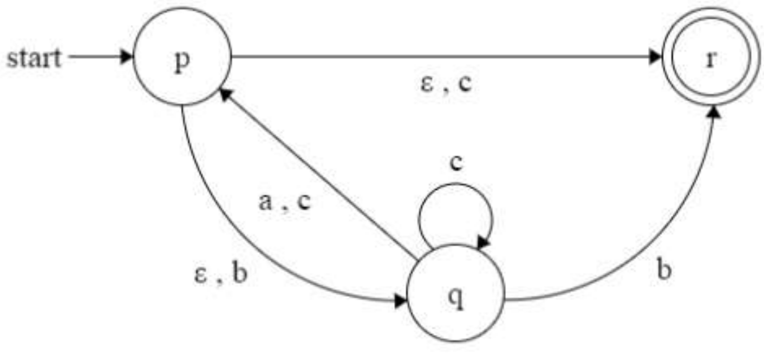
(B) ✶ ε- closure of $\{B\} = \{B, C\}$

$\left(B \xrightarrow{\varepsilon} C\right)$

(C) ✶ $\in$ - Closure of $\{C\} = \{C\}$.

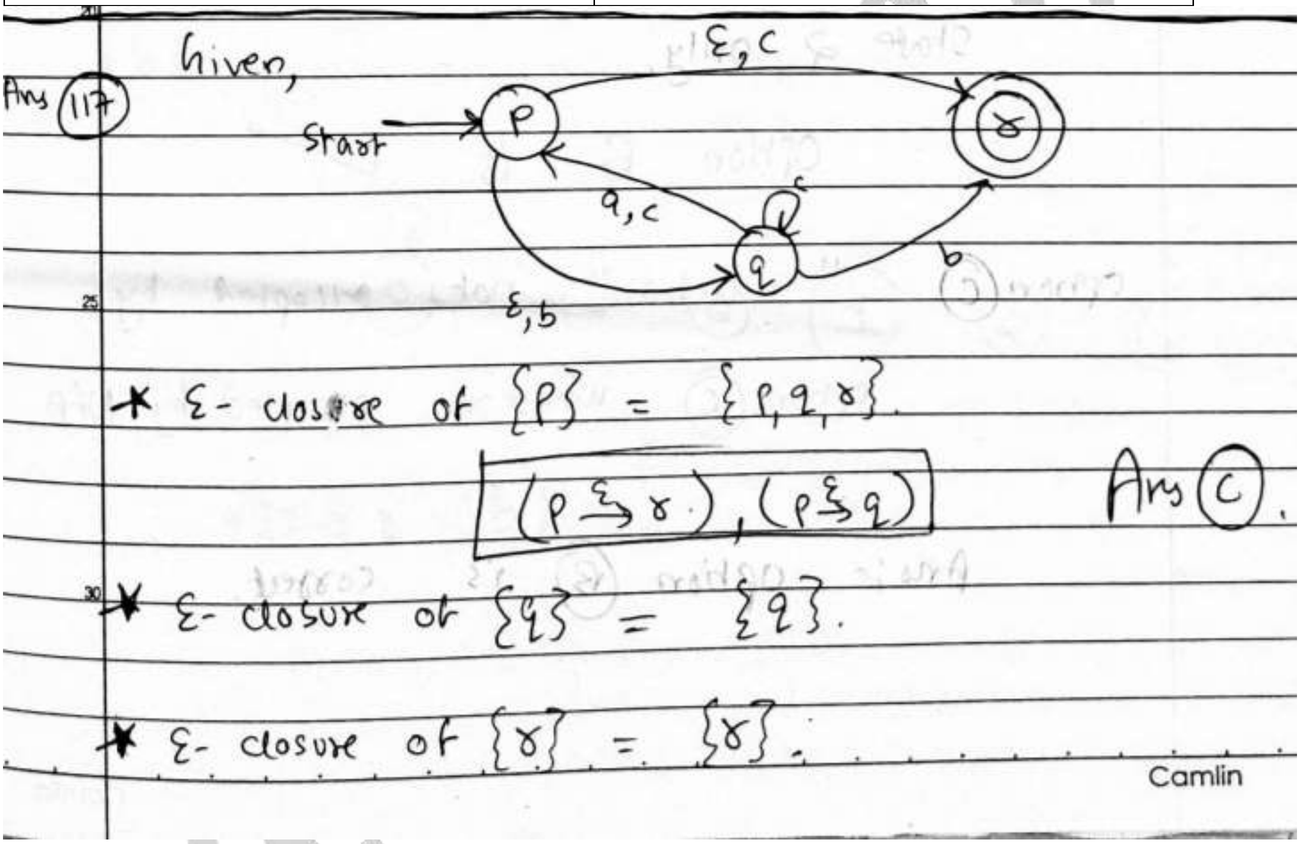
Ans :- option A, B, C are correct.

Q117. Consider the following NFA with $\in$ (epsilon): :



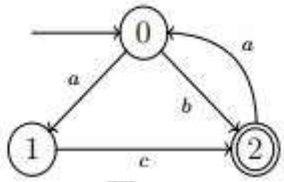
Which of the following option(s) is/are true about $\in$-closure of different states of given NFA?

(A $\in -closure(p) = \{p, q, r\}$ $\in -closure(q) = \{p, q, r\}$ $\in -closure(r) = \{p, q, r\}$	(D) $\in -closure(p) = \{p, q, r\}$ $\in -closure(q) = \{q, r\}$ $\in -closure(r) = \{ r\}$
(C) $\in -closure(p) = \{p, q, r\}$ $\in -closure(q) = \{q\}$ $\in -closure(r) = \{r\}$	(D) None of these



Q118. Consider the following NFA with $\in$ (epsilon):

The regular expression of the following non-deterministic finite automaton is



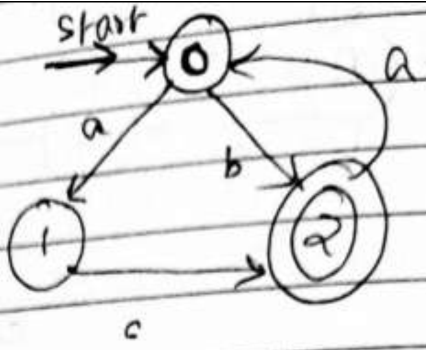
(A)ac + b(ab)*

(B) (ac + b)(aac + ab)*

C)(aca +ba)(b + ac)*

(D) Both b and c

Ans (118) :- Given NFA,



option (A) NFA, accepts "acbab" but option (A) not, ∴ (A) is incorre

option (B) $(ac+b)(aac+ab)^*$.

from 0 to 2 can be reached in 2 two w

ac/b after that any no. of cycles

of aac or ab will lend NFA to

State 2 only.

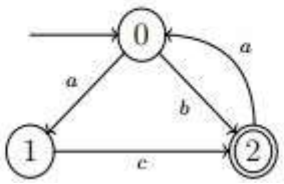
Option B is ✓

Option (C) "acbab" not accepted by option (C) whereas accepted by NFA

Ans:- option (B) is correct.

Solution:

Option (A) is false.



because acab generate by automata.

But acab does not generate by option.(a).

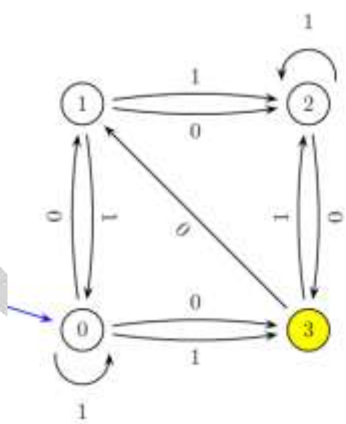
(b) option B is correct.

(c) option c is false because expression c generate aca, but NDFA doesnot generate aca.

Answer: B

Q119. **[MSQ]**

Consider the following FSA: (Where state '3' is final state) :

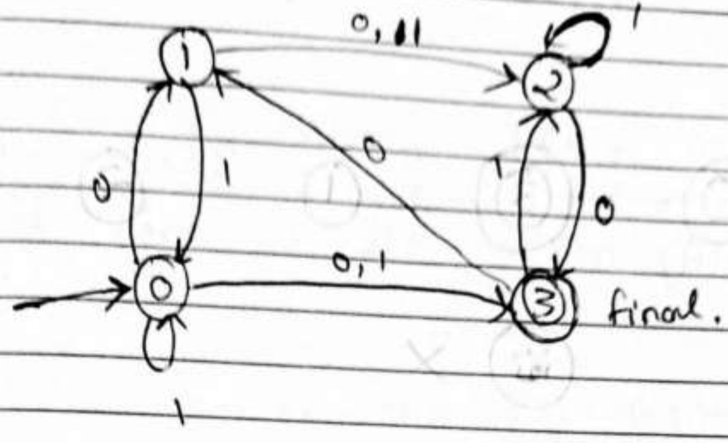


Which of the following statements is/are true?

(A) The FSA accepts 011111101.
(B) The FSA accepts 11101000.
(C) The FSA rejects 0000.
(D) The FSA accepts all bit strings with an odd number of

Page :
Date :

Ans : 19 Given FSA is :-

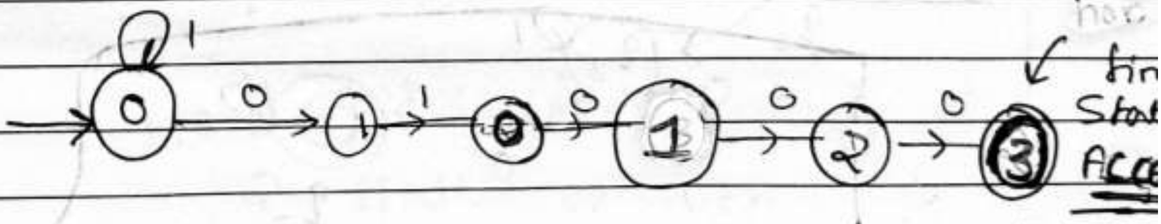
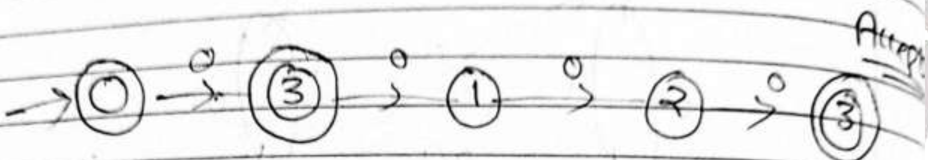
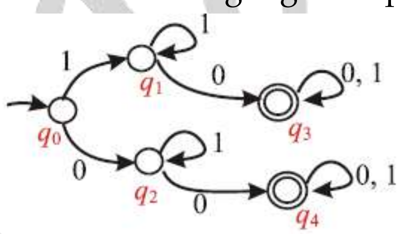


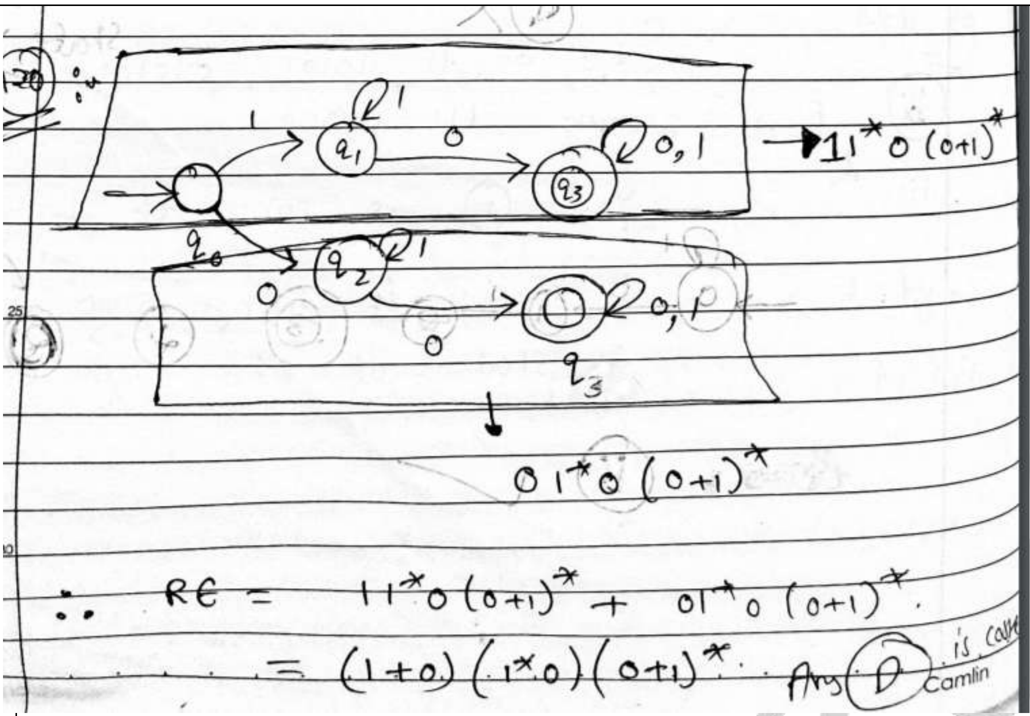
(a) FSA accepts 011111101

Reject (as 2 is not final state)

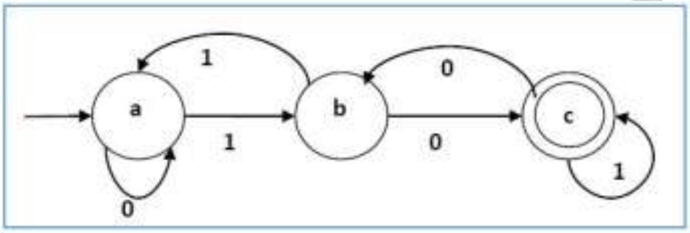
(a) ✗

(b) FSA accepts 11101000

	 Ans:- (b) ✓ (c) fsA reject 0000  (c) × (D) fsA Rejects "000 00" ∴ option (D) ×. Ans:- Only (b) is correct.
Q120.	What is the language accepted by the following DFA?  (A) 0*1* 0* (C) (1+0)* 1*(0+1)* +0)1*0(0+1)*



Q121. The regular expression for following automata will be:



(A) (011)*10(00 +1)*
(B) 0*11*10(00 +1)*
(C) (0+11)*10(00)*1*
D)(0+11)*10(00 +1)*

Answer: D

Solution:

Option a: False

Because our automata generate 000010, but our regular expression can't generate this.

so option (a) is false.

Now check for option (b)

Automata generate 10, but regular expression $0^* 11^*10(00+1)^*$ does not generate 10.

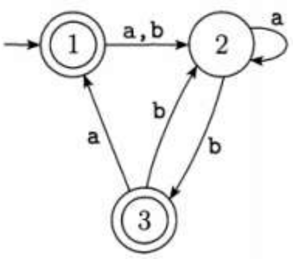
Option c is also false.

011101100 string generate by automata, but regular expression

$(0+11)^*10(00)^* 1^*$ does not generate it.

So answer is D

Q122. What is the regular expression corresponding to the language accepted by the following finite state automata?



(A) $((a + b)(a^*(bb)^*)^*b(\lambda+a))^*$

$(a^*(bb)^*)^*b+b(a^*(bb)^*)^*a)$

$+b)(a^*(bb)^*)^*a$

one

Answer: D

Solution:

Option(a) is false:

$((a+b)(a^*(bb)^*)^*(\lambda+a))^*$

$((a+b)(a^*(bb)^*)\ b(\lambda+a))^2$

$(ab)^2 = abab$

so it generate abab.

but abab does not generate by automata.

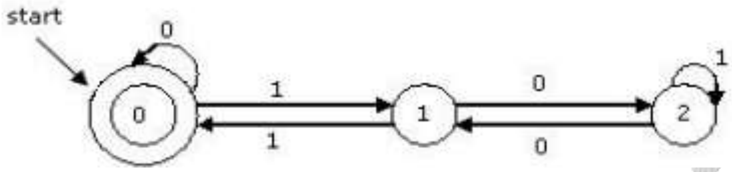
So option(a) is false.

(b) option (b) is also false.

because option (b) does not generate λ, but our automata generate λ.

so option (b) is false.

(c) is also false, because expression (c) does not generate λ, but our automata

	generate λ. Answer: D
Q123.	How many of the following regular expressions that denotes a subset of the language recognized by the given DFA? ___________  (1) 0*(11)*0* (2) 0*1(10*1)*1 (3) 0*1(10*1)*10* (4) 0*1(10*1)0(100)* (5) (0*1(10*1)*10* + 0*)*

123) R.E for given DFA is

$\Rightarrow (0 + 1(01^*0)^*1)^*$

$L = \{\epsilon, 0, 00, 11, 10101, 010101, 1001, \ldots\}$

Option 1 :- Yes 1 is subset of L as it makes transitions to first 2 states of DFA only and accepts strings which are part of L.

Option 2 Yes option 2 generates strings which are part of L.

Hence, denotes subset of language.

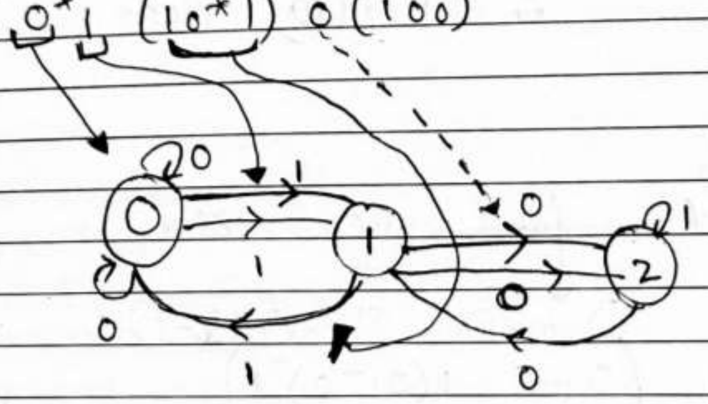
Camlin

(3) $0^*1(10^*1)^*10^*$.

Yes, subset of given L.

Observe, ((3) is superset of (2))

(4) $0^*1(10^*1)0(100)^*$



will lead DFA in state 2

As "1100" "1010" generated by (4) but Not by L $\therefore$ (4) $\not\subset$ L

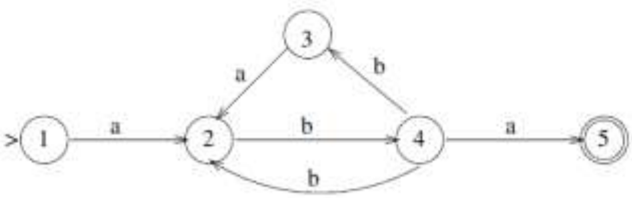
$\therefore$ (4) X

(5) Yes option (5) generates all the strings which are part of L.

$\therefore$ option (5) $\subseteq$ L

(1), (2), (3), (5) correct **Ans:-** 4.

Q124. What is the language accepted by the following finite state automata?



