REGULAR LANGUAGE

Q1. Consider the follwing grammar G:

$S \rightarrow aSa \mid aAa$

$A \rightarrow Bb$

$B \rightarrow c$

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

Q2. Consider the following grammar G with start symbol S

$S \rightarrow a\ SC \mid T$

$T \rightarrow bTd \mid R$

$dC \rightarrow Cd$

$RC \rightarrow Cr$

$R \rightarrow \epsilon$

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

(A)Type 0

(B) Type1

(C) Type2

(D) Type 3

Q3. Consider the following grammar G with start symbol S

$S \rightarrow Aa$,

$A \rightarrow Ba$,

$B \rightarrow abc$.

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

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
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

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

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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

Q8. A grammar has the following productions:

$S \rightarrow aSSb \mid a \mid bSa$

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

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

$$S \rightarrow AS \mid SB \mid \lambda$$
$$A \rightarrow Aa \mid a$$
$$B \rightarrow Bb \mid b$$

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

(A) a

(B) abb

(C) abba

(D) aaabbb

Q10. Consider the following grammar G:

$S \rightarrow AB \mid aB \qquad A \rightarrow aab \mid \lambda \qquad B \rightarrow bbA$

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

Q11. Consider the language L = {w : for some $u \in \Sigma^*$, $w = u^R u$}. 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)

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

Q13. Identify in the list below a sentence of length 6 that is generated by the grammar

```
S →(S)S| λ
```

(A) ( ) ( ) ( )

(B)))) (((

(C))) (( ) (

(D)) (( ) ( )

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

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

Q16.	Which of the following strings cannot be derived from the symbol S using the rules $S \rightarrow SS \mid aaa \mid aaaaa$? (A) aaaaaa (B) aaaaaaa (C) aaaaaaaa (D) aaaaaaaaa

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

Q18.	Consider the following context-free grammar over the alphabet $\sum$ = {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

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 }

Q20. Consider the following grammar

```
S → aSc | X
X → bXc | 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+ k }

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

(D) None of the above

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) {$a^nb^nc^n$ | n >= 0}

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

(D) none of the above

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

S →ASb | c A → a

(A) {a^ncb^n | n ∈ N}

(B) {xcb | x ∈{a}*}

(C) {acy | y ∈ {b}*}

(D) All of the answers above are incorrect

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

S → aSa | aBa B → bB | b

(A) L(G) = { $a^nb^ma^n$ | n > 0, m > 0}.

(B) L(G) = { $a^nb^ma^n$ | n > 0, m < 0}.

(C) L(G) = { ba^nb | n > 0, m > 0}.

(D) None of these

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Q24.	Consider the following grammar G: $S \rightarrow aSbb \mid \lambda$ The language generated by the above grammar is: (A)$L=\{a^nb^n:n\geq0\}$ (B)$L=\{a^nb^{2n}:n\geq0\}$ (C) $L=\{a^mb^n:n\geq0\}$ (D)None
Q25.	The language generated by the following grammar is: $S \rightarrow 0S1 \mid C \qquad C \rightarrow 1C0 \mid \lambda$ (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) $L=\{0^n1^n1^m0^m \mid n, m \geq 0\}$
Q26.	Consider the following grammar G with start symbol S over the alphabet $\Sigma = \{a, b\}$ $S \rightarrow aSaa \mid B$ $B \rightarrow bB \mid \lambda$ 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
Q27.	Consider the following language: $L = \{a^kb^{2k} \mid k >=2\}$ Which of the following grammar generates L? (A) $S \rightarrow aSbb \mid \lambda$ (B) $S \rightarrow aSbb \mid abb$ (C) $S \rightarrow aSbb \mid aabbbb$ (D) $S \rightarrow aX \mid bbY \qquad X \rightarrow aX \mid \lambda \qquad Y \rightarrow bbY \mid \lambda$

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) $S \to aX \mid bY \qquad X \to bX \mid \lambda \qquad Y \to baY \mid \lambda$

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

(D) None of the above

Q29. Consider the Grammar G, with productions.

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

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

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

Q31. Consider the following grammar G with start symbol S over the alphabet $\Sigma = \{a, b\}$

```
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.