(i) a(bb + bba)*ba

(ii) ab(bb + bab)*a

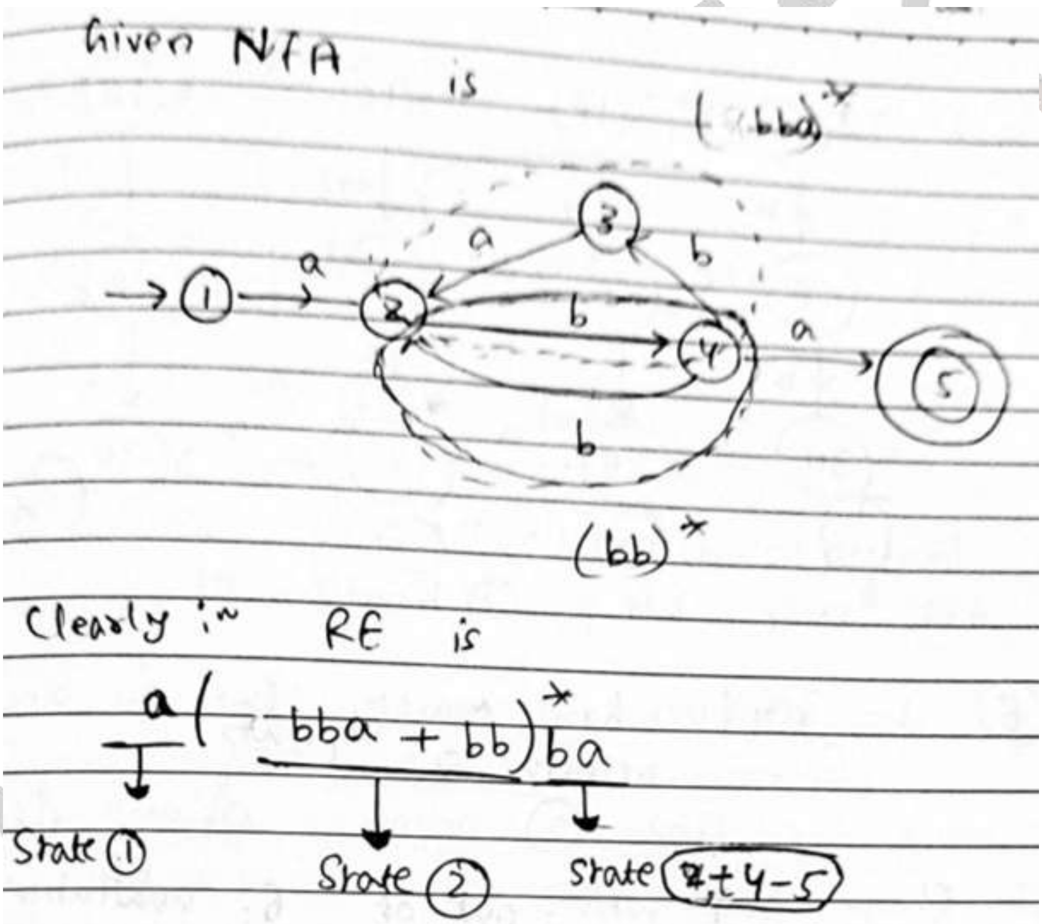
(iii) ab(b+ba)*a

(A) i only (B)ii and iii only

(C)All of these (D)i and iii only

Answer: i & ii Only

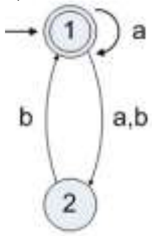
Solution:



Similarly, There is another path to reach final states. First we move from q1 to q2 then q2 to q4. After that, we have two loop (q4q2, q2q4)* and (q4q3, q3q2, q2q4)* then we will traverse q4q5 edge to reach final state q5.

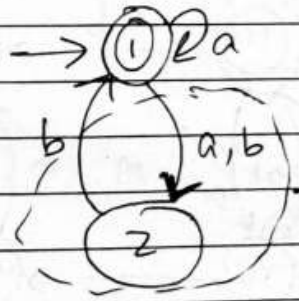
So, its regular expression will be a(bb + bab)*a. So, i & ii are correct.

Q125.	**[MSQ]** What will be the regular expression for following automata?



(A) a*(a+b)b
(B) a*(a+b)ba*
(C) a*{((a+b)b)*a* + λ}
(D) (a +(a+b)b)*

Ans (125) :-



a^*

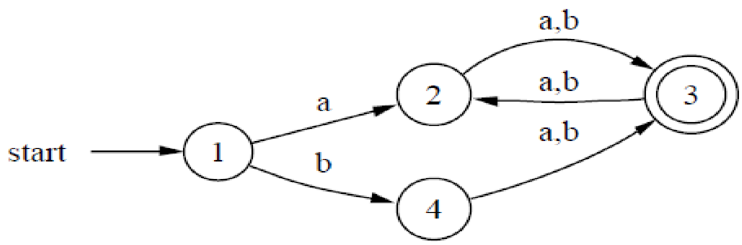
$\longrightarrow ((bb)^* (ab)^*)^*$.

$\therefore L = (a + ab + bb)^*$

$= (a + (a+b)(b))^*$.

Ans :- D. Only.

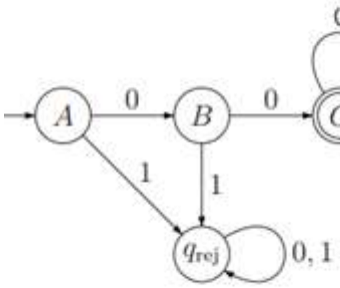
Q126.	What is the language accepted by following automata?



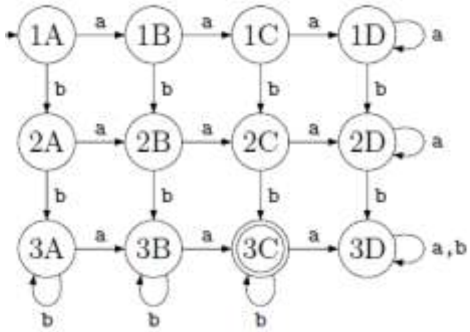
(A) Any string starts or ends with b
(B) The strings with an even number of characters
(C) The strings with an even number of characters and length of at least 2
(D) The strings with an even number of a's or b's and length of at least 2

Solution:

Option(a) is false.

	Any string start or end with b is false because automata also generate string that start with a and end with a. (b)option(B) is partially true, but not defined accurate language. (c)true string with an even number of characters and length of at least 2. (d) false abbb(this string generate by automata) but this string contain neither even number of a or b. **Answer is C**
Q127.	The language accepted by the following DFA is:  (A) All strings of the form 0^+w, where w contains an even number of ones. (B) All strings of the form 000^+w, where w contains an even number of ones. (C) All strings of the form 00^+w, where w contains an odd number of ones. (D) All strings of the form 00^+w, where w contains an even number of ones. Solution: Option (a): All string of the form 0w, where w contain an even number of one's is false because string contain at least two zero's. Option (b) is false. all string contain at least 3a's this also false, because automata generate string at least two zero's and even number of ones . **So option d is correct.** **Answer: D**

Q128. The language accepted by the following DFA is:



(A) L= {w| w has number of 'a' divisible of 4 and number of 'b' divisible of 3}

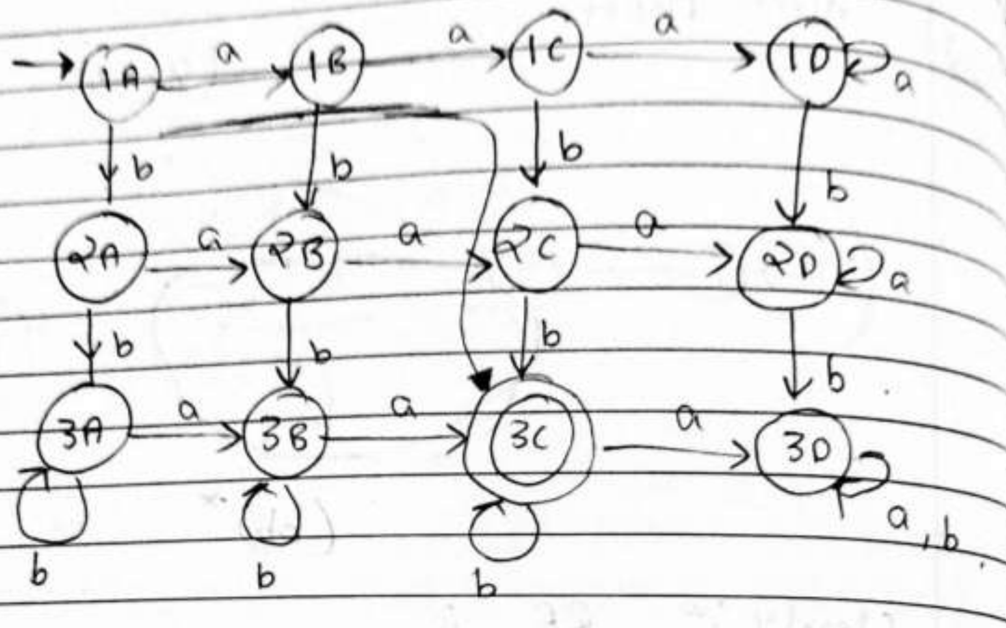
(B) L= {w| w has exactly two a's and at least two b's}

(C) L= {w | w has exactly two a's and number of b's divisible by 2}

(D) L= {w | w has at least two a's and number of b's divisible by 2}

Ans(128):

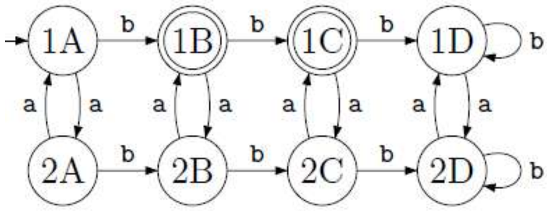
Ans: B



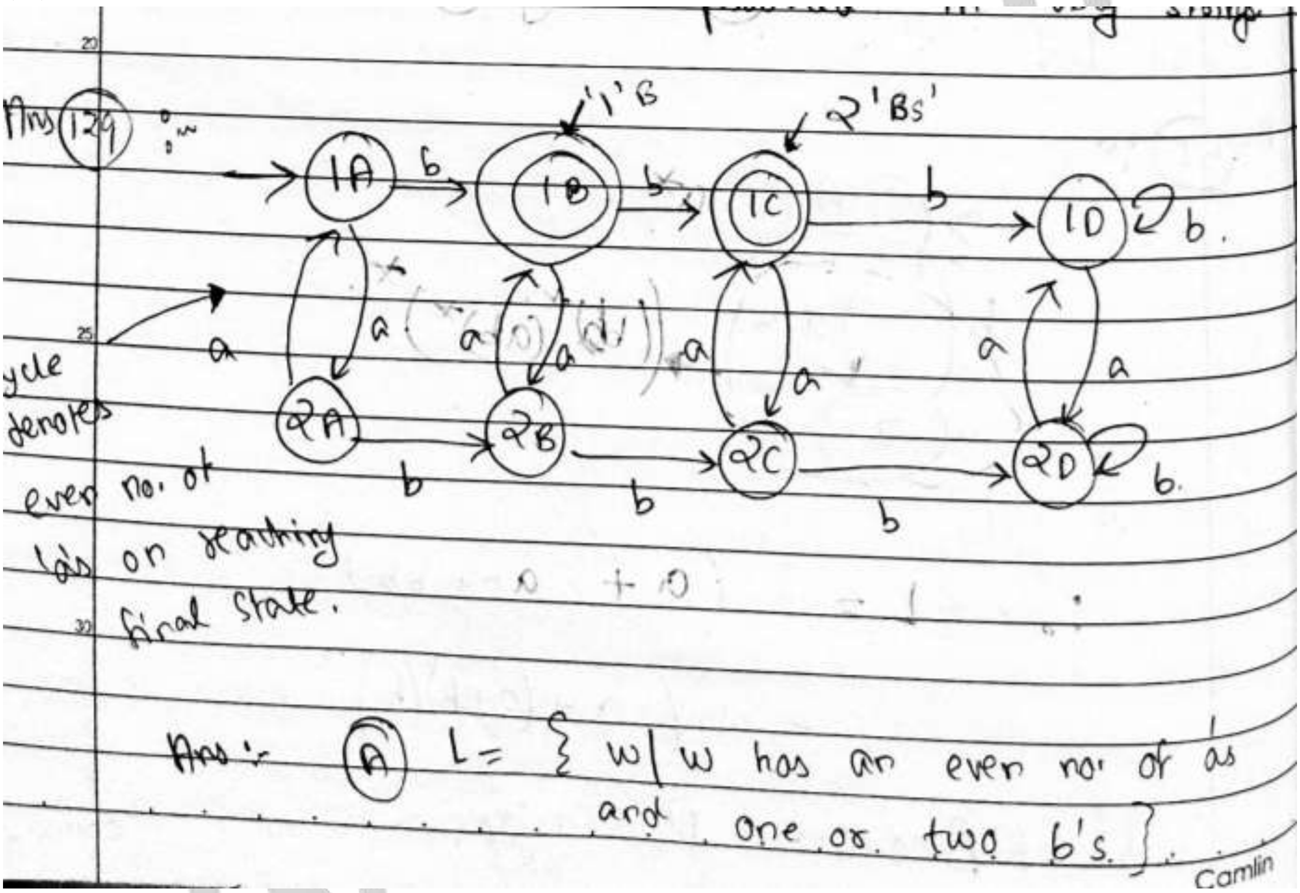
(B) L = {w | w has exactly two a's and atleast 2 b's}

Choose any path out of 6 available paths, same exactly 2 a's and atleast 2 b's are produced in any strings

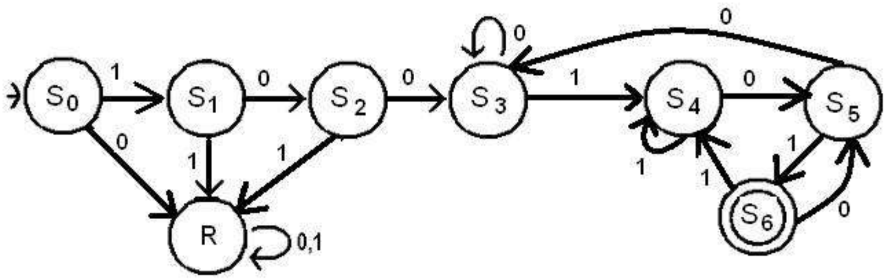
Q129. The language accepted by the following DFA is:



(A)L= {w | w has an even number of a's and one or two b's}
(B)L= {w | w has an even number of a's and at least two b's}
(C)L= {w | w has an at least two a's and one or two b's}
(D)L= {w | w has an at least two a's and one or two b's}



Q130. Consider the following DFA D:



If L(D) is language accepted by DFA D, then which of the following language is exactly equivalent to L(D)?

(A) All the strings containing substring 100101

(B) All the strings start with 10 and end with 01

(C) All the strings start with 100 and end with 101

(D) All the strings of length greater than or equal to six.

Ans (130) :- (A) option 'A' claims that 1001011 which is containing "100101" must be accepted whereas given DFA rejects.

So, (A) is false.

(B) As "1001" must be accepted according to option (B), but given DFA rejects.

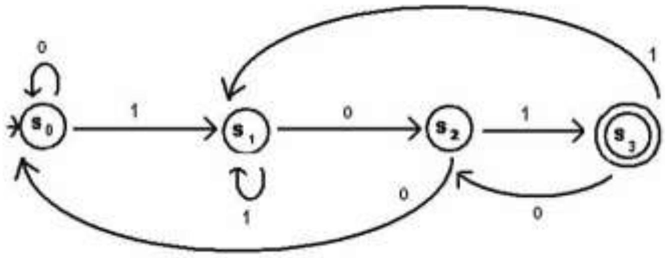
So option (B) is false.

(C) Yes, option (C) satisfies given DFA.

(D) As, "10010111" is rejected by DFA

So, option (D) is false.

Ans :- (C) is correct.

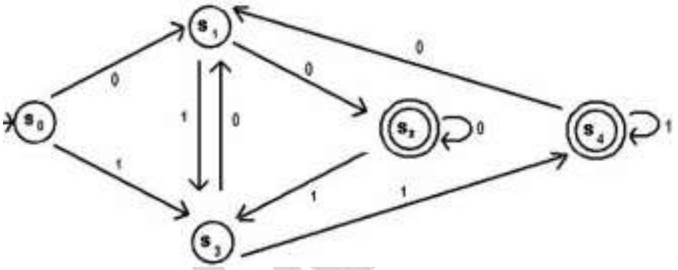
Q131.	The following DFA accepts  (A) All the strings that contains 101 as substring (B) All the strings that ends with 101 (C) All the strings does not end with 0 (D) All the strings that ends with 01

Ans 131 :- A As "1011" is rejected by DFA, so A is false.

B Yes DFA accepts all the strings that ends with 101.

C as '1' is rejected by DFA, so C is false

D '01' is rejected by DFA. Ans :- B

Q132.	The following DFA accepts  (A) $(00+11)^+$ (B) All the strings containing 00 and 11 as substring (C) All the strings end with 00 or 11 (D) All the strings of length greater than or equal to two

Ans (137) :- (A) ∴ option (A) generates 000 but not "000" where as "000" is Also accepted

Accepted by DFA, So (A) is fal

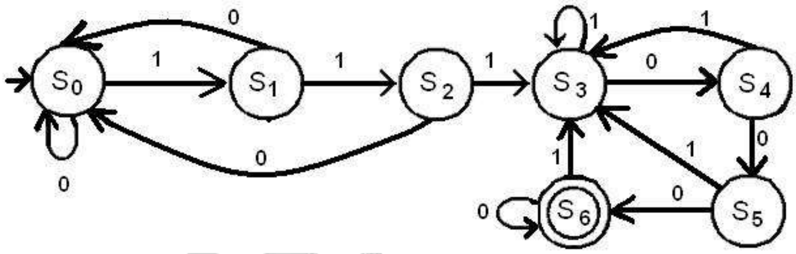
(B) "001" contains substring "00" rejected by DFA. (B) false

(C) "100" ends with 00 accepted by DFA. (C) is correct (check more strings)

(D) "1110" rejected by DFA, which is of length 4 ∴ D is False.

Ans :- (C) is Correct.

Q133. The following DFA accepts



(A) All the strings containing 111 as the substring.

(B) All the strings containing 111and 000 as the substring.

(C) All the strings start with 111 and ends with 000.

(D) All the strings containing 111 a substring and ends with 000.

Ans (133) :- Option (A) is false, as "111" is rejected.

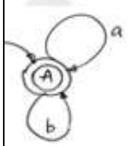
Option (B) false, as "111" is not accepted

Option (C) false, as "0111000" is also accepted

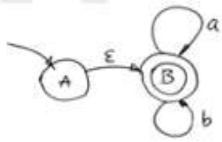
Option (D) True, DFA accepts all the strings containing 111 as substring and ends with 000.