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.

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)$\{w \in \{0, 1\}^* \mid$ the length of w is odd $\}$ (B)$\{w \in \{0, 1\}^* \mid$ the length of w is odd and the middle symbol is 0 $\}$ (C)$\{w \in \{0, 1\}^* \mid$ the length of w is odd and the middle symbol is 1 $\}$ (D)$\{w \in \{0, 1\}^* \mid$ w contains 0 in middle $\}$

Q34.	Consider the following grammar G with start symbol S over the alphabet $\Sigma = \{a, b\}$
	`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.

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)*

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
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
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
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

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
Q41.	The regular expression b*ab*ab*ab* represents the language (A) L = {w : w ∈ Σ*, $n_a(w)$ = 3} (B) L = {w : w ∈ Σ* $n_a(w)$ <=3} (C) L = {w : w ∈ Σ* $n_a(w)$ >= 3 } (D) none
Q42.	The regular expression b* + b*ab*+ b*ab*ab* represents the language (A) L = {w : w ∈ Σ*, $n_a(w)$ = 2} (B) L = {w : w ∈ Σ* $n_a(w)$ <=2} (C) L = {w : w ∈ Σ* $n_a(w)$ >= 2 } (D) none
Q43.	Which of the following pair of regular expression is/are true? I. (01 +0)*0 ⇔ 0(10 +0)* II. 0(120)*12 ⇔01(201)*2 III. ϕ* ⇔ λ* IV. (0*1*)* ⇔ (1*0*)* (A) I, III and IV only (B) II and III only (C) II, III and IV only (D) All the above
Q44.	Regular expression r = (aa*b)* (aa* + λ) is equivalent to: (I) (ab)* (a+λ) (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

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
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
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)*

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) $(a + b)^*$
Q49.	[MSQ] Which of the following regular expression is equivalent to given regular expression: $\varepsilon+1^*(011)^*(1^*(011)^*)^*$ (A) $(1+011)^*$ (B) $(1^*(011)^*)$ (C) $(1+(011)^*)^*$ (D) $(1011)^*$
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
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

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)

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

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

L1 = {pwp: p, w∈ {0, 1}*, |p|=7, k∈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

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 ∈ Σ*, $n_a(w)$ is divisible of 2 }

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

(C) L = {w : w ∈ Σ* $n_a(w)$ >= 2 }

(D) None of these.

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

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

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

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

Q59. Which of the following expression best describes the language

$L = \{\alpha \in \{0, 1\}^* \mid \alpha$ contains only 0's or only 1's$\}$

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

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

Q60. Let $\Sigma = \{0, 1\}$, and language over Σ, $L = \{\alpha \in \Sigma^* \mid \alpha$ 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) $1(11)^*$

Q61. Let $\Sigma = \{0, 1\}$, and language over Σ,

$L = \{\alpha \in \Sigma^* \mid$ 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) $1^*(0111)^*01^* + 1^*$

Q62. Let $\Sigma = \{0, 1\}$, and language over Σ, $L = \{\alpha \in \Sigma^* \mid \alpha$ 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) $(0+1)^*\,100$

Q63.	Let $\Sigma = \{0, 1\}$, and language over Σ, $L = \{\alpha \in \Sigma^* \mid \alpha$ 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) $(0+10)^*$
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*
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
Q66.	Consider the language defined by the regular expression $(a\|b)^*b^+$. Which of the following regular expression(s) also define that language? (1) $(a^*b^+) \mid (b^*b^+)$ (2) $(ab \mid bb)^* b^*$ (3) $(a \mid b \mid ba)^*b^+$ (A) (1) and (2) (B) (2) and (3) (C) Only (3) (D) Only (2)
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

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
Q69.	What is the best description of languages denoted by the following regular expression R = 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.
Q70.	What is the best description of the languages denoted by the following regular expressions R = ((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.
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