$\boxed{\text{Ans: D}}$

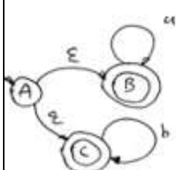
Q134. Which of the following finite automata accepts different language than other three?



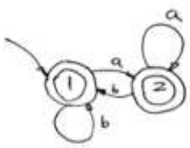
a)



b)



c)



d)

(134) :- Ans :- A, B, D having $L = (a+b)^*$.

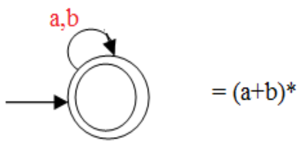
C having regular expression $a^* + b^*$.

$\therefore$ C is Different.

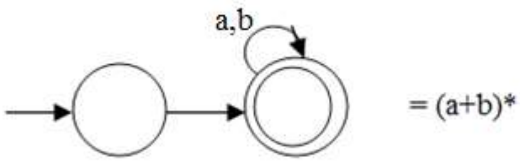
Ans (C).

Answer: C

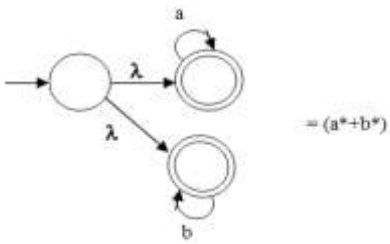
Solution: (a)



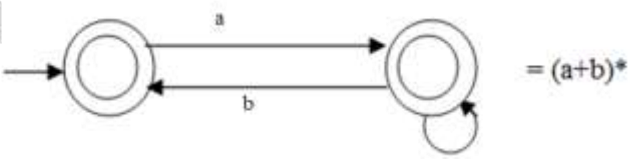
(b)



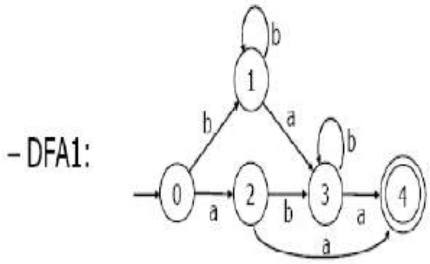
(c)

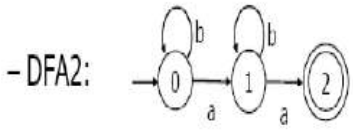


(d)



<table>
<tr><td></td><td>Option (c) generates different language.

Answer: C</td></tr>
<tr><td>Q135.</td><td>Consider the following two DFAs




Let the language accepted by DFA1 is L1 and that of DFA2 is L2. Which of the following is true?
(A) L1 $\subset$ L2
(B) L2 $\subset$ L1
(C) L1= L2
(D) L1 $\neq$ L2</td></tr>
</table>

3) 135 :- Regular Expresion for DFA 1 :-

$\Rightarrow \quad bb^*ab^*a + abb^*a + aa$

On Simplyifying

$= (bb^*a + ab)b^*a + aa.$

$= b^*ab^*a.$

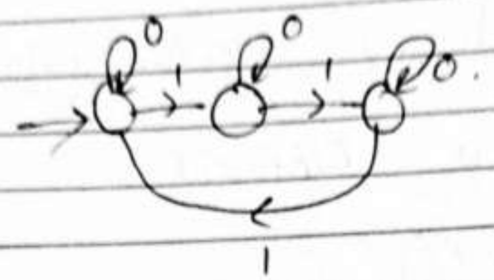
DFA 2 :- b^*ab^*a

Hence $L_1 = L_2$ Ans C.

Hint :- DFA 2 can be obtained by minimizing DFA 1.

Q136. Minimum number of states in a deterministic finite state automaton (FSA) that recognizes all bit strings with a multiple of three 1's. (For example, the following strings are in the language: 111, 111111, 1110, 0111, 10011, but not 1, 11, 1111, 0110. ______

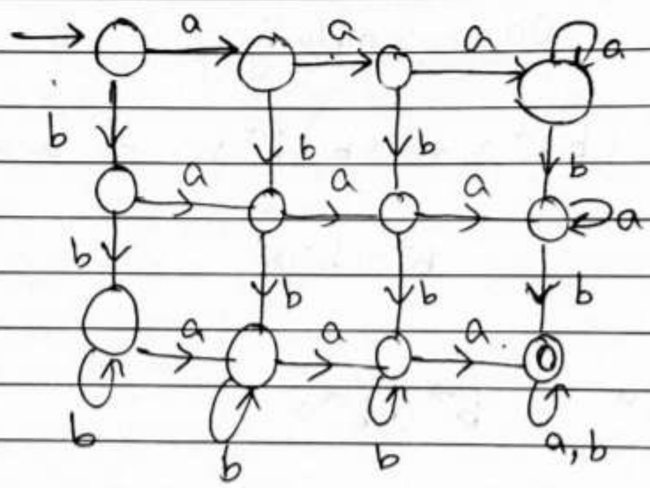
4) 136 DFA can be constructed as



Minimal DFA for given L has 3 states.

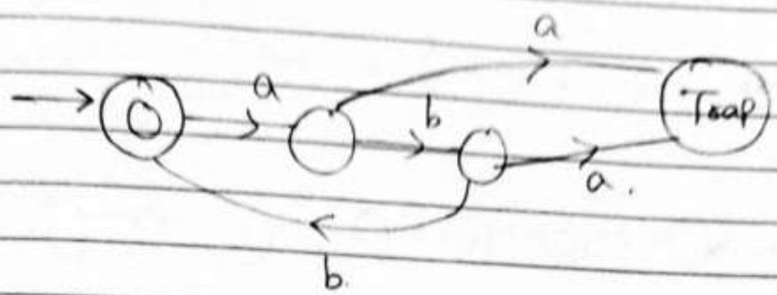
Ans: 3

<table>
<tr><td>Q137.</td><td>Minimum number of states in a deterministic finite state automaton (FSA) that recognizes all strings over a and b that has at least three a’s and at least two b’s i.e.
L = {w | w has at least three a’s and at least two b’s}__________

Ans (137) :- DFA for given L is

4×3 ⇒ 12 states

Trick :- for atleast "m" a's and "n" b's.
minimum no. of States = (m+1)(n+1).
Ans is 12.</td></tr>
<tr><td>Q138.</td><td>Consider the following language:L = {w ∈ {a, b}∗ | every a’s in w is followed immediately by the string bb}. Minimum number of states in a deterministic finite state automaton for L is __________</td></tr>
</table>

An (138) :- DFA for given L is implemented as



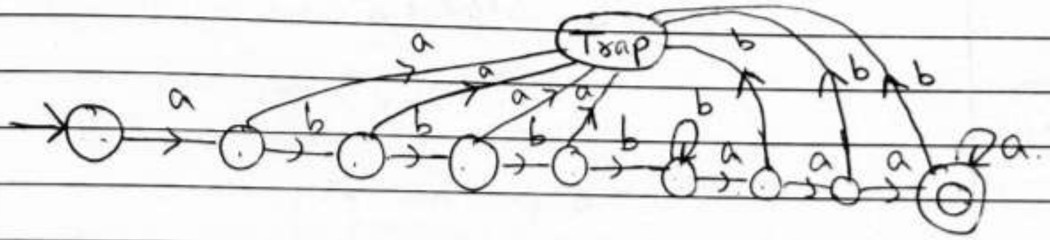
minimal DFA for given L has 4 states.

Ans: 4

Q139. Minimum number of states in a DFA for the language L = {ab^na^m | n>3, m>2 } is___

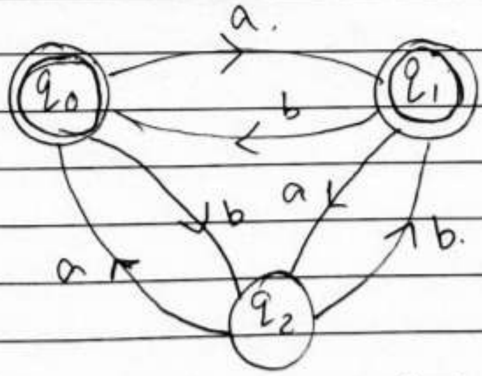
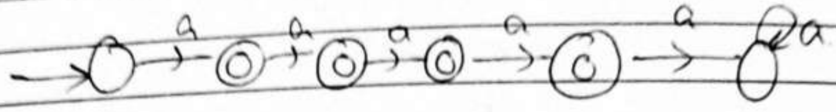
Ans (139) :- Given,

$L = \{ab^n a^m \mid n>3, m>2\}$.



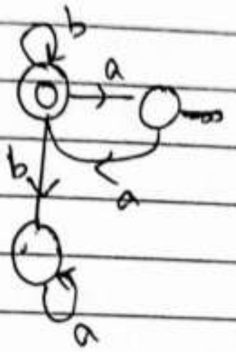
Minimal DFA has 10 states (include Trap state)

Ans: 10

Q140.	The minimum number of state in the DFA for the language L = {w | $(n_a(w) + 2n_b(w)) \bmod 3 < 2$} is ______ Ans (140) DFA is  Ans :- 3 States
Q141.	How many number of states are required to construct the minimized DFA for following languages over {a, b}whose languages of accepted strings (exactly) are: (i) {a, aa, aaa, aaaa}. ________ (ii) all strings not in {a, aa, aaa, aaaa}. ____________ (iii) all strings whose length is divisible by 2 or 3. ___________ (iv) all strings matching the regular expression (aa|b)*+(bb|a)*.____ (v) all strings not matching the regular expression $(\phi^*)^*$_________ Ans (141) :- (i) DFA for L = {a, aa, aaa, aaaa}  6 States. (ii) Complement of (i) option, ∴ 6 States.

Date :

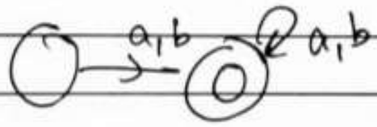
(iv) Given R.E is $(aa+b)^* + (bb+a)^*$.

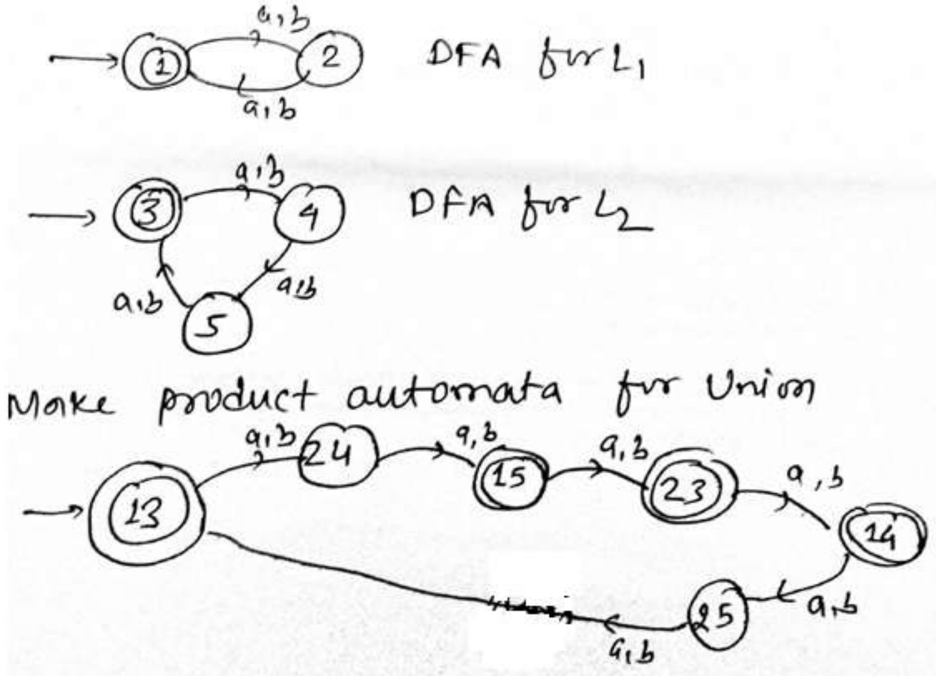
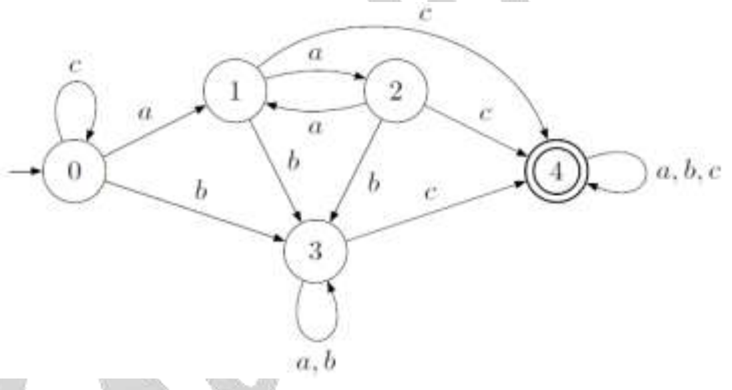


(v) All strings not matching the regular expression $(\phi^*)^* = \lambda$

$L = \lambda$

$\bar{L} = (a+b)^+$



	(iii)L= all strings whose length is divisible by 2 or 3 = L1 U L2 ; Where L1 = {w |w ∈ $\{a, b\}^*$ and |w| mod 2 = 0 } and L2 = {w |w ∈ $\{a, b\}^*$ and |w| mod 2 = 0 }  Apply minimization algorithm: $\pi_0 = \{24, 25\}, \{13, 15, 23, 14\}$ $\pi_1 = \{24, 25\}, \{13, 14\},\ \{15, 23\}$ $\pi_2 = \{24\}, \{25\}, \{13\}, \{14\},\ \{15\},\ \{23\}$ $\pi_3 = \{24\}, \{25\}, \{13\}, \{14\},\ \{15\},\ \{23\}$ So, minimized DFA contains 6 states.
Q142.	Consider the following DFA D over the alphabet Σ = {a, b, c}:  The number of state states in minimized DFA will be _______ Answer: 3 Solution:

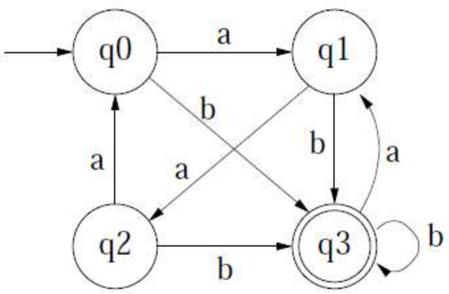
	a	b	c
→ 0	1	3	0
1	2	3	4
2	1	3	4
3	3	3	4
4	4	4	4

Merge 1, 2, 3 as single state [1 2 3]

	a	b	c
→ 0	[123]	[123]	0
[123]	[123]	[123]	4
4	4	4	4

So number of states in minimized DFA = 3.

Q143. Consider the following DFA over {a, b}



How many states does the minimized DFA have? _________

Answer: 2

Solution:

	a	b
$\rightarrow q_0$	q_1	q_3
q_1	q_2	q_3
q_2	q_0	q_3
q_3	q_1	q_3

merge q_0 q_1 q_2 as single state $[q_{012}]$

	a	b
$\rightarrow q_{012}$	q_{012}	q_3
q_3	q_{012}	q_3

So number of states in minimized DFA = 2

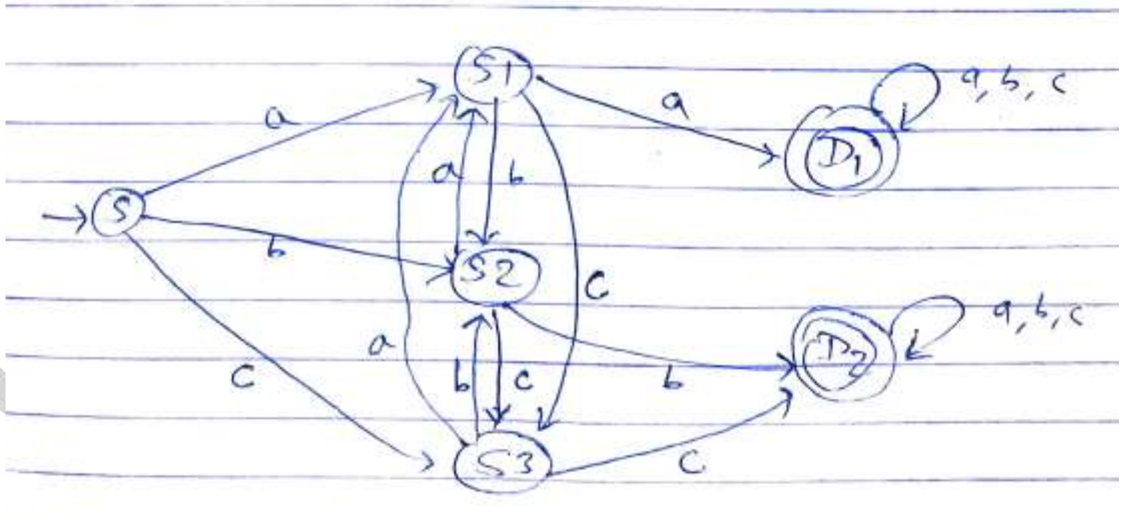
Q144. Consider the finite automaton MDL = ({S, S1, S2, S3, D1, D2}, {a, b, c} δ, S,{D1,D2}, where δ is defined as follows:

δ(S, a) → S1   δ(S, b)→S2   δ(S, c) → S3   δ(S1, a) → D1
δ(S1, b) →S2   δ(S1, c) → S3   δ(S2, a) → S1   δ(S2, b) → D2
δ(S2, c) → S3   δ(S3, a) → S1   δ(S3, b) → S2   δ(S3, c) → D2
δ(D1, a) →D1   δ(D1, b) → D1   δ(D1, c) → D1   δ (D2, a) → D2
δ(D2, b) → D2   δ(D2, c)→ D2

Minimum number of states in DFA of given MDL is___________

Answer: 5

Solution:



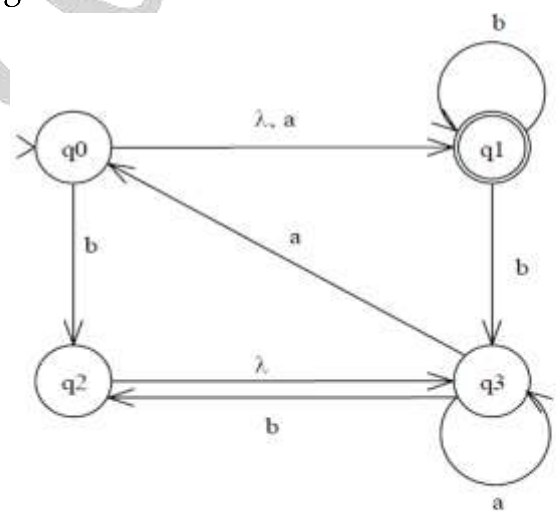
	a	b	c
→ S	S1	S2	S3
S1	D1	S2	S3
S2	S1	D2	S3
S3	S1	S2	D2
D1	D1	D1	D1
D2	D2	D2	D2

merge both final states as D_{12}

	a	b	c
→ S	S1	S2	S3
S1	D_{12}	S2	S3
S2	S1	D_{12}	S3
S3	S1	S2	D_{12}
D_{12}	D_{12}	D_{12}	D_{12}

So ~~[illegible]~~ number of states in minimized DFA = 5

Q145. Consider the following NFA



The number of states in the equivalent minimized DFA will be? ____________

(145)

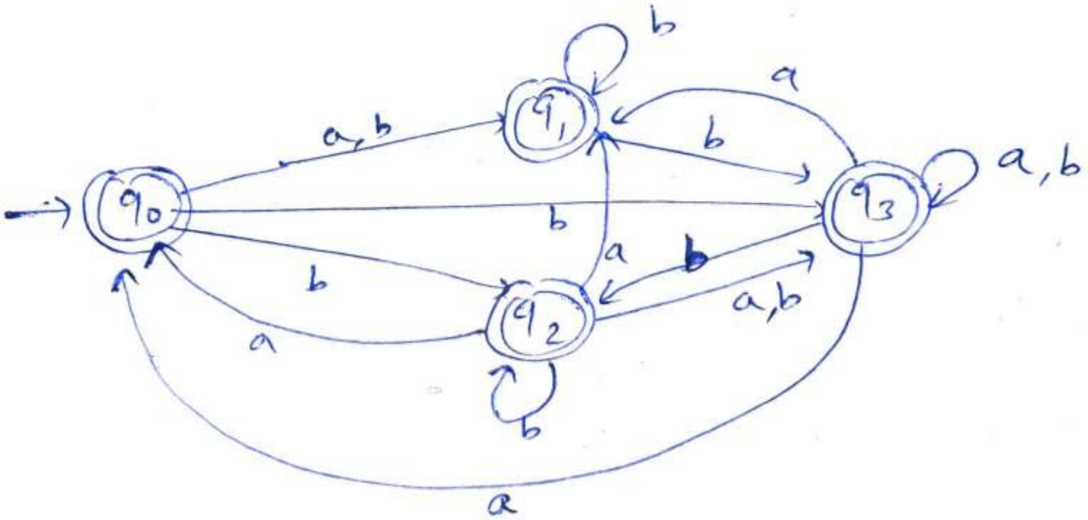
Convert the NFA to DFA →

λ closure $(q_0) = \{q_0, q_1\}$
λ closure $(q_1) = \{q_1\}$
λ closure $(q_2) = \{q_2, q_3\}$
λ closure $(q_3) = \{q_3\}$

State	λ closure	a	b
q_0	$q_0 q_1$	q_1	$q_2 q_1 q_3$
q_1	q_1	ϕ	$q_1 q_3$
q_2	$q_2 q_3$	$q_0 q_3$	q_2
q_3	q_3	$q_0 q_3$	q_2

$q_0(a) = \lambda$ closure $(q_1) = q_1$
$q_0(b) = \lambda$ closure $(q_1 q_2 q_3) = \{q_1, q_2, q_3\}$
$q_1(a) = \phi$
$q_1(b) = \lambda$ closure $(q_1 q_3) = \{q_1, q_3\}$
$q_2(a) = \lambda$ closure $(q_0 q_3) = \{q_0 q_1, q_3\}$
$q_2(b) = \lambda$ closure $(q_2) = \{q_2 q_3\}$

$q_3(a) = \lambda closure(q_0 q_3) = \{q_0\ q_1 q_3\}$
$q_3(b) = \lambda closure\ (q_2) = \{q_2 q_3\}$



NFA without λ moves.

now Convert to DFA

	a	b
$\rightarrow q_0$	q_1	$q_1 q_2 q_3$
q_1	$\cancel{\phi}\ q_t$	$q_1 q_3$
$q_1 q_2 q_3$	$q_0 q_1 q_3$	$q_1 q_2 q_3$
$q_1 q_3$	$q_0 q_1 q_3$	$q_1 q_2 q_3$
$q_0 q_1 q_3$	$q_0 q_1 q_3$	$q_1 q_2 q_3$
q_t	q_t	q_t

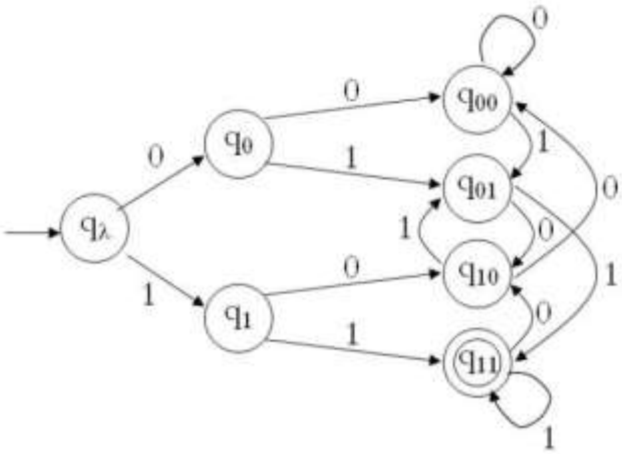
here q_t is trap state.

Merge $q_0 q_1 q_3$, $q_1 q_3$ and $q_1 q_2 q_3$ as q_{0123}

	a	b
$\rightarrow (q_0)$	q_1	q_{0123}
(q_1)	q_t	q_{0123}
(q_{0123})	q_{0123}	q_{0123}
q_t	q_t	q_t

So number of states in minimized DFA is 4.

Q146. Consider the following NFA



The number of states in the equivalent minimized DFA will be? ___________

Answer: 3

Solution: We will apply minimization algorithm:

$\pi_0 = \{q_\lambda, q_0, q_1, q_{00}, q_{01}, q_{10}\}, \{q_{11}\}$.

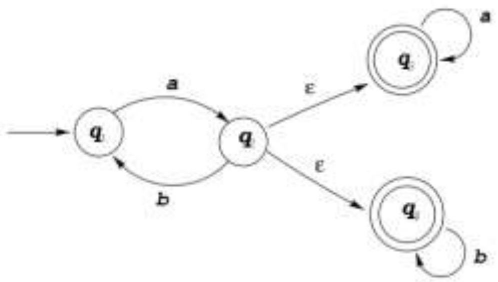
$\pi_1 = \{q_\lambda, q_0, q_{00}, q_{10}\}, \{q_{01}, q_1\} \{q_{11}\}$.

$\pi_2 = \{q_\lambda, q_0, q_{00}, q_{10}\}, \{q_{01}, q_1\} \{q_{11}\}$.

$\pi_3 = \{q_\lambda, q_0, q_{00}, q_{10}\}, \{q_{01}, q_1\} \{q_{11}\}$.

So, minimized DFA contains 3 states.

Q147. Consider the following NFA



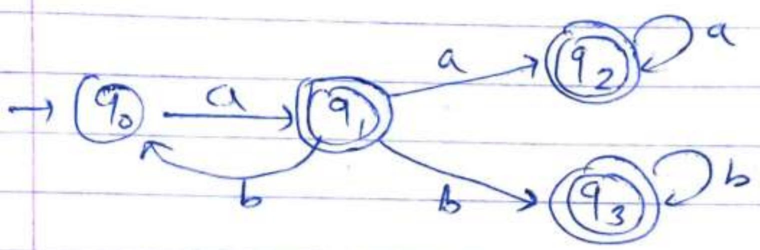
The number of states in the equivalent minimized DFA will be? ________

Q.(147)

Language accepted by NFA is

$$a(ba)^*(a^* + b^*)$$

~~NDFA~~ NFA for this language without λ moves



NFA transition table

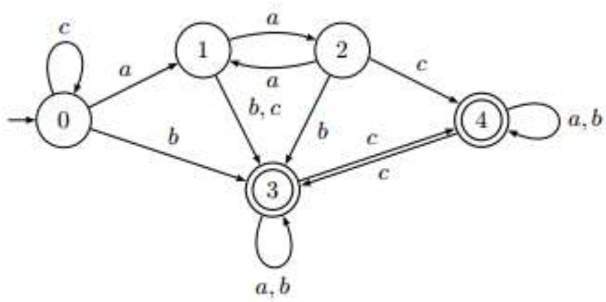
	a	b
$\rightarrow q_0$	q_1	ϕ
q_1	q_2	q_0q_3
q_2	q_2	ϕ
q_3	ϕ	q_3

DFA transition table

	a	b
$\rightarrow q_0$	q_1	q_t
q_1	q_2	q_0q_3
q_2	q_2	q_t
q_0q_3	q_1	q_3
q_t	q_t	q_t

No. of states in minimized DFA = 5

Q148.	Consider the following DFA D over the alphabet ΣD = {a, b, c}:



The numbers of states in the equivalent minimized DFA is__________

148

	a	b	c
→ 0	1	3	0
1	2	3	3
2	1	3	4
3	3	3	4
4	4	4	3

merge state 3 and 4 as [34]
and state 1 and 2 as [12]

	a	b	c
→ 0	[12]	[34]	0
[12]	[12]	[34]	[34]
[34]	[34]	[34]	[34]

No. of states in minimized DFA.

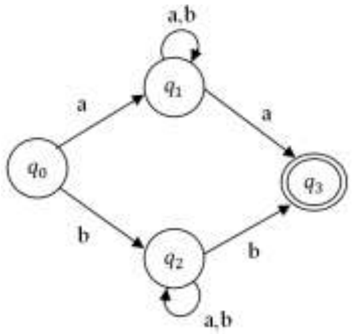
Q149. Find out how many states exist when we draw minimized DFA for the regular language given below $L = \{w\,x\,w^r \mid w \in (a+b)^+ \text{ and } x \in (a+b)^*\}$?__________

Solution:

Given= $L= \{wxw^r \mid w \in (a+b)^+, x \in (a+b)^*\}$

Draw its NFA.

Here we have consider w as a single alphabet, so every string that accepted by this language will start and end with same symbol, and rest will be covered by x.



q_0	q_1	q_2
q_2	q_2	q_2q_3
q_1	q_1q_3	q_1

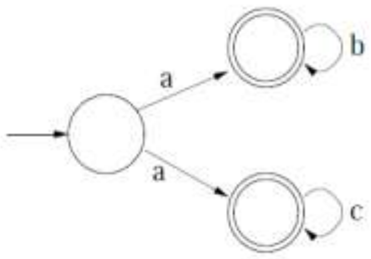
Draw its corresponding DFA transition table.

	a	b
→ q_0	q_1	q_2
q_1	q_{13}	q_1
q_2	q_2	q_{23}
q_{13}	q_{13}	q_1
q_{23}	q_2	q_2q_3

Hence the minimized DFA has 5 states.

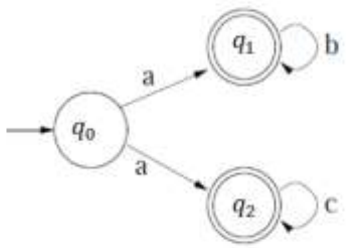
Answer: 5.

Q150. What is the minimum number of states of an equivalent DFA corresponding to Following NFA? (Assume $\Sigma = \{a, b, c\}$)



(A) 2 (B) 3 (C) 4 (D) 5

Solution:



NFA

	q_1q_2		
q_1		q_1	
q_2			q_2

Now convert it into DFA:

	a	b	c
$\rightarrow q_0$	q_{12}	q_t	q_t
q_{12}	q_t	q_1	q_2
q_1	q_t	q_1	q_t
q_2	q_t	q_t	q_2
q_t	q_t	q_t	q_t

Final state

$\{q_0, q_t\}\{q_{12}, q_1, q_2\}$

$\{q_0\}\{q_t\}\{q_{12}, q_1, q_2\}$

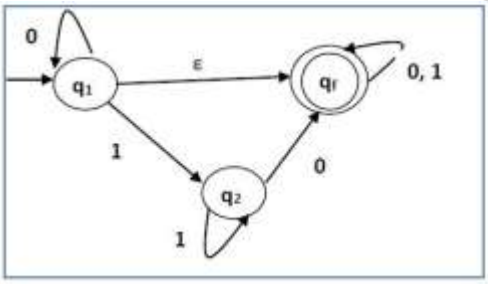
$\{q_0\}\{q_t\}\{q_{12}, q_1\}\{q_2\}$

$\{q_0\}\{q_t\}\{q_{12}\}\{q_1\}\{q_2\}$

So number of state is 5

Answer: D

Q151. Minimum numbers of states required to construct the equivalent DFA of the following NDFA? __________

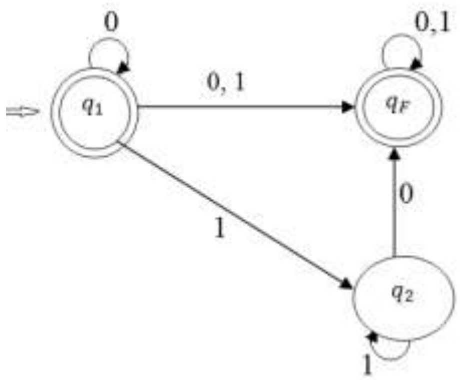


Solution:

Now remove ∈ closure

∈- Closure of q_1

$\{q_1, q_F\}$, so now copy the all outgoing transaction of q_F.



Now q_1 also become final, because q_F is final and definition said that if any state of ∈ closure contain final state that q_1 is also become final.

NFA:

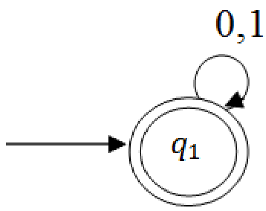
q_1	$q_1 q_F$	q_F
q_2	q_F	q_2
q_F	q_F	q_F

Now convert it into DFA.

	0	1
q_1	q_{1F}	q_F
q_{1F}	q_{1F}	q_F
q_F	q_F	q_F

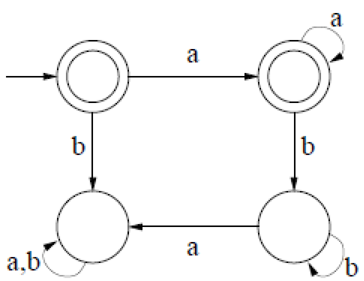
$\{q_1, q_{1F}, q_F\}$

So, only one state is in its minimized DFA.



Answer is 1

Q152. Supposewe apply minimization to the following DFA over {a, b}:



Which of the following correctly describes the resulting DFA M?

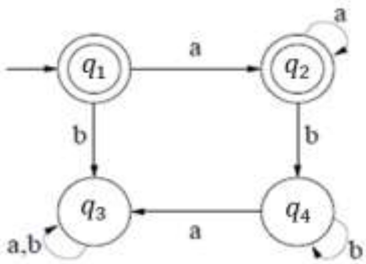
(A) M has 3 states, 1 of which is accepting.

(B) M has 3 states, 2 of which area accepting.

(C) M has 2 states, 1 of which is accepting.

(D) M has 4 states, 2 of which are accepting

Solution:

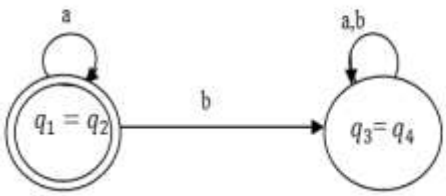


	a	b
→ q_1	q_2	q_3
q_2	q_2	q_4
q_3	q_3	q_3
q_4	q_3	q_4

Now perform minimization of this DFA.

$\{q_1, q_2\}\{q_3, q_4\}$

So M has 2 state, 1 of which accepting.



So answer is C

Q153. Suppose that there are two DFA's D1 and D2. DFA D1 has 7 states out of which 3 states are final states. DFA D2 has 6 states out of which 4 states are final states. In the product DFA for the intersection of their languages, maximum how many final states Will be there?

(A) 12 (B) 9

(C) 3 (D) 1

Solution: In product automata of two DFA.

Maximum number state is final = number of state final in Ist DFA* number of state final in IInd DFA = 3*4 = 12 and maximum number of state occurred, when all state make pair with each other.

Answer: A

Q154. Suppose that there are two DFA's D1 and D2. DFA D1 has 7 states out of which 3 states are final states. DFA D2 has 6 states out of which 4 states are final, In the product DFA for the union of their languages, how many final states will be there?

(a) 42 (b) 34

(c) 2. (d) 18

Solution:

In case of union in product automata if one of the state is final than resulting state is final. So, total number of final states = 3*6 + 4*7 – 3*4 = 18 + 28 – 12 = 46 – 12 = 34.

Answer: B

Q154 DFA D1 → 7 states

3 accepting 4 nonaccepting

accepting → final

nonaccepting → non f

DFA D2 → 6 states

4 accepting 2 nonaccepting

In union only states which are non accepting are th join of 2 non accepting states

⇒ Total states in union = $6 \times 7 = 42$

non accepting = $4 \times 2 = 8$

⇒ accepting = $42 - 8 = 34$ (b)

Q155. Suppose we have a DFA D = (Q, Σ, δ, q0, F) and know that D accepts every string. What can we infer about D?

(A) Every state in D is a final state.

(B) There is at least 1 state in D that is not final.

(C) Every reachable state from q0 in D is a final state.

(D) There is only 1 character in the alphabet.

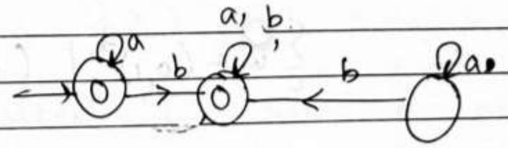
Ans (155) :- Given,

D accepts every string.

$\therefore L(D) = (a+b)^*$.

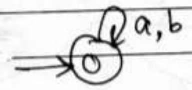
Option (a) false;

Consider D as



Option (B). false,

D can be implemented as



Option (C) Yes, true as every reachable state from q_0 in D is a final state.

Option (D) false, alphabet set may contain more than 1 character as well.

$\boxed{\text{Ans: C}}$

Q156. A = {0^n1^m | n<=m} and B = {0^n1^m | m<=n} then which options are incorrect?

(i) A U B is regular.

(ii) A intersection B is regular.

(iii) Both A and B are regular.

(A) ii & iii only (B) i & ii only

(C) i & iii only (D) All

Solution:

(i) A = {0^n1^m | n<=m} and B = {0^n1^m | m<=n }

Union of this either n<m or m<n or m=n

So it generate 0^*1^*

So it is regular of option (i) is true.

(ii) is false.

$A \cap B = \{0^n1^m \mid m=n\}$

So it is not possible to write a regular expression, and design a NFA/DFA for it because FA is memory less device.

(iii) A and B is not regular because by NFA/DFA, we can't ensure that number of 1 is more than 0 and number of 0 is more than.

So option (A) is true.

Q157. Which of the following languages is/are regular?

L1 = {wz: |w| = |z|, w ∈ (a + b)* and z ∈ (b + c)*}.

(B) L2 = {w: every a in w is followed by at least one b and at least one c}.

(C) L3 = {w: w does not have the same number of a's, b's, and c's}.

(D) L4 = {w: w contains the same number of patterns ac and abc}.