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*
Q73.	How many strings of length less than 4 contains the language described by the regular expression (a + d)*b(a + bc)*?_______
Q74.	How many strings are there in the language defined by regular expression? __________((Ø*∩ a) ∪ (Ø∪ b*)) ∩ Ø*
Q75.	How many strings are there in the language defined by regular expression?__________((Ø*∪ b) ∩ (b*∪Ø))
Q76.	How many strings of length less than 5 contains the language described by the regular expression 0*1(0 + 1)* 01*? ______________
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? ______
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)*
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^+

Q80.	Consider the following grammar G: $S \rightarrow AB \mid aAb \quad A \rightarrow b \mid baA \mid \lambda \quad B \rightarrow aB \mid abB \mid \lambda$ 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) $a((ba)^*(b + \lambda))b + (ba)^*(b + \lambda)(a + ab)^*$
Q81.	Which of the following grammar generates the language generated by given regular expression $R = a(a+b)^*a + b(a+b)^*b$ (A) $S \rightarrow aSa \mid bSb \mid aS \mid bS \mid \lambda$ (B) $S \rightarrow aAa \mid bAb \quad A \rightarrow aA \mid bA \mid \lambda$ (C) $S \rightarrow aAa \mid bAb \quad A \rightarrow aA \mid bA \mid aAa \mid bAb \mid \lambda$ (D) Both b & c
Q82.	Which of the following grammar generates the language generated by given regular expression $R = aaa^+ + (ba+bb)^*a$ (A) $S \rightarrow aaX \mid Ya \quad X \rightarrow aX \mid \lambda \quad Y \rightarrow baYbbY \mid \lambda$ (B) $S \rightarrow aX \mid Ya \quad X \rightarrow aX \mid a \quad Y \rightarrow baY \mid bbY \mid \lambda$ (C) $S \rightarrow aaX \mid Ya \quad X \rightarrow aX \mid a \quad Y \rightarrow baY \mid bbY \mid \lambda$ (D) None of the above
Q83.	Which of following Grammar generates the language $L(a^*a(a+ba)^*)$? (A) $S \rightarrow S_1 \mid S_2, \quad S_1 \rightarrow aA, \quad A \rightarrow aA \mid \lambda, \quad S_2 \rightarrow aS_2 \mid baS_2 \mid \lambda$ (B) $S \rightarrow S_1S_2 \mid S_1, \quad S_1 \rightarrow aA, \quad A \rightarrow aA \mid \lambda, \quad S_2 \rightarrow aS_2 \mid baS_2 \mid \lambda$ (C) $S \rightarrow S_1S_2 \mid a, \quad S_1 \rightarrow aA, \quad A \rightarrow aA \mid a, \quad S_2 \rightarrow aS_2 \mid baS_2 \mid \lambda$ (D) Both B and C

Q84. Which of the following grammars is a right regular grammar with the same language as the regular expression $(a^* \cup b^*) \cap (a^*b^*)$?

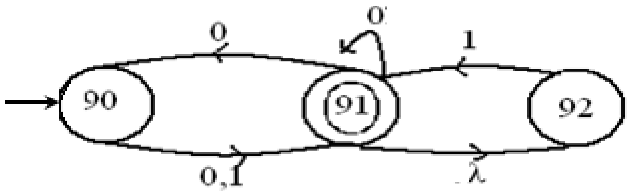
(A) $S \rightarrow AB$ $\quad$ $A \rightarrow aA \mid \varepsilon$ $\quad$ $B \rightarrow bB \mid \varepsilon$

(B) $S \rightarrow A \mid B$ $\quad$ $A \rightarrow Aa \mid \varepsilon$ $\quad$ $B \rightarrow Bb \mid \varepsilon$

(C) $S \rightarrow A \mid B$ $\quad$ $A \rightarrow aA \mid a$ $\quad$ $B \rightarrow Bb \mid a$

(D) $S \rightarrow A \mid B$ $\quad$ $A \rightarrow aA \mid \varepsilon$ $\quad$ $B \rightarrow bB \mid a$

Q85. Consider the following NFA

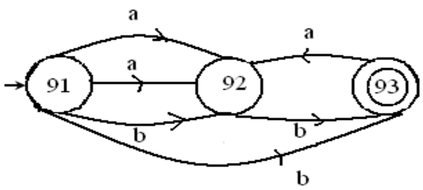


Which of the following string is not accepted by the following NFA?