Answer: B

Solution:

(A) It is non-regular because w and z both have different set of alphabets.

(B) Regular expressions for L2 = $b^*c^*(ab^+c^+)^*b^*c^*$.

(C) FA can't remember. So, it is non-regular.

(D) We cannot write regular expressions for L4. So, it is non-regular.

Q158. Which of the following is/are regular?

(i) $L_1 = \{a^kb^mc^n \mid (k = m \text{ or } m = n) \text{ and } k + m + n \geq 2\}$

(ii) $L_2 = \{a^kb^mc^n \mid (k = m \text{ or } m = n) \text{ and } k + m + n \leq 2\}$

(iii) $L_3 = \{a^kb^mc^n \mid k + m + n \geq 2\}$

(A) i, ii, iii only

(B) ii, iii only

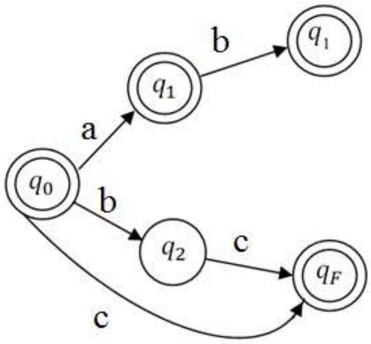
(C) ii only

(D) iii only

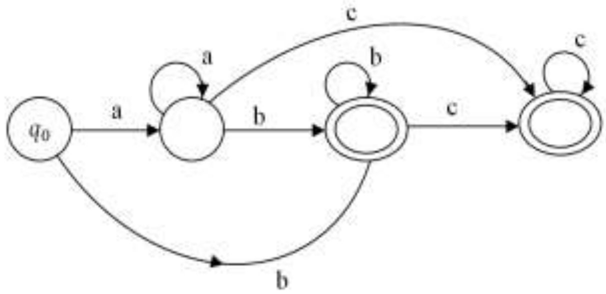
Solution:

(i) Regular expression I is not regular because we cannot ensure k=m or m=n by FA. Because finite automata cannot remember.

(ii) Regular expression II is regular, because it is finite.



(iii) It is also regular.



Answer is B

Q159. Which of the following languages over $\Sigma = \{a, b\}$ is/are not regular?

(i) $\{a^m b^n \mid m, n \in N\}$;

(ii) $\{a^m b^n \mid m \leq n\}$;

(iii) $\{a^m b^n \mid m + n \leq 4\}$;

(iv) $\{w \in \Sigma^* \mid w \notin L\}$; where L is some given language which is regular.

(v) $\{w \in \Sigma^* \mid w \notin L\}$; where L is some given language which is not regular.

(A) i and iii only (B) i, iii and iv only

(C) ii and v only (D) ii, iv and v only

Solution: (i) is regular $\{a^m b^n \mid m,n \in N\}$

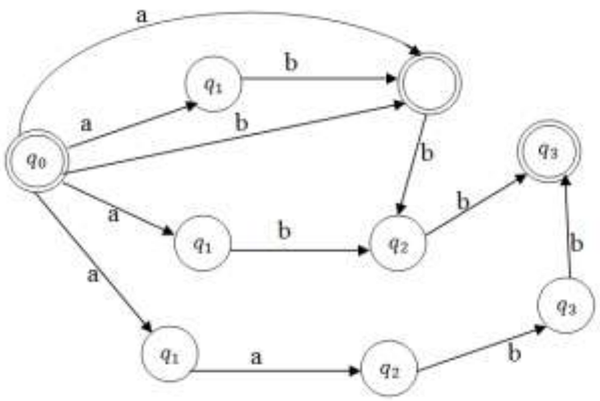
a*b* (Regular expression for it)

ii. $\{a^m b^n \mid m \leq n\}$

for this we can't design DFA ,NFA for it .

So it is not regular.

iii. $\{a^m b^n \mid m+n \leq 4\}$



It is regular

v. It is not regular.

So answer is C

Q160. For which of the following languages over the alphabet {a, b} is / are not regular?

(i) L1 = {w | w is not a palindrome}

(ii) L2 = {a^k | k is multiple of 4}

(iii) L3 = {a^k | k mod 6 = 1 or 5}

(iv) L4 = {wxw | 'x' can be any non-empty string and |w|<=3}

(A) i and iv only (B) ii and iii only

(C) iii and iv only (D) i only

Solution:

(i) Is not regular.

Palindrome said that if we read string from either MSB or LSB , than string should be same.ex: {aba, abba}. So for this we can't design NFA/DFA.

(ii) & (iii) are regular because L2 = (aaaa)* and we can design DFA for L3.

(iv)L4 is also regular because w is finite.

Answer is D

Q161. For which of the following languages over the alphabet {a, b} is/are regular?

(i) L_1 = { ww | w ∈ $\{a\}^*$}

(ii) L_2 = { ww | w ∈ $\{a,b\}^*$}

(iii) L_3 = { w_1w_2 | $w_1 \in \{a\}^*$ and $w_2 \in \{b\}^*$}

(iv) L_4 = {w | w ∈ $\{a,b\}^*$and w contains the same number of a's and b's}

(v) L_5 = {w | w ∈ $\{a,b\}^*$and w contains the same number of a's and b's and that number is no more than 128}

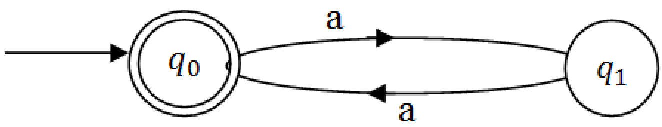
(A) i, iii and v only (B) iii and v only

(C) ii and iv only (D) i, ii and iii only

Solution:

(i) $L1 = \{ww \mid w \in \{a\}^*\}$

It is tell that first w than again w, so it will generate even number of a's string aa, aa, aaaa, aaaaaa.

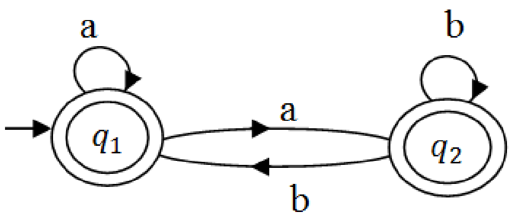


So (i) is regular

(iii) also regular.

$L3 = \{ w_1w_2 \mid w_1 \in \{a\}^* \text{ and } w_2 \in \{b\}^* \}$

It is regular , it said that



(v) It is regular number of a's = number of b's , and that is no more than 128 . so it is finite.

Answer is A

Q162. Which of the following languages is/are regular?

(A) $L1 = \{wz: |w| = |z|, w \in (a + b)^* \text{ and } z \in (b + c)^*\}$.

(B) L2 = {w: every a in w is followed by at least one b and at least one c}.

(C) L3 = {w: w does not have the same number of a's, b's, and c's}.

(D) L4 = {w: w contains the same number of patterns ac and abc}.

Answer: B

Solution:

(A) It is non-regular because w and z both have different set of alphabets.

(B) Regular expressions for $L2 = b^*c^*(ab^+c^+)^*b^*c^*$.

(C) FA can't remember. So, it is non-regular.

(D) We cannot write regular expressions for L4. So, it is non-regular.

Q163. Which of the following language is/ are not regular?

(i) $L1 = \{a^{k!}: k \geq 1\}$

(ii) $L2= (a^k$: k is perfect square$\}$

(iii) $L3 =\{w \epsilon \{a, b\}^*: |w| = 4 * n_a(w)\}$

(A) L1 and L2 only (B) L2 and L3 only

(C) L1 and L3only (D) All the above

Solution:

(i) $L1= \{ a^{k!}: k \geq 1\}$

factorial k if k =1 a^1

k=2 a^2

k= 3 a^6

k=4 a^{24}

Here there is no relation in a, 1,2, 6,24,120 …….

so it is not regular because there is no pattern in accepting string of a).

(ii) $L2 = \{a^k$: k is perfect square $\{ a^2 , a^4, a^9, a^{25}$…..here also there is no pattern are catch . In accepting a, so we can't make NDFA /DFA for it , so it is also not regular.

(iii) $|w| > 4*n_a(w)$).

Here length of w is greater than number of a, because we can not memorized that how many a is accepted.

Answer: D

Q164. Which of the following language is/ are regular?

i) $L1 = \{w \in \{0, 1\}^* \mid (n_0(w) - n_1(w)) \bmod 3) = 0 \}$.

ii) $L2 = \{w \in \{0, 1\}^* \mid (|n_0(w) - n_1(w)| \bmod 3) = 1 \}$.

(A) I only (B) ii only

(C) Both L1 and L2 (D) Neither L1 nor L2

Answer: C

Solution: i & ii are regular. We can make DFA for Both.

Q165. Which of the following languages is/are regular?

i) $L1 = \{ a^n b^l : n \geq 100, l \leq 100 \}$.

ii) $L2 = \{uww^Rv : u, v, w \in \{a, b\}^+\}$

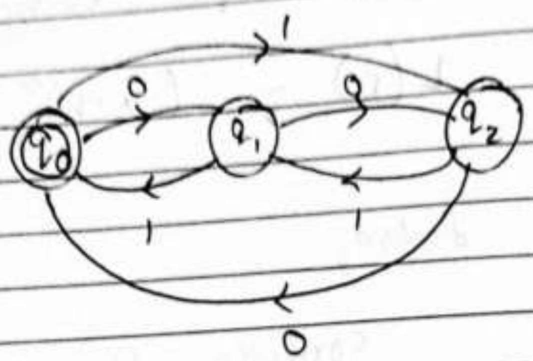
iii) $L3 = \{uu^Rv : u, v \in \{a, b\}^+ \}$

(A) i and ii only (B)i and iii only

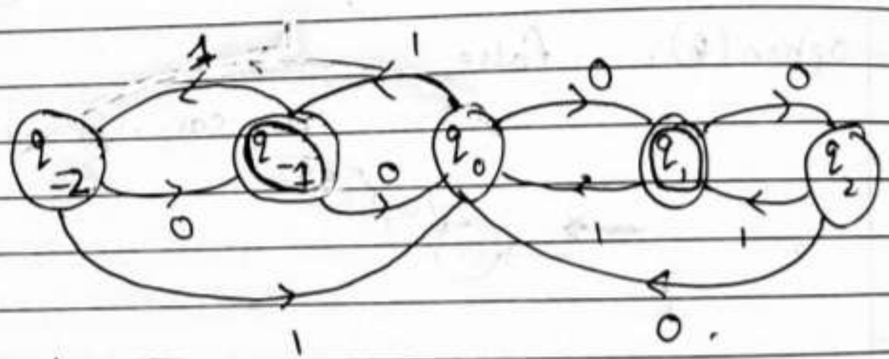
(C)i, ii &iii (D)None of three

Ans:- (C) L1 & L2.

Q165 (i) $L_1 = \{ w \in (0,1)^* \left(n_0(w) - n_1(w) \right) \bmod 3 \} = 0$



(ii) $L_2 = \{ w \in (0,1)^* \mid (|n_0(w) - n_1(w)| \bmod 3) = 1 \}$.



$\boxed{\text{Ans: A}}$

Note :- No. of States in

Case (I) $k \bmod n = p$ is n States.

States :- $(q_0, q_1, \dots q_{k-1})$

Case II $|k| \bmod n = p$ is $(2n-1)$ States.

States :- $(-q_{k-1}, \dots q_0, q_1, \dots q_{k-1})$.

where p is $[0, k-1]$

$0 \le p \le k-1$

Q166. Which of the following languages is/are regular?

L1 = {uww^Rv: u, v, w ϵ{a,b}⁺}

L2 = {uww^Rv: u,v, wϵ{a,b}⁺, |u|≥|v|}

L3 = {ww^Rv: v,wϵ{a,b}⁺}

(A) L1 only (B) L2 and L3 only

(C) L1 and L2only (D) L1 and L3 only

Solution:

Regular expression for it

$(0+1)^+00(0+1)^+$

$(0+1)^+11(0+1)^+$

so this language is regular.

So L1 is regular language.

L2: is non- regular.

because by NDFA/DFA, we can not ensure that |u|≥|v|.

So L2 is not regular.

L3:- It is not regular.

$ww^R v$ {Here we can not ensure that first w, than reverse of w, than other string .

Answer: A

Q167. Which of the following language are not regular?

L1 = $\{a^n b^l a^k : k \geq n+l\}$

L2 = $\{a^n b^l : n+l \geq 0\}$

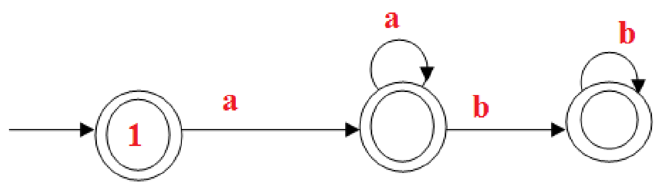
L3 = $\{a^n b^k : n \geq 100 \text{ and } k \leq 100\}$

(A) L1 only (B) L2 and L3 only

(C) L1 and L2 only (D) L1 and L3 only

Solution:

L2= $\{a^n b^1 ! \ n+1 \geq 0\}$



So this is FA for language L2.

L3:- = $\{a^n b^k : n \geq 100 \text{ and } k \geq 100\}$

In FA after accepting 100 a, make loop on state , and k can be 0 to 100.

so for a we can make DFA , and b is finite so this is regular langue.

So L1 is not regular

Answer: A

Q168. Which of the following languages is/are regular?

L1=$\{a^k b^k : k \geq 1\} \cup \{a^k b^l : k \geq 1, l \geq 1\}$

L2 = $\{a^{k+1} b^{k+1} : k \geq 0\} \cup (a^{k+1} b^{k+3} : k \geq 0\}$

L3 = $\{ww : w \in \{a\}^+\}$

(A) All the above (B) L2 and L3 only

(C) L1 and L2 only (D) L1 and L3 only

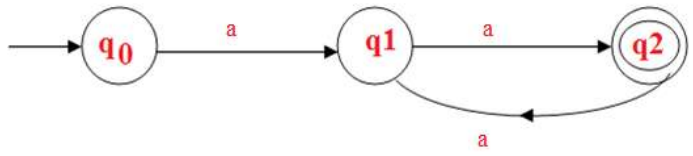
Solution:

L1 = $\{a^k b^k, k \geq 1\} \cup \{a^k b^1 : k \geq 1, 1 \geq 1\}$

L1 = $\{a^n b^n \mid n \geq 1\} \cup a^+ b^+ = a^+ b^+$

So, L1 is regular.

L3 is also regular.



So it is also regular.

Answer: D

Q169. Which of the following language is/ are regular?

1. $L = \{a^n b^m a^n : m, n \geq 0\}$
2. $L = \{a^n a^n a^n b^m b^m b^m : m, n \geq 0\}$
3. $L = \{a^n b^m : m \neq n \text{ and } m \leq 10, n \geq 0\}$

(A) 2 only (B) 2 & 3 only

(C) 1 only (D) none of these

Ans 169 :- (1) $L = \{a^n b^m a^n : m, n \geq 0\}$.

as after 'b' same no. of a's we want as before 'b', and hence dfA can remember and we need PDA.

Hence L is CFL But not Regular.

(2) $L = \{ a^{3n} b^{3m} \;\; m, n, \geq 0 \}$

Regular, as DFA can be implemented for given L.

(3) $L = \{ a^n b^m : m \neq n \text{ and } m \leq 10, n \geq 0 \}$.

As given L is infinite, but b is restricted

Hence Regular.

$\boxed{\text{Ans :- (b)}}$ 2 & 3 are Regular.

<table>
<tr><td></td><td>3) $L = \{a^n b^m : m \neq n \text{ and } m \leq 10 \text{ \& } n \geq 0\}$
this can be written as
$\{\overline{a^0}\} \cup \{(\overline{a^1}).b\} \cup \{(\overline{a^2}).b^2\} \ldots \cup \{(\overline{a^{10}}).b^{10}\}$
$\overline{a^x} \rightarrow$ complement of language that accepts only a^x is regular since a^x is finite.
and union of regular languages is regular.
$\Rightarrow$ regular.</td></tr>
<tr><td>Q170.</td><td>Which of the following language is/ are not regular?
1. L = {xy : x∈ L1 and y∉L1; where L1 is regular}
2. L = {w1w2 :w1, w2 ∈ L2; where L2 is regular}
3. L = $\{a^{i^3} : i \geq 0 \ \ and\ \Sigma = \{a\}\}$
(A)1& 3 only   (B) 2 only
(C) 3 only   (D)All</td></tr>
</table>

Ans 170 :- ① $L = \{ xy : x \in L_1 \text{ and } y \notin L1 : \text{ where } L1 \text{ is regular} \}$,

As, $L = \{ L_1 \cdot \overline{L_1}$ where L1 is regular $\}$.

* $\overline{L_1}$ Also regular (Complement of Regular is Regular).

* $L_1 \cdot \overline{L_1}$ Also regular (As Regular lang. are closed under Concatenation).

∴ L is Regular.

② $L = \{ w_1 w_2 : w_1, w_2 \in L2 : \text{ where } L2 \text{ is regular} \}$.

As regular languages are closed under contenation.

∴ L is regular.

③ $L = \{ a^{i^3} : i \geq 0 \text{ and } \Sigma = \{a\} \}$.

Given L is CSL.

Hence Not Regular.

Ans:- (C) 3 only.

Q171. [MSQ]

Which of the following languages is/are regular?

(A) L1 : $\{ wxw^R \mid w, x \in \{a, b\}^* \}$, w^R is the reverse of string w

	(B) L2 : { $a^n b^{2m}$ | m≤1000 or n≥1000 } (C) L3 : { $a^p b^q c^r$ |p<10 and q>100 and r ≥ 0 } (D) L4 : {$a^n b^n w$ | n >= 0 and w ∈ {a, b}*}

Ans (13) (a) $L_1 : \{ wxw^R \mid w, x \in \{a,b\}^* \}$

as x can be extended to any length

$x \in (a+b)^*$ ∴ L_1 is regular.

(b) $L_2 : \{ a^n b^{2m} \mid m \leq 1000 \text{ or } n \geq 1000 \}$.

$L_2 = a^n b^2 \cup a^n b^4 \cup a^n b^6 \ldots\ldots a^n b^{2000}$

infinite regular. - - - - - - finite union.

Note, :- finite union of infinite regular is regular.

(c) $L3 : \{ a^p b^q c^r \mid p < 10 \text{ and } q > 100 \text{ and } r \geq 0 \}$.

Again Same logic as of option (b).

	(d) L4 : $\{ a^n b^n w \mid n \geq 0 \text{ and } w \in (a+b)^* \}$ as $w \in (a+b)^*$ will eat (take) all strings in it. Hence, L4 is Regular $\boxed{\text{Ans } a, b, c, d.}$ Camlin
Q172.	**[MSQ]** Which of the following languages is/are not regular? (A) L1 = $\{w^R x w : w, x \in \Sigma^*\}$ (B) L2 = $\{w w^R x : w, x \in \Sigma^+\}$ (C) L3 = $\{w x w^R : w, x \in \Sigma^+\}$ (D) L4 = $\{w x w : w, x \in \Sigma^+\}$

Ans (172) :- (a) $L1 = \{ w^R x w : w, x \in \Sigma^+ \}$.

Regular, as x take all strings in it leaving w as d.

(b) $L_2 = \{ w w^R x : w, x \in \Sigma^+ \}$

as ww^R is NCFL and cant be d.

$\therefore$ L_2 is NCFL, Hence Not Regular.

(c) $L_3 = \{ w x w^R : w, x \in \Sigma^+ \}$.

Yes, Regular as L_3 is accepts all Strings starts and ends with same symbol.

(d) $L_4 = \{ w x w : w, x \in \Sigma^+ \}$

as wxw cant be ensured even with PDA, Hence L_4 is CSL

L_4 is Not Regular.

$\boxed{\text{Ans :- b, d}}$ Not regular.

Q173.	**[MSQ]** Which of the following languages is/are not regular? (A) L = $\{w : n_a(w) \neq n_b(w)\}$ (B) L = $\{a^i b^j c^k : i \geq j+k\}$ (C) L = $\{a^i b^j c^k : j \neq 2i+k\}$ (D) L = $\{a^i b^j c^k : i = j \text{ or } j \neq k\}$

173 (a) $L = \{w : n_a(w) \neq n_b(w)\}$

L can be ensured by PDA but not by DFA. $\therefore$ L is CFL but not Regular

(b) $L = \{a^i b^j c^k : i \geq j+k\}$.

L is number of a's is greater than equal to sum of no. of b's and c's. and can be ensured by PDA but not by DFA as DFA does not memorize.

So, L is CFL but not regular.

(c) $L = \{a^i b^j c^k : j \neq 2i+k\}$.

as L involves single comparision in no. of b's to some scalar sum of a's and c's,

can be ensured by PDA but not by DFA

Ans 173 (a) $L = \{ w : n_a(w) \neq n_b(w) \}$

L can be ensured by PDA but not by DFA. $\therefore$ L is CFL but not Regular.

(b) $L = \{ a^i b^j c^k : i \geq j+k \}$.

L is number of a's is greater than equal to sum of no. of b's and c's. and can be ensured by PDA but not by DFA as DFA does not memorize.

So, L is CFL but not regular.

(c) $L = \{ a^i b^j c^k : j \neq 2i+k \}$.

as L involves single comparision in no. of b's to some scalar sum of a's and c's,

can be ensured by PDA but not by DFA

(D) $L = \{ a^i b^j c^k : i = j \text{ or } j \neq k \}$.

as $(i = j)$ implies either a no. of a's equal to no. of b's or $(j \neq k)$ no. of b's not equal to no. of c's.

$\therefore$ L is NCFL. $\therefore$ L is Not Regular.

Camlin

Ans :- A, B, C, D.

Q174. If L1 = $\{1^P$: P is a prime number$\}$ and L2 = $\{1^{2^i} : i \geq 0\}$ then which of the following statement is/ are true?

I. $\{(L1)^+ \cup \phi^*\}$ is regular.

II. $(L2)^*$ is also regular.

III. $(L1.(L2 \cup \lambda))^*$ is also regular.

(A)I & II only

(B)II& III only

(C)I & III only

(D) All the above

Ans(174)

Ans: D

Given,

$L_1 = \{ 1^P : P \text{ is a prime no.} \}$.

$L_2 = \{ 1^{2^i} : i \geq 0 \}$.

I $\{(L1)^+ \cup \phi^*\} = \{(L_1)^+ \cup \lambda\}$

$= L_1^* \Rightarrow (1^* - \lambda\{1\})$.

as, $L = \{\lambda, 1^2, 1^3, 1^4, 1^5 \dots\}$

regular expression for $(L_1)^*$

$= 11^+ + \lambda$

So, it is regular.

	II $(L_2)^*$ is Also regular. Trues, as $1^{2^0} \Rightarrow 1$ and 1^* is itself generates all possible length of 1's. $\therefore$ II is Regular. III $(L_1 \cdot (L_2 \cup \lambda))^*$ Now, $L_1 = \{1^1, 1^3, 1^5 \dots\}$ $L_2 = \{1^1, 1^2, 1^4, 1^8 \dots\}$. $(L_1 \cdot (L_2 \cup \lambda))^* = \{\lambda, 1, 1^2, 1^3, 1^4, 1^5 \dots\} = 111^* + \lambda$ Ans is I II III (D) Ans
Q175.	[MSQ] Let L1 and L2 are two regular languages over Σ then which of the following is/are regular? (A) L = $\{x \in \Sigma^* \mid \text{either } x \in L1 \text{ or } x \in L2\}$ (B) L = $\{x \in \Sigma^* \mid x \in L1 \text{ but } x \notin L2\}$ (C) L = $\{x \in \Sigma^* \mid xy \in L1 \text{ or } xy \in L2; \text{ where } y \in \Sigma^*\}$ (D) L = $\{x \in \Sigma^* \mid xy \in L1 \text{ and } \lvert x \rvert = \lvert y \rvert\}$

Page :
Date :

Ans (75) (a) $L_a = \{ x \in \Sigma^*$ either $x \in L1$ or $x \in L2 \}$.

$L_a = L1 \cup L2$.

As union of two regular language is regular. $\therefore$ L_a is regular.

(b) $L_b = \{ x \in \Sigma^* \mid x \in L1$ but $x \notin L2 \}$.

$L_b = (L_1 \cap \overline{L_2}) = (L_1 - L_2)$.

As, Difference of two regular is regular

$\therefore$ L_b is Regular.

(c) $L_c = \{ x \in \Sigma^* \mid xy \in L1$ or $xy \in L2$: where $y \in \Sigma^* \}$.

L_c is Prefix of $(L1 \cup L_2)$. which is Also regular as, Prefix of regular lang. is Regular.

(d) $L_d = \{ x \in \Sigma^* \mid xy \in L1$ and $|x| = |y| \}$

As Half length Prefix of Regular is also regular. $\therefore$ L_d is Regular.

$\boxed{\text{Ans :- a, b, c, d}}$ (All are Regular).

Q176. Which of the following language is regular?

(A) L = $\{a^k : k \text{ is not perfect square}\}$

(B) L = $\{a^k : k \text{ is perfect cube}\}$

(C) L = $\{a^k : k \text{ is either prime or product of two or more prime numbers}\}$

(D) L = $\{a^k : k = 2^i \text{ for some } i \geq 0\}$

Ans (176) :- (a) $L_a = \{a^k ; k \text{ is not perfect square}\}$

$L_a = a^* - \{a^i : i \text{ is perfect square}\}$

(power is not in A.P)

$\therefore$ CSL

$\therefore$ L_a is not Regular.

(b) $L_b = \{a^k : k \text{ is perfect square}\}$.

as power of a is not in A.P.

$\therefore$ L_b is not regular (CSL).

	(C) $L_c = \{a^k : k$ is either prime or product of two or more prime$\}$. $L_c = \{a^2, a^3, a^4, a^5 \ldots\}$ $L_c = aa^+$ $\therefore$ L_c is Regular. (D) $L_d = \{a^k : k = 2^i$ for some $i \geq 0\}$. Clearly power of 'a' is in G.P (Not in A.P). $\therefore$ L_d is Not Regular (CSL). $\therefore$ (4) is not correct. Ans (C)
Q177.	**[MSQ]** Which of the following language/s is/are not regular? (A) $L = \{a^ib^jc^k: i+j+k>4\}$ (B) $L = \{a^ib^jc^k: i<10, j>5 \text{ and } k>i\}$ (C) $L= \{a^ib^j: i+2j \text{ is a prime number}\}$ (D) $L = \{a^ib^j : \|i-j\| = 3\}$

Ans:- 177 (a) $L_a = \{ a^i b^j c^k : i+j+k > 4 \}$.

Clearly L_a does not require any memorization and DFA can be constructed for all strings of length greater than 4 provided b always occur only after some series of 'a', Similarly c only after a's and b's.

(b) $L_b = \{ a^i b^j c^k : i < 10, j > 5 \text{ and } k > i \}$

clearly L_b is Regular as DFA can be implemented with given constraints.

R.E is $(a^0 b^6 . b^* c^+ + a^1 b^6 . b^* c^1 c^+ + a^2 b^6 b^* . c^2 . c^+ + \ldots\ldots a^9 b^6 b^* c^9 c^+ .)$

(c) $L_c = \{ a^i b^j : i+2j \text{ is Prime no.} \}$.

	as $(i+2j)$ is prime can be ensured by LBA or TM but not with DFA or PDA. $\therefore$ L_c is CSL which is not Regular. (D). $L_d = \{ a^i b^j = \lvert i-j \rvert = 3 \}$. R.E for LD does not exist. $L_d = a^i b^{i+3} \cup a^{i+3} b^i \Rightarrow$ CFL Camlin Ans: (C), (D) Not Regular.
Q178.	**[MSQ]** Which of the following language/s is are regular? (A) L = $\{a^i b^j : i = j \text{ or } i<j \text{ or } i>j\}$ (B) L = $\{a^n b^n : n\geq 1\} \cup \{a^n b^m : n, m \geq 1\}$ (C) L = $\{w1w2: w1 = w2 \text{ and } w1, w2 \in \Sigma^*\} \cap \{a^n b^n : n\geq 1\}$ (D) L = $\{a^n: n = k^3 \text{ for some } k\geq 0\}$

Ans (78) :- (a) $L_a = \{a^i b^j : i = j \text{ or } i < j\}$.

clearly R.E is $a^* b^*$ which is regular

$\therefore$ La is regular.

(b) $L_b = \{a^n b^n ; n \geq 1\} \cup \{a^n b^m ; n, m \geq 1\}$.

R.E for L_b is $a^+ b^+$, which is regular. $\therefore$ L_b is regular.

(c) $L_c = \{ w_1 w_2 : w_1 = w_2 \text{ and } w_1, w_2 \in \Sigma^* \}$

$\cap \{a^n b^n ; n \geq 1\}$.

$L_c = \{ww, w \in \Sigma^*\} \cap \{a^n b^n \geq 1\}$.

$L_c = \phi$ (which is regular).

	(d) $L_d = \{a^n : n = k^3$ for some $k \geq 0\}$. as power of 'a' is perfect cube, which is not in A.P. $\therefore$ L_d is CSL But not regular. Hence L_a, L_b, L_c are regular. Ans:- (A) (B) (C) are regular.
Q179.	Which of the following is/are true? (A) Union of two non-regular languages is always non-regular. (B) Union of a regular language with a disjoint non-regular language is always non-regular. (C) L ((ab*ba*) ∩ (ba*ab*)) = {ε}. (D) L = $\{1^n : n \leq 1000$ and n is prime$\}$. A DFA accepting L may have less than 900 states.

Ans (179) (a) Union of two non regular language can be regular as

L let as CFL and $\bar{L}$ let us CSL, Now $L \cup \bar{L} = \Sigma^*$ (which is regular).

$\therefore$ (a) is false.

(b) union of a regular language with a disjoint non-regular language is always non regular.

As $L = L_1 \cup L_2$

where L_1 regular

L_2 is disjoint non regular,

then L will always non regular.

$\therefore$ (b) is True

(c) $L = ((ab^*ba^*) \cap (ba^*ab^*))$

$L_1 \cap L_2$

$L_1 = \{ab, abb, abbb, abba, abaaa \ldots\}$

$L_2 = \{ba, baa, baaa, baab, babbb \ldots\}$

$L_1 \cap L_2 = \phi \neq \{\varepsilon\}$

$\therefore$ (c) is false.

	(d) $L = \{1^n : n \leq 1000$ and n is prime$\}$ As 997 is also prime and in order to accept we need 998 states + (1 Trap state). ∴ (d) is false. $\boxed{\text{Ans : (B) only.}}$
Q180.	Which of the following languages are not regular? 1. L = $\{wwww^R : w\in\{a, b\}^*\}$ 2. L = $\{w\in\{a, b\}^* \mid w = w^R\}$ 3. L = $\{ w\in\{a, b\}^* \mid$ w has more a's than b's$\}$ 4. L = $\{a^{2n}b^{4n}a^n\}$ (A)1 & 2 only (B) 2, 3 & 4 only (C)1, 3& 4 only (D)All the above Ans 180 : (1) $L_a = \{www w^R : w \in (a+b)^*\}$ as ww itself is CSL and ww^R is CFL and $www w^R$ is CSL ∴ (1) L_a is Not regular. (2) $L_b = \{w \in (a,b)^* \mid w = w^R\}$ As L_b accepts all length Pallindrome Strings, which is CFL. Hence L_b is not regular

	(3) $L_c = \{w \in (a,b)^* \mid w$ has more a's than b's$\}$. As L_c has context free grammer but not regular grammer. ∴ L_c is CFL, Hence not regular. (4) $L_d = \{a^{2n} b^{4n} a^n\}$ as 2 comparisions involved in every string of L_d. ∴ PDA cant be implemented for such L_d, whereas LBA exist for such L_d. Hence L_d is CSL, which is Not regular. Ans (D) All (1, 2, 3, 4 are non Regular)
Q181.	Given that L is regular and L1 = {wx: w∈Σ* and x∈L}, L2 = {w: wx∈L and |w| = |x|}, and L3 = {w: wx∈L1, for some x∈L2} Which of the above language is/are regular? (A) L1, L2 only (B) L2, L3 only (C) L1, L3 only (D) All are regular

Ans 81) # $L_1 = \{wx : w \in \Sigma^* \text{ and } x \in L\}$.

$L_1 = (a+b)^* \cdot L$ where L is regular

$L_1 =$ (regular) $\cdot$ (regular) ; which is regular.

Hence, L_1 is regular.

$L_2 = \{ w : wx \in L \text{ and } |w| = |x| \}$.

L_2 collects half length prefix of all strings in L, which is regular, (As prefix of Regular is regular.)

$\therefore$ L_2 is Regular.

Camlin

$L3 : \{ w : wx \in L1, \text{ for some } x \in L2 \}$.

L3 collects ~~so~~ all such Prefixes from String in L1 which ~~has~~ leaves suffix as String present in L2.

Hence, L3 collects Prefix of regular.

∴ L3 is regular.

Ans:- (D)

$\left(L3 = \frac{L1}{L2} \right)$ Also called Right Quotient, and regular is closed under Right Quotient. So, L_3 is regular.

Q182. Which of the following statement/s is are true?

I. If A is a non-regular language and B is a language such that B ⊆ A, then B must be Non-regular.

II. If (L1.L2 U L3) is regular, L3 is regular and complement of L2 is regular then L1 must be regular.

(A) I only (B)II only

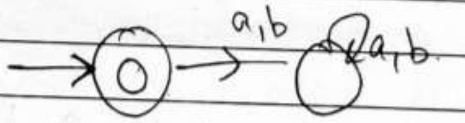
(C)Both (D)Neither I nor II

Solution: I. A = $\{a^n b^n : n>=0\}$ and B = $\{\lambda\}$

III. L1 = $\{a^n b^n : n>=0\}$, L2 = ϕ, and L3 = a*

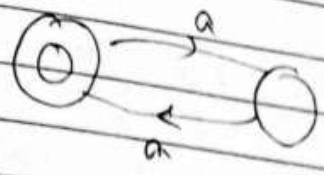
	Q182 I finite sets are subsets of non regular sets ⇒ false II $(L_1.L_2 \cup L_3)$ if L_3 & $\bar{L}_2$ are regular ⇒ L_2 is regular for $(L_1.L_2 \cup L_3)$ to be regular some conditions ar $L_1.L_2 \subset L_3$ or $L_1.L_2$ is regular. $L_1.L_2$ can be regular if L_2 is regular & L_1 has λ too eg : $L_1 = \{a^k : k \text{ is prime}\} \cup \{\lambda\}$ $L_2 = \{a^n : n \geq 0\}$ $L_1.L_2$ = regular but L_1 is not regular ⇒ $\{L_1.L_2 \cup L_3\}$ is regular. (let $L_3 = \{a, a^2\}$ or any other regular ⇒ false Ans → (d) both are false
Q183.	Select the correct statement 1. A DFA with n states must accept at least one string of length greater than n. 2. A DFA with n states that accepts an infinite language must accept at least one string x such that $2n < \|x\| \leq 3n$. 3. If R is a regular language and L is some language, and L ∪ R is a regular language, then L must be a regular language. 4. If F is a finite language and L is some language, and L − F is a regular language, then L must be a regular language. (A) 2 only (B) 1 and 3 only (C) 2 and 4 only (D) None

Q33) (1) false, as consider DFA



accepts only "λ" of 0 length and does not accept any string of length greater than Q.

(2) Yes true, Example.



$L = \{\text{even no. of } a\text{'s}\}$

$2(2) \leq |x| \leq 3(2)$ Yes there exists

$4 \leq |x| \leq 6$ a^6 which satisfies

And for all DFA's such property holds true

(3) false,

Consider $L = \{a^n b^n \quad n \geq 1\}$.

$R = a^* b^*$.

Now, $L \cup R = a^n b^n \cup a^* b^*$

$= a^* b^*$ which is regular.

but L is not Regular.

	Suppose, L is non regular, Now, given f is finite language. $\therefore$ $L - f$ = Non regular. Which contradicts the given question. (as ((L-f) must be regular a/c to question). $\therefore$ L has to be regular. Ans :- (C) 2 & 4 only Camlin
Q184.	Which of following is/are correct? S1: Let $r1$ and $r2$ be two regular expressions. Then $L((r1 + r2)^*) = L((r1^*r2^*)^*)$. S2: Let $L4 = L1 \cdot L2 \cdot L3$. If $L1$ and $L2$ are regular and $L3$ is not regular, it is possible that $L4$ is regular. (A) Only S1 (B) Only S2 (C) Both S1&S2 (D)Neither S1 nor S2

Ans (C) Both S1 & S2.

Ans 184 :- S1 :- As Given,

r_1, r_2 as two R.E.

Now, By property of R.E.

$$(a+b)^* = (a^* b^*)^*$$

Hence,

$$(r_1 + r_2)^* = (r_1^* r_2^*)^*.$$

$\therefore$ Language generated by $(r_1 + r_2)^*$ is equivalent to Lang. generated by $(r_1^* r_2^*)^*$.

$\therefore L((r_1+r_2)^*) = L((r_1^* r_2^*)^*)$.

S2 $\therefore$ let $L4 = L1.L2.L3$.

Given, L_1, L_2 is regular.

L_3 non regular.

Suppose, $L_1 = \phi$, $L_2 = a^*b^*$, $L_3 = \{a^nb^n, n \geq 1\}$

Now, $L_4 = \phi . \{a^*b^*\} . \{a^nb^n\}$

$\boxed{L_4 = \phi}$ which is regular.

|| Ans: C

Q185. Which of following is/are correct?

S1: $L1 \subseteq L \subseteq L2$ where $L1$ and $L2$ are regular, then L must be regular.