(A) 00000000 $\qquad$ (B) 01001

(C) 111110010 $\qquad$ (D) None

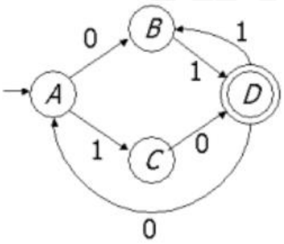
Q86. Which of the following string is accepted by given DFA?



(A) aaabbbbb $\qquad$ (B) aababb

(C) abab $\qquad$ (D) babaa

Q87. Consider the following DFA:



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

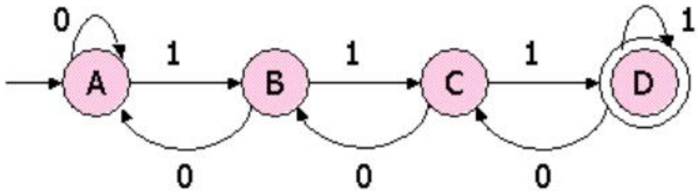
(A) CD

(B) AC

(C) BC

(D) BD

Q88. Consider the following DFA:



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

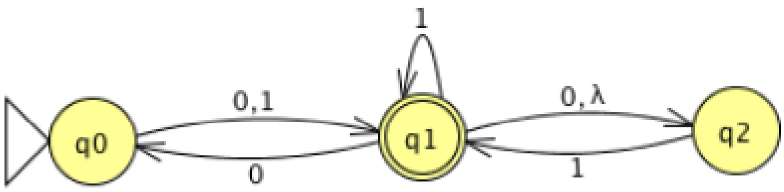
(A)111

(B) 111001

(C) 11011

(D) 0010111

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



(i) 00

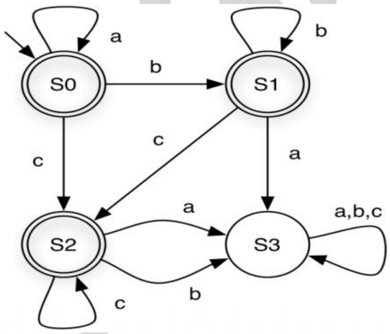
(ii) 01001

(iii) 10010

(iv) 000

(v) 0000

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



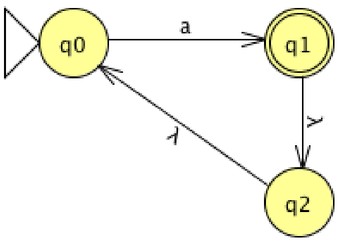
(A) aabbbcca

(B) aabbbcccca

(C) abbbcccc

(D)bccccabc

Q91. What is the complement of the language accepted by the following NFA? ($\Sigma = \{a\}$)



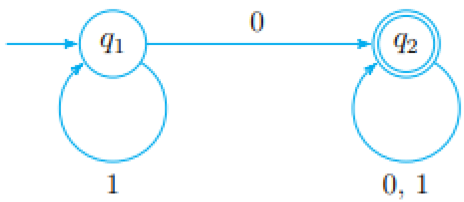
(A) $\emptyset$

(B) $\{\lambda\}$

(C) a^*

(D) a^+

Data for next two questions: Consider the following DFA D: (New Question)