S2: $\{w = xyzy \mid x, y, z \in \{0, 1\}^+\}$ is regular.

(A) Only S1
(B) Only S2
(C) Both S1&S2
(D) Neither S1 nor S2

Q 185 $\therefore$ S1 Consider L_1 as ϕ (regular

L_2 as $(a+b)^*$ (regular

Now L can be $(a^nb^n$ $n \geq 1)$ which is

$L_1 \subseteq L \subseteq L_2$ But L is non regular.

$\therefore$ S1 is false.

S2 $\{w = xyzy \mid x, y, z \in \{0, 1\}^+\}$ is regular.

R.E for given Language is

$(0+1)^+ 1 (0+1)^+ 1 + (0+1)^+ 0 (0+1)^+ 0.$

$\therefore$ S2 is regular.

Ans (B) only S2.

Q186. Which of following statement is/are correct?

S1: $(\emptyset^* \cdot \emptyset)^* \cdot \emptyset^* = \emptyset$

S2: $\{xyx^R \mid x, y \in \{a, b\}^+\}$ is regular.

(A) Only S1 (B) Only S2

Both S1&S2 (D)Neither S1 nor S2

Ans 186 :-

S1 : $(\phi^*.\phi)^*.\phi^*$

as $\boxed{\phi^* = \lambda}$

$(\lambda.\phi)^*.\phi^*$

$\phi^*.\phi^* \Rightarrow \lambda \neq \phi$

∴ S_1 is false.

S2 $\{xyx^R \mid x,y \in (a+b)^+\}$

Yes, S2 is regular, and Language for S2 is L accepts all strings which starts and ends with same Symbol, and R.E is

$$a(a+b)^+a + b(a+b)^+b$$

∴ S2 is correct.

Ans :- B only S2.

Q187.	Which of following statement is/are correct? S1: If L1.L2 is regular then at least one of them (L1 or L2) is regular. S2: If L1.L2 is non-regular then at least one of them (L1 or L2) is non-regular. (A) Only S1 (B) Only S2 (C)Both S1&S2 (D)None of them

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187) S1 is false, for example.

Consider, $L_1 = \{a^p$, where p is prime$\}$

$L_2 = \{a^q$, where q is not prime$\}$

$\therefore L_1 \cdot L_2 = \{a^2, a^3, a^5, a^7 \ldots\} \cdot \{\epsilon, a, a^4, a^6 \ldots\}$

$= a \cdot a^+$ which is regular.

	... is regular. S2 Assume, Both L_1 and L_2 as regular, Now, $L_1 \cdot L_2 \Rightarrow$ Concatenation of two regular. $\Rightarrow$ which is Regular. Hence, $L_1 \cdot L_2$ as regular contradicts the given question criteria. $\therefore$ atleast one of L_1 or $L2$ has to be non regular for $L_1 \cdot L_2$ to be non regular. $\therefore$ S2 is True. Ans: B only S2.
Q188.	Select the correct statement: (A) If L1 is regular and L2 $\subseteq$ L1, then L2 is regular as well. (B) If L1 is regular and L2 is not regular, then L1 U L2 is not regular. (C) If L1 is regular and L1 U L2 is not regular, then L2 is not regular. (D) If L1 is regular and L2 is not regular, then L1$\cap$ L2 is not regular.

188 sol: (A) false, consider L_1 as a^*b^*.

Now, L_2 as $\{a^n b^n, n \geq 1\}$

Clearly, $L_2 \subseteq L_1$ But L_2 is non regular (CFL).

(B) false, consider same examples,

$L_1 = \{a^*b^*\}$

$L_2 = \{a^n b^n, n \geq 1\}$.

$L_1 \cup L_2 = a^*b^*$. which is regular,

(C) True, as assume L2 as regular.

Given L_1 as regular,

Now, $L_1 \cup L_2$ = Union of two regular is Regular.

$\therefore L_1 \cup L_2$ = Regular, but given question criteria contradicts our assumption, So, our assumption is incorrect, Hence, L2 is non Regular.

Camlin

	(P) Consider $L_1 = \phi$ $L_2 = \{a^n b^n, n \geq 1\}$. Now, $L_1 \cap L_2 = \phi$ which is regular. $\therefore$ (d) is false. Ans is (c).
Q189.	Select the correct statements (1) L1 = L2 if and only if L1* = L2* (2) For any languages L1, L2 and L3, L1 (L2 $\cap$ L3) $\subseteq$ (L1L2) $\cap$ (L1L3) (3) For any languages L1, L2 and L3, (L1L2) $\cap$ (L1L3) $\subseteq$ L1 (L2 $\cap$ L3). (A) 1 and 3 (B) 2 and 3 (C) 2 only (D) None.

	189 Ans (C) (1) false, consider, $L_1 = \phi$ $L_2 = \epsilon$. Now, $L_1^* = \epsilon$ $L_2^* = \epsilon$ But $\boxed{L_1 \neq L_2}$. (2) It is always true because (i) whenever one of the language is ϕ (L_1 or L_2 or $L_3 = \phi$) then L.H.S $\subseteq$ R.H.S (ii) when $(L_2 \cap L_3) = \phi$ then L.H.S = R.H.S = ϕ (iii) when $L_2 \cap L_3$ is finite & non-empty then, $L_1 . L_3 \cap L_2 L_3$ is also non-empty and finite and L.H.S $\subseteq$ R.H.S So, 2nd is true. Camlin (3) It is false when, $L_1 = \{ba, b\}$, $L_2 = \{ab, a\}$, $L_3 = \{b, \lambda\}$ Page : Date : So, correct answer is (C).
Q190.	Consider the following statements: 1. An infinite language can have an infinite complement. 2. All infinite languages have infinite complements. 3. The union of infinitely many regular languages is always regular. Which of the above statements is/are true? (A) 1 only (B) 1 and 2 only (C) 1 and 3 only (D) 2 and 3 only

Ans(190) (1) True.

Consider

$L = \{a, ab, abab \cdots\}$

L is strings starting with 'a'.

$\bar{L} = \{b, ba, bab, \cdots\}$. which is also infinite.

(2) false,

Let $L = (a+b)^*$

Now, $\bar{L} = \phi$ which is finite.

(3) false,

Let, $L_1 = \{ab\}$

$L_2 = \{aabb\}$

$L_3 = \{aaabbb\}$

$\vdots$

Now, $L = L_1 \cup L_2 \cup L_3 \cdots$

$L = \{ab\} \cup \{aabb\} \cup \{aaabbb\} \cdots$

$L = \{a^n b^n \quad n \geq 1\}$. which is non regular.

Ans: (A) 1 only.

Camlin

Q191. Consider the following statements

1. If L is regular then so is $\{xx : x \in L\}$.
2. If L is regular then so is $\{xy : x, y \in L\}$.
3. Let $A = \{1^{2^p} : p \text{ is prime}\}$. Then A^* is regular.

Which of the above statements is true?

(A) 1 only (B) 1 and 2 only
(C) 1 and 3 only (D) 2 and 3 only

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Q191

(1) if L is regular then so is $\{xx : x \in L\}$

false, as ww, where $w \in L$

and assume L as $(a+b)^*$.

Then, ww is CSL.

(2) if L is regular then so is $\{x, y : x, y \in L\}$

As concatenation of regular is regular.

$\therefore$ 2 is correct.

(3) $A = \{1^{2^p} ; p \text{ is prime}\}$.

$A^* = \{\epsilon, (1^4 + 1^8 + 1^{32} \ldots\ldots)^*\}$.

$L = \{\epsilon, 1^4, 1^8, 1^{12}, 1^{16}, 1^{20} \ldots\}$

which is Regular.

Ans:- (D) 2 and 3 only.

Q192. Select correct statements:

S1: If L1 and L2 are non-regular languages then L1 $\cup$ L2 is also non-regular.

S2: IfL1 is non-regular language and L2 is regular language then L1.L2 may be regular language.

S3: If L1$\cup$L2 and L2 are regular then L1 may not be regular.

(A) S1 and S2 only (B) S2 and S3 only

(C) S1 and S3 only (D) All the above.

Answer :- (B) S2 and S3 only

Solution:

If L1 is non-regular language L1= $\{a^m b^n, m \geq n\}$

If L2 is non-regular language L2 = $\{ a^m b^n, n \geq m\}$

L1+L2 = (L1$\cup$L2) = $a^m b^n$ $m \geq n$ + $a^m b^n$,$n \geq m$

=$a^* b^*$ (Which is regular)

So statement S1 is false.

S2:- Now check for statement 2.

L1= NR(non-regular) L2= Regular.

L1= $a^n b^n$

L2=ϕ

$a^n b^n . \phi = \phi$\{Where (ϕ) , is regular\}

So statement S2 is true.

S3 : - L1$\cup$L2 = Regular

L2= Regular $a^* b^*$

L1= Non-regular ($a^n b^n$)

$a^n b^n + a^* b^* = a^* b^*$ (Regular)

So L1 is not regular here.

So statement is also true.

Answer: B

Q193. Select correct statements:

S1: For every regular language L, every subset of L is regular as well.
S2: Every non-regular language is infinite.
S3: The intersection of any two non-regular languages is non-regular.
S4: If each of the languages L1, L2 . . . is regular, then $\bigcup_{i=1}^{\infty} Li$ is regular as well.

(A) S1 and S2 only (B) S2 and S3
(C) S3 and S4 (D) S2 and S4

Answer :- None

Solution:

S1: Statement S1 is false, because not every subset of L is regular.

For example: Let L1 = a*b* (L is regular)

One of the subset of L = $\{a^n b^n \mid n>=0\}$i.e. $\{a^n b^n \mid n>=0\} \subseteq a^*b^*$ but $a^n b^n$ is not regular.

So statement S1 is false.

S2:- Every non- regular language is infinite.

Because every finite language is regular.

So statement S2 is true.

S3: It is False.

L1 = $\{a^n b^n \mid n \geq 1\}$

L2 = $\{b^n a^n \mid n \geq 1\}$

L1 ∩ L2 = ϕ{which is regular language}

So, S3 is false.

S4 is false, because regular language is not closed under infinite union.

Answer: None

Q194. Let L1 and L2 are two languages over ∑ and it is given that L1.L2 is non-regular languages. Then which of the following statement is not always true?

(A) $\overline{L1}$ is not regular.
(B) L1 ∪ $\overline{L1}$ is regular.
(C) L1, L2 ⊆ Σ*
(D) L1∪L2 contain infinitely many strings.

Answer: - (A)$\overline{L1}$ is not regular.

Solution:

(a) It is not always true.

L1.L2 =non-regular

$(a^*b^*).\{a^nb^n \mid n>=0\}$= Non regular

$\overline{a^*b^*}$ = Regular (its complement is regular).

So, option (a) is not always true.

(b) $L1\cup\overline{L1}$ is always regular.

If $L1= a^nb^n$ then $L1\cup\overline{L1} = a^nb^n\cup\overline{a^nb^n} = (a+b)^*$

So, it is always regular.

(c) It is true ; because every language is subset of Σ^*.

(d)If $L1\cup L2$ contain infinite string is always true. Because L1.L2 = non-regular so at least one language is infinite.

Answer: A

Q195. Let L= 01* + 10*. Which of the following is regular expression of L^R (reverse of L)?

(A)0*1 + 1*0 (B) 1*0 + 01*

(C) 1*0 + 0*1 (D) (10)* + (01)*

Answer: - (C) 1*0 + 0*1

Solution:

L= 01* + 10*

L^R = 1*0+0*1 = 0*1 + 1*0

Answer: C

Q196. The set of non-regular languages is closed under which of the following operations?

(A) Complement (B) Union

(C) Intersection (D) Concatenation

Answer: - (A) Complement

Solution:

(a) Non- regular language is closed under complement, because complement of non-regular is always non-regular.

(b) $\{a^mb^n \mid m \geq n\} \cup \{a^mb^n \mid n \geq m\} = a^*b^*$

So, union of two non-regular languages may be regular. Sometimes it may not be regular.

	(c) $\{a^m b^n \mid m>n\} \cap \{a^n b^n \mid n>=0\}$ is ϕ which is regular, so intersection of two non-regular may or may not regular. (d) Non regular language is not closed under concatenation. For example: Let L_1 is non-regular language then $L_1 \cup \{\lambda\}$ and $\overline{L_1} \cup \{\lambda\}$ are also non-regular language. But its concatenation is $(L_1 \cup \{\lambda\}).(\overline{L_1} \cup \{\lambda\}) = \Sigma^*$; which is regular language. Answer: A
Q197.	Let $L1 = \{a^nb^nc^m \mid n, m>=0\}$ and $L2 = \{a^nb^mc^m \mid n, m>=0\}$ then what is $\overline{\overline{L1} \cap \overline{L2}}$? (A) L1U $\overline{L2}$ (B) $\Sigma^* - \{a^nb^nc^n \mid n>=0\}$ (C) $\{a^nb^nc^n \mid n>=0\}$ (D) a*b*c* Answer: - none Solution: $L1 = \{a^nb^nc^m \mid n, m>=0\}$ = {abc, aabbc….}and L2= $\{a^nb^mc^m \mid n, m>=0$ {abc, abbcc} $\overline{\overline{L1} \cap \overline{L2}}$ =L1∪L2= $\{a^n b^m c^k \mid n, m, k \geq 0 \,; where\ n = m\ or\ m = k\}$ Answer: none
Q198.	The right quotient of a language L1 with respect to L2 is defined as L1/L2 = {x: y∈L2, xy∈L1} Let L1 = L(a^*ba^+) and L2 = {aba*} then what will be the L1/L2? (A)a* (B)a^+ (C)a*b (D)a^+b

198 Given, $L_1 = L(a^*ba^+)$

$L_2 = \{aba^*\}$.

$\frac{L_1}{L_2} = ?$ (Right quotient)

$L_1 = \{aba, aaba, abaa, \text{---}\}$

$L_2 = \{aba, abaa, abaaa \text{---}\}$.

$L = \frac{L_1}{L_2} = \{\lambda, a, aa, aaa \text{---}\}$

for "λ" in L consider string "aba" in

both L_1 and L_2,

Hence, $L = a^*$

Ans (a) a^*.

Q199. Which of the following strings is NOT in the Kleene closure of the language {abb, ba, bba}?

(A) abbbabbaabb
(B) abbbba
(C)abbbbababb
(D) abbbabbababbaba

Answer :- (C)

Solution:

Option (a) Language L={abb,ba,bba}

$L^0+L^1+L^2+\ldots\ldots+L^n$ {Kleen closure}

L^1= {abb, ba, bba}$\Rightarrow L^1.L^1=L^2$

L^3= {abb}.{ba}.{bba}

$L^3.L= L^4$ = {abb}.{ba}.{bba}.{abb}

So (a) is in kleene closure of L.

Now check for option (b).

$L^1.L^1$= {abb}.{bba} = abbbba.

So it also in kleene closure of the language.

Now same way to check option (c)

C is not in kleen closure of L.

Answer: C

Q200. Let L1 = {a, ab, c, d, λ}, L2 = {d} and L3 = L1.L2. Which string is not in L3?

(A) a (B)abd

(C) cd (D) d

200) $L_3 = \{ad, abd, cd, dd, d\}$.

∴ a . Ans :- a

Q201. If L = {001, 1101, 101} then the prefix of L is

(A) {λ, 0, 00, 001, 1, 11, 110, 1101, 1, 10, 101}

(B) {λ, 0, 00, 001, 1, 11, 110, 1101, 10, 101}

(C) {λ, 1, 01, 001, 101, 1101}

(D) None of the above

Answer :- (B)

Answer: B

Solution: If L = {001, 1101, 101} then

prefix (001) = {λ, 0, 00, 001}, prefix (1101) = {λ, 1, 11, 110, 1101},

prefix (101) = {λ, 1, 10, 101}.

Then the prefix of L = prefix (001) ∪ prefix (1101) ∪ prefix (101)

= {λ, 0, 00, 001, 1, 11, 110, 1101, 10, 101}.

Q202. If L = {001, 1101, 101} then the suffix of L is

(A) {λ, 0, 00, 001, 1, 11, 110, 1101, 1, 10, 101}

(B) {λ, 1, 01, 001, 101, 1101, 10, 110}

(C) {λ, 1, 01, 001, 101, 1101}

(D) None of the above

Answer :- (C)

Answer: C

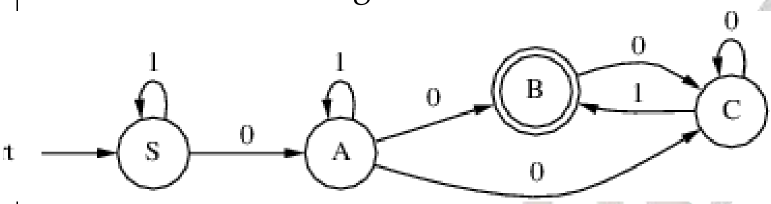
Solution: If L = {001, 1101, 101} then

suffix (001) = {λ, 1, 01, 001}, suffix (1101) = {λ, 1, 01, 101, 1101},

suffix (101) = {λ, 1, 01, 101}.

Then the prefix of L = prefix (001) ∪ prefix (1101) ∪ prefix (101) = {λ, 1, 01, 001, 101, 1101}.

Q203. Consider the following NFA:



Which of the following grammar generates the language accepted by NFA given above?

(A) S →1S/0A, A→1A/0B/0C, B→0C, C→1B/0C

(B) S →1S/0A, A→1A/0B, B→0C/λ, C→1B/0C

(C) S →1S/0A, A→1A/0B/0C, B→0C/λ, C→1B/0C/λ

(D) S →1S/0A, A→1A/0B/0C, B→0C/λ, C→1B/0C

Q203 (a) False, language is φ as gramm
not terminated with any termi
symbol.

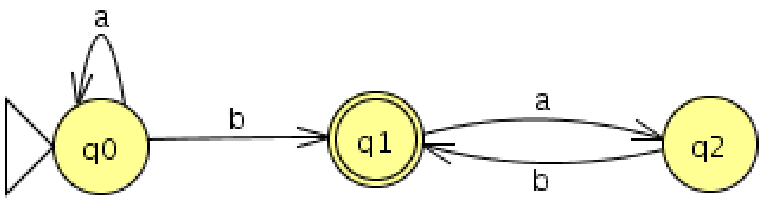
(b) Grammar can be written directly
from NFA as

S→1S/0A A→1A/0B/0C.
B→0C/λ
C→0C/1B

(d) Ans

Camlin

Q204. Consider the following NFA



Which Regular grammar corresponds to the following NFA?

(A) $S \to bA \mid aS$, $A \to aB \mid \lambda$, $B \to bA$

(B) $S \to bA \mid aS$, $A \to bB \mid \lambda$, $B \to bA$

(C) $S \to Ba$, $A \to aB \mid \lambda$, $B \to bA$

(D) None

204

for state q_0,

$q_0 \to a q_0 \mid b q_1$.

Rewrite

$\boxed{S \to aS \mid bA.}$

q_0 as S and q_1 as A.

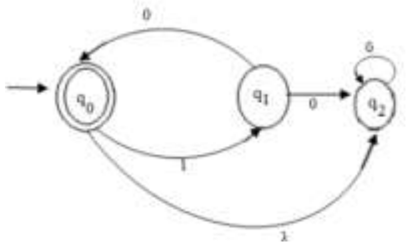
for state q_1

$q_1 \to a q_2 \mid \lambda$

q_2 as B

Rewrite

$\boxed{A \to aB \mid \lambda.}$

	for State q_2 $q_2 \to b q_1$ Rewrite $\boxed{B \to bA}$ ∴ Grammar is $\boxed{S \to aS/bA \quad A \to aB/\lambda. \quad B \to bA.}$ Ans A
Q205.	Consider the following NFA.  Which of the following is a left linear grammar for the language accepted by M? (A) $S \to 1S0 \mid \lambda$ (B) $S \to 10S \mid \lambda$ (C) $S \to 1A \mid \lambda,\ A \to 0S$ (D)$S \to A0 \mid \lambda$, $A \to S1$

	205 (a) False, as grammer generates "1100" but NFA rejects. (b) Yes satisfies grammer for given NFA. but Right Linear, so false (c) $S \to 1A \mid d$, $A \to 0S$. as grammer generates $(10)^*$ satisfies NFA language, but Right linear. (d) Yes satisfies given NFA. and left linear Ans :- (d).
Q206.	How many of the following statement(s) is/are true? ________ (i)The language generated by the grammar G = ({S}, {a}, S, {S → Saaa | aS | a }) is not regular. (ii) The language generated by the grammar G = ({S}, {a}, S, {S → aSSa | aS | a }) is regular. (iii) The language generated by the grammar G = ({S}, {a}, S, {S → bSb | aSa | a | b })is regular. (iv) The language generated by the grammar G = ({S}, {a}, S, {S → bSa | λ | a }) is not regular.

206 (i) Language generated by G is a^+ which is Regular. ∴ (i) is false.

Ans: 2

(ii) language generated by G is a^+ which is Regular ∴ (ii) is True.

(iii) Even length pallindrom CFL. ∴ Not Regular.

(iv) $b^n a a^n$ or $b^n a^n$ CFL (Not Regul True

Ans (2).

Q207. Consider a generated grammar G with production

```
S →abA
A→baB
B→aA | bb
```

How many states are required to construct minimized DFA for language accepted by G?

(A) 2

(B) 3

(C) 4

(D) more than 4

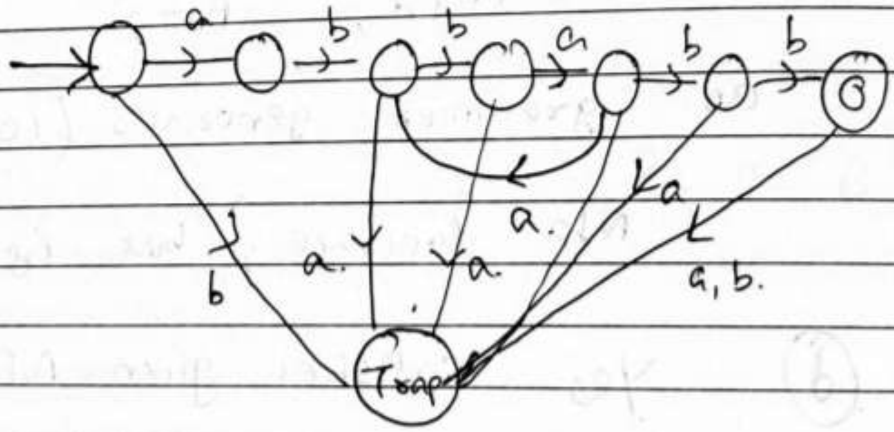
Ans (207) :- Given Grammar,

$S \to abA$

$A \to ba B$

$B \to aA \mid bb.$

$L = abba(aba)^* bb.$



Clearly DFA has more than 4 States

$\therefore$ Ans (D) is correct.

Data for next two question: Consider a language $L = \{a^n b^m : n \geq 2, m \geq 3\}$

Q208. Which of the following grammar is left-linear grammar for given L?

(A) $S \to S_1S_2$, $S_1 \to aaA$, $A \to aA \mid \lambda$, $S_2 \to bbbB$, $B \to bB \mid \lambda$

(B) $S \to S_1bbb$, $S_1 \to S_1b \mid A$, $A \to aaB$, $B \to aB \mid \lambda$

(C) $S \to aaA$, $A \to aA \mid B$, $B \to bbbC$, $C \to bC \mid \lambda$

(D) none of these

Answer:D

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208 Given, $L = \{a^n b^m : n \geq 2, m \geq 3\}$

for a^n $n \geq 2$.

$$\boxed{\begin{aligned} A &\to aaB \\ B &\to aB \mid \lambda. \end{aligned}} \quad — \ (1)$$

for b^m $m \geq 3$.

$$\boxed{\begin{aligned} S &\to S_1 bbb \\ S_1 &\to S_1 b. \end{aligned}} \quad — \ (2)$$

Now, befor b's we need a's.

$\therefore$ Combinining (1), (2) we get grammer for given L as.

$S \to S_1 bbb$

$S_1 \to S_1 b \mid A.$

$A \to aaB.$

$B \to aB \mid \lambda$ .... matches with option (B).

But option B is not left-linear grammar.

Q209.	Which of the following grammar is right-linear grammar for given L? (A) $S \to S_1S_2$, $S_1 \to aaA$, $A \to aA \mid \lambda$, $S_2 \to bbbB$, $B \to bB \mid \lambda$ (B) $S \to S_1bbb$, $S_1 \to S_1b \mid A$, $A \to aaB$, $B \to aB \mid \lambda$ (C) $S \to aaA$, $A \to aA \mid B$, $B \to bbbC$, $C \to bC \mid \lambda$ (D) None of these

Ans(209) for a^n, $n \geq 2$.

$$\boxed{\begin{array}{l} S \to aaA \\ A \to aA \end{array}} \quad -(1)$$

for b^m, $m \geq m$.

$$\boxed{\begin{array}{l} B \to bbbC \\ C \to bC \mid \lambda \end{array}} \quad -(2).$$

Right linear grammar for given L by combining (1) (2) as.

$S \to aaA$
$A \to aA \mid B$.
$B \to bbbC$
$C \to bC \mid \lambda$.

Answer :-C

Q210. Consider following grammar G

$S \rightarrow aA \mid bB \mid \lambda,$

$A \rightarrow bC \mid aS,$

$B \rightarrow aC \mid Bs$

$C \rightarrow aB \mid bA$

Which of the following language is generated by G?

(A) L = {w : $n_a(w) + n_b(w)$ is even}

(B) L = {w : $|n_a(w) - n_b(w)|$ is even}

(C) L = {w : $n_a(w)$ and $n_b(w)$ are both even}

(D) L = {w : $n_a(w)$ and $n_b(w)$ are both odd}

Ans (C)

Ans 210

Given Grammar G.

$S \rightarrow aA \mid bB \mid \lambda.$

$A \rightarrow bC \mid aS,$

$B \rightarrow aC \mid bS$

$C \rightarrow aB \mid bA.$

$L = \{ \lambda, aa, bb, abab, baba, baab, abba, \ldots \}.$

Ans (C) i.e $L = \{ w : n_a(w)$ and $n_b(w)$ are both even $\}$.

	option (A) false, as it claims, "ab" to be accepted which is not generated by G. option (B) false, it also claims "ab" to be accepted whereas it is not generated by G. option (D) It also claims "ab" to be accepted but not gener. by G. $\boxed{\text{Ans:- C}}$
Q211.	Consider following grammar G S →aA|bB A →abA | λ B →ccB | λ Which of the following regular expression is for language generated by G? (A)a(ab)*b(cc)* (B) $a(ab)^+b(cc)^+$ (C) a(ab)*+b(cc)* (D) $a(ab)^++b(cc)^+$

	Ans (211) Given Grammar, $S \rightarrow aA \mid bB$. $A \rightarrow abA \mid \lambda \Rightarrow (ab)^*$ $B \rightarrow ccB \mid \lambda \Rightarrow (cc)^*$ Now, $S \rightarrow aA \Rightarrow a(ab)^*$ $S \rightarrow bB \Rightarrow b(cc)^*$ $\therefore$ R.E is $a(ab)^* + b(cc)^*$ Ans: option (c). Trick: String "a" is accepted by grammar & only accepted by option (c) whereas rejected by option (a) (b) (d).
Q212.	The language generated by the grammar with productions where $\Sigma = \{a, b\}$ is? $S \rightarrow AaAaAaA$, $A \rightarrow aA \mid bA \mid \lambda$. (A) All the strings over Σ^* with at least three a's. (B) All the strings over Σ^* with at most three a's (C) All the strings over Σ^* with at least three a's or three b's

(D) None of these

Ans:- Q212

Given grammer

$S \rightarrow AaAaAaA$

$A \rightarrow aA \mid bA \mid \lambda \Rightarrow (a+b)^*$.

R.E for given grammer is

$$(a+b)^* a (a+b)^* a (a+b)^* a (a+b)^*.$$

Hence, grammer generates all the strings over Σ^* with atleast 3 a's.

Ans (a).

Q213. Consider the following grammar G:

$S \rightarrow XY$

$X \rightarrow aX \mid bX \mid a$

$Y \rightarrow Ya \mid Yb \mid b$

The regular expression for the language generated by G is

(A) $(a + b)^+$

(B) $(a + b)^*ab(a + b)^*$

(C) $(a + b)^+ab(a + b)^+$

(D) $(a + b)^+ (a + b)^+$

	Q213 Given G :- $S \to XY$ $X \to aX \mid bX \mid a \Rightarrow (a+b)^*a$ $Y \to Ya \mid Yb \mid b. \Rightarrow b(a+b)^*.$ R.E for G is $(a+b)^*a \cdot b(a+b)^*.$ Ans (B). Camlin
the next two questions: Let Σ1 ={0, 1, 2} and Σ2 = {a, b, c, d}and define h(0) = aab, h(1)=aabc, h(2) = cccd.	
Q214.	Then holomorphic image of L = {010, 102, 1011, 0100} is (A) h(L) = {aabaabcaab, aabcaabccccd, aabcaabaabaab, aabaabcaabaab} (B) h(L) = {aabaabcaab, aabcaabcccd, aabcaabaabaabc, aabaabcaabaab} (C) h(L) = {aabaabcaab, aabcaabcccd, aabcaabaabaab, aabaabcaabaabc} (D) h(L) = {aabaabcaab, aabcaabcccd, aabcaabaabcaabc, aabaabcaabaab}

	Q214 Given, $h(0) = aab$. $h(1) = aabc$. $h(2) = cccd$. Now, Homomorphic image of L $010 = \underbrace{aab}_{0}\ \underbrace{aabc}_{1}\ \underbrace{aab}_{0}$ $102 = \underbrace{aabc}_{1}\ \underbrace{aab}_{0}\ \underbrace{cccd}_{2}$ $1011 = \underbrace{aabc}_{1}\ \underbrace{aab}_{0}\ \underbrace{aabc}_{1}\ \underbrace{aabc}_{1}$ $0100 = \underbrace{aab}_{0}\ \underbrace{aabc}_{1}\ \underbrace{aab}_{0}\ \underbrace{aab}_{0}$ matches with Option (D).
Q215.	Let h(L) = {aabaabaabccccdaab, cccdaabccccdaabaabc} then L will be (A){00020, 21201} (B){00120, 20201} (C){00120, 21201} (D) {00020, 20201}

	Given $h(L) = \{ \underbrace{aab}_{0}\underbrace{aab}_{0}\underbrace{aabc}_{1}\underbrace{cccd}_{2}\underbrace{aab}_{0},$ $\underbrace{cccd}_{2}\underbrace{aabc}_{1}\underbrace{cccd}_{2}\underbrace{aab}_{0}\underbrace{aabc}_{1} \}$ $L = \{00120, 21201\}$. Ans. :- (C)
Q216.	Let $A = \{xx \mid x \in \{a, b\}^*\}$. Consider homomorphism $h : \{a, b\}^* \rightarrow \{0, 1\}^*$ with $h(a) = 00$, $h(b) = \epsilon$. What is $h(A)$? (A) $\{0^{4n} \mid n \geq 0\}$ (B) $\{0^{n} \mid n \geq 0\}$ (C) $\{0^{2n} \mid n \geq 0\}$ (D) none of these Given, $h(a) = 00$, $h(b) = \varepsilon$. $A = \{xx \mid x \in \{a,b\}^*\}$. $A = \{xx \quad x \in (00+\lambda)^*$ $\Rightarrow \{0^{4n} \mid n \geq 0\}$.
For next three questions suppose h is the homomorphism from {0,1,2} to {a,b} defined by $h(0)$ = a; $h(1)$ = ab; $h(2)$ = ba.	
Q217.	What is $h(21120)$ (A) baababbaa (B) bababbaa (C) bbaababbaa (D) abaababbaa

	217 Given $h(0) = a$ $h(1) = ab$ $h(2) = ba$ $h(21120) = \underbrace{ba}_{2}\ \underbrace{ab}_{1}\ \underbrace{ab}_{1}\ \underbrace{ba}_{2}\ \underbrace{a}_{0}.$ (A) baababbaa.
Q218.	If L = 01*2, then what is *h*(L)? (A)aab(ab)*ba (B) (ab)*ba (C) a(ab)*ba (D) aa(ab)*ab 218 Ans: C $L = 01^*2.$ $= \underbrace{a}_{0}\ \underbrace{(ab)^*}_{1^*}\ \underbrace{ba}_{2}$ Ans (C) $a(ab)^*ba.$
Q219.	If L = a(ba)*, then what is h^{-1}(L)? (A) 02*1*0 (B) 02* (C) 1*0 (D) 02*U 1*0

Q19 Ans: D

$L = a(ba)^*$ then, $h^{-1}(L)$.

$h(0) = a$

$h^{-1}(a) = 0$

$h^{-1}(ba) = 2.$

$h^{-1}(L) = 0\,2^*$

$= a\,(ba)^*$ —(1) Ans

We know that $a(ba)^* = (ab)^* a$

$\therefore h^{-1}(L) = 1^*0$ —(2)

from (1) & (2) we can say that

$h^{-1}(L) = 0\,2^* \cup 1^*0$

$\therefore$ Answer is (D)

Q220. The pumping lemma for regular languages implies that

(A) Every regular language contains a string that can be pumped.

(B) All strings in a regular language can be written as uvw so that uv^iw is also in the language when $i \geq 0$.

(C) A regular language is infinite if and only if it contains a string that can be pumped

(D) Regular languages are closed under the regular operations

Answer : B

Solution:

By the definition of pumping lemma, all string in a regular language can be written as uvw so that uv^iw is also in the language when $i \geq 0$.

Q221. Let L = $\{a^n b^m \mid n > m \geq 0\}$ is

(A) not regular because $a^{p+1}b^p$ cannot be pumped

(B) regular because it is a subset of a*b*

(C) regular because it is described by a regular expression

(D) not regular because $a^p b^p$ cannot be pumped.

Answer : A

Solution:

(a) It is regular a^{p+1} $b^p \Rightarrow$ aaabb.

$aa(ab)^n b$

aaababb$\Rightarrow$so it is not pumped for this type of string so this is not regular .

(b) False because $a^p b^p$ is not part of $a^n b^m$, n>m≥ 0

Q222. **[MSQ]**

Consider the language L = $\{a^i b^j \mid j < i\}$. Which of the following string can be used in a pumping lemma proof that L is not regular? [Assume n is pumping length]

(A) $a^n b^n$ (B) $a^{2n} b^n$ (C) $a^{2n+1} b^{2n}$ (D) $(ab)^n a$

Answer: B, C

Solution: Pumping lemma: For any regular language L, there exists an integer n, such that for all x ∈ L with |x| ≥ n, there exists u, v, w ∈ Σ∗, such that x = uvw, and

(1) |uv| ≤ n

(2) |v| ≥ 1

(3) for all i ≥ 0: $uv^i w \in L$

Options (A) and (D) are not correct because both strings don't belong to L.

Option (B): Given string x= $a^{2n} b^n$

Case I: If u = λ, v = a^n, w = $a^n b^n$ then $uv^i w \notin L$ for i =0.

Case II: If $u = a^{n-k}, v = a^k (k \geq 1), w = a^n b^n$ $then\ uv^i w \notin L;\ for\ i = 0, n = 1, k = 1$

So, this is correct string to proof L is non-regular.

Option C: Given string $x = a^{2n+1} b^n$

Case I: If $u = \lambda, v = a^n, w = a^{n+1} b^n\ then\ uv^i w \notin L\ for\ all\ i = 0$

Case II: If $u = a^{n-k}, v = a^k (k \geq 1), w = a^{n+1} b^n,\ then\ uv^i w \notin L\ for\ all\ i = 0$

So, this is incorrect string to proof L is non-regular.

So, option (B)& (C)are correct.

Q223.	The pumping lemma for regular languages can be proved by (A) showing that an NFA can be converted to an equivalent DFA. (B) showing that the regular languages are closed under the regular operations. (C) showing that an NFA computation must repeat a state. (D) showing that a DFA computation must repeat a state. Answer : D Solution: The pumping lemma for regular languages can be proved by showing that a DFA computation must repeat a state. Because pumping lemma is defined for infinite regular language.
Q224.	Consider the language L= {w ∈: Σ* w is a palindrome } is not regular. Which of the following are good choices of a string to pick to show that L is not regular with the help of pumping lemma? (A) $a^p bba^p$ (B) a^p (C) $ba^p b$ (D) All of the above are good choices of strings Answer : A Solution:
Q225.	$\{a^n b^m : n > m > 0\}$ is (A) not regular because $a^{p+1}b^p$ cannot be pumped (B) regular because it is a subset of a*b* (C) not regular because $a^p b^p$ cannot be pumped (D) regular because it is described by a regular expression Answer : A Solution:
Q226.	Let L be the regular language (11)*0*1* and L' = $\{(11)^n 10^m 1^m \mid n, m>= 0\}$. Then L ∪ L' is (A) regular by closure under union (B) not regular because it contains $0^m 1^m$ (C) regular because you can always pump by setting v to be the leading 1 or 11 (D) not regular because L' is not regular, because $10^p 1^p$ cannot be pumped in L' Answer : D

Q227.	How many of the following statement is/are false? ________ 1. The pumping lemma for regular languages is about proving a language to be regular. 2. The language {ww : w $\in\Sigma^*$ with $\lvert w \rvert \geq 2$ } is not regular. 3. The language {w $\in$ {a +b)* and the number of occurrences of a in w is the same as that of b in w} is not regular. 4. The language {w$\in$ {a +b)* : the number of occurrences of ab in w is the same as that of ba in w} is not regular. 5. Every non-regular language is infinite. Answer: 2 Solution: 1 & 4 are false.