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) $1(0+1)^*$

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

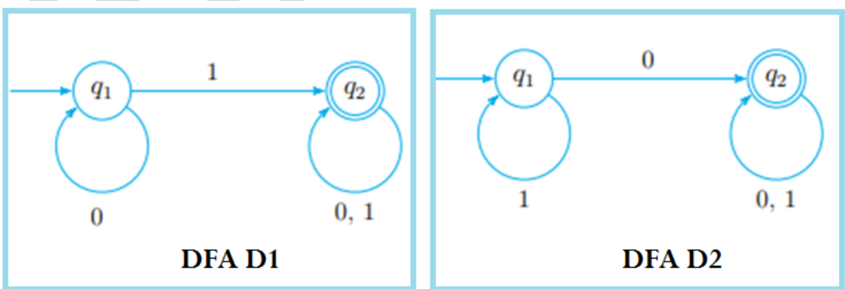
(A) 01^*

(B) $1^*0(0+1)^*$

(C) $(0+1)^*01^*$

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

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) $(0 + 1)^+$
Q95.	If L(D) = L(D1) ∩ L(D2), then the regular expression for L(D) is equivalent to (A) $\emptyset$ (B) $(01 + 10)(0 + 1)^*$ (C) $(00^*1 + 11^*0)(0 + 1)^*$ (D) None of these
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
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) $(0 + 1)^+$
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) $(0 + 1)^*01^*(0 + 1)^*10^*$
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^*
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) $(0^+1 + 1^+0)(0+1)^*$
Q101.	**[MSQ]** If L(D) = $L(D1)^* \cup L(D2)^*$, 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

Q102.	Minimum how many states are required to construct the DFA for L(D1) ∪ L(D2)? ____
Q103.	Minimum how many states are required to construct the DFA for L(D1) ∩ L(D2)? ____
Q104.	Minimum how many states are required to construct the DFA for $\overline{L(D1)} \cap \overline{L(D2)}$? ____
Q105.	Minimum how many states are required to construct the DFA for $\overline{L(D1)} \cup \overline{L(D2)}$? ____
Q106.	Minimum how many states are required to construct the DFA for $\overline{L(D1)}\ .\ \overline{L(D2)}$? ____
Q107.	Minimum how many states are required to construct the DFA for L(D1) . L(D2)? ____
Q108.	**[MSQ]** Which of the following Grammars accept the language L(D1) ∪ L(D2)? (A) $S \rightarrow 0S \mid 1S \mid 0 \mid 1$ (B) $S \rightarrow 0A \mid 1B$, $A \rightarrow 0A \mid \lambda$, $B \rightarrow 1B \mid \lambda$ (C) $S \rightarrow 0S1 \mid 1S0 \mid 0S \mid 1S \mid 0 \mid 1$ (D) None of the above
Q109.	**[MSQ]** Which of the following Grammars accept the language L(D1) ∩ L(D2)? (A) $S \rightarrow 0X1A \mid 1Y0A$, $X \rightarrow 0X \mid \lambda$, $Y \rightarrow 1Y \mid \lambda$, $A \rightarrow 0A \mid 1A \mid \lambda$ (B) $S \rightarrow XY$, $X \rightarrow 0A1 \mid 1B0$, $A \rightarrow 0A \mid \lambda$, $B \rightarrow 1B \mid \lambda$, $Y \rightarrow 0Y \mid 1Y \mid \lambda$ (C) $S \rightarrow 0S \mid 1S \mid 0 \mid 1$ (D) None of the above
Q110.	**[MSQ]** Which of the following Grammars accept the language $L(D1)^R \cup L(D2)^R$? (A) $S \rightarrow 0S \mid 1S \mid 0 \mid 1$ (B) $S \rightarrow 0A \mid 1B$, $A \rightarrow 0A \mid \lambda$, $B \rightarrow 1B \mid \lambda$ (C) $S \rightarrow 0S1 \mid 1S0 \mid 0S \mid 1S \mid 0 \mid 1$ (D) None of the above

Q111. **[MSQ]**

Which of the following Grammars accept the language L(D1) . L(D2)?

(A) S → AB,A→X1Z, X→ 0X | λ, B→Y0Z, Y→ 1Y | λ, Z → 0Z | 1Z | λ

(B) S → 0S | 1S | 0 | 1

(C) S → 0S1 | 1S0 | 0S | 1S | 0 | 1

(D) None of the above

Q112. **[MSQ]**

Which of the following Grammar(s) accept the language $\overline{L(D1)}\ .\ \overline{L(D2)}$?

(A) S → 0S | 1S

(B) S → λ

(C) S → 0S | 1S | 0 | 1

(D) S → XY X → 0X | λ Y → 1S | λ

Q113. Which of the following Grammar accepts the language $\overline{L(D1)} \cap \overline{L(D2)}$?

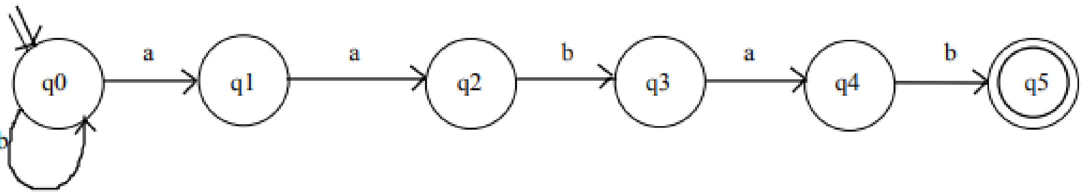
(A) S → 0S | 1S

(B) S → λ

(C) S → 1S | 0S | 0 | 1

(D) None of the above

Q114. Consider the following NFA M: :



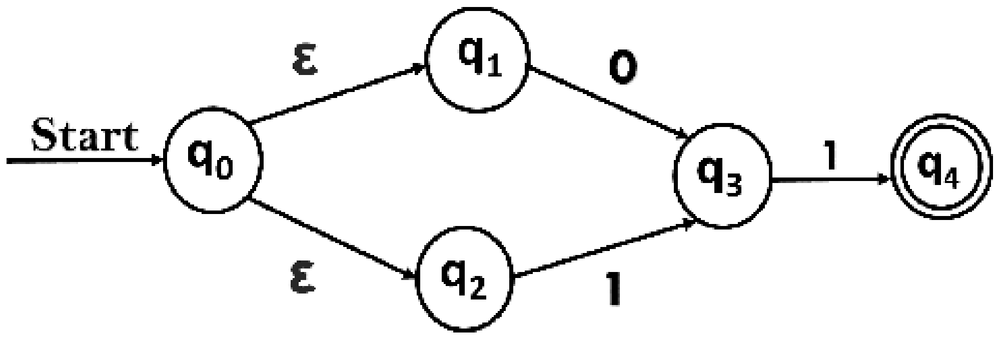
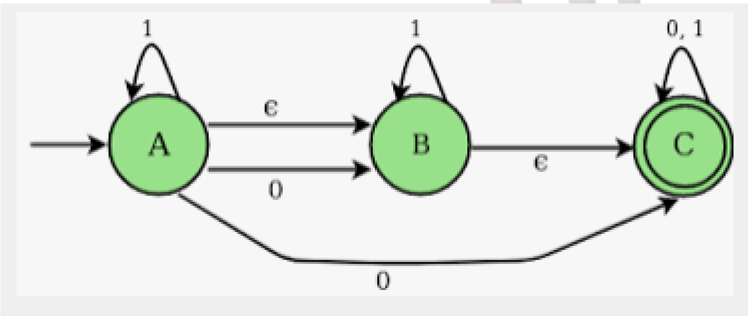
If the language accepted by M is L(M) then the regular expression for reverse of L(M) is

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

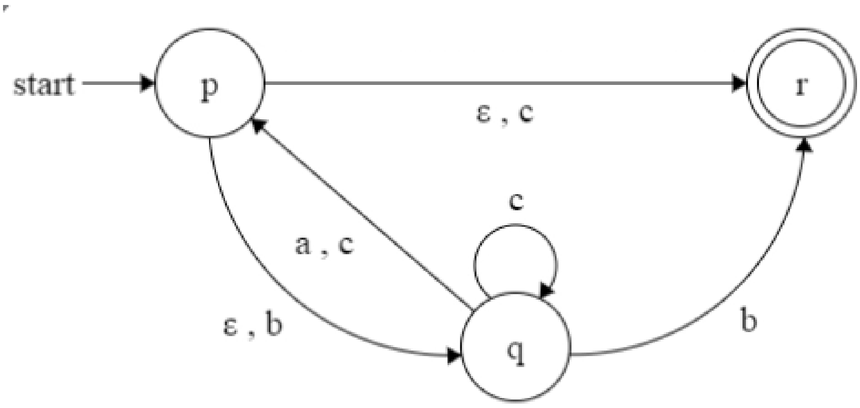
(B) (aabab)(a + b)*

(C) babaa (a + b)*

(D) None of the above

Q115.	**[MSQ]** Consider the following NFA with ∈ (epsilon): :  Which of the following statement is/are true? (A) ∈ −closure $\{q_0\} = \{q_0,\ q_1, q_2\}$ (B) ∈ −closure $\{q_1\} = \{q_1, q_2\}$ (C) ∈ −closure $\{q_2\} = \{q_0, q_2\}$ (D) ∈ −closure $\{q_3\} = \{q_3\}$
Q116.	**[MSQ]** Consider the following NFA with ∈ (epsilon):  Which of the following statement is/are true? (A) ∈ −closure $\{A\} = \{A,\ B, C\}$ (B) ∈ −closure $\{B\} = \{B,\ C\}$ (C) ∈ −closure $\{C\} = \{C\}$ (D) ∈ −closure $\{A\} = \{A, B\}$

Q117. Consider the following NFA with ∈ (epsilon): :

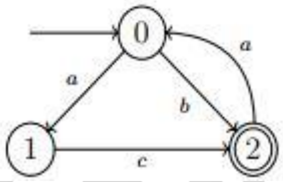


Which of the following option(s) is/are true about ∈-closure of different states of given NFA?

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

Q118. Consider the following NFA with ∈ (epsilon):

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



(A)ac + b(ab)*

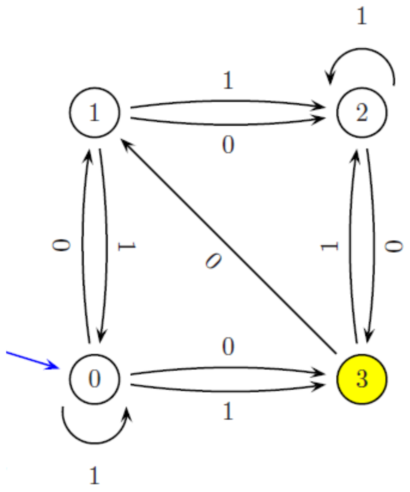
(B) (ac + b)(aac + ab)*

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

(D) Both b and c

Q119. **[MSQ]**

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



Which of the following statements is/are true?

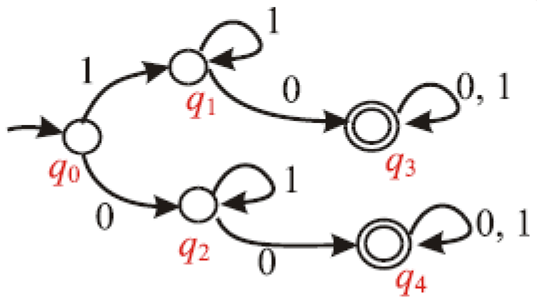
(a) The FSA accepts 011111101.

(b) The FSA accepts 11101000.

(c) The FSA rejects 0000.

(d) The FSA accepts all bit strings with an odd number of 0.

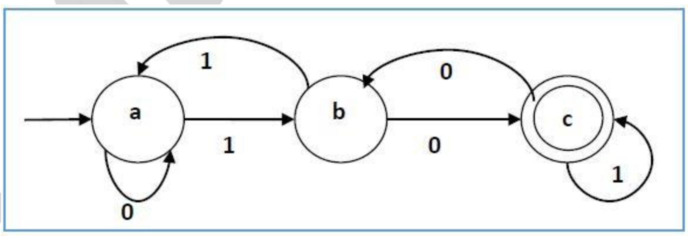
Q120. What is the language accepted by the following DFA?



(A) 0*1* (B) 1*0*

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

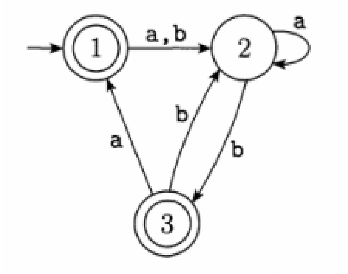
Q121. The regular expression for following automata will be:



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

(C) (0+11)*10(00)*1* (D)(0+11)*10(00 +1)*

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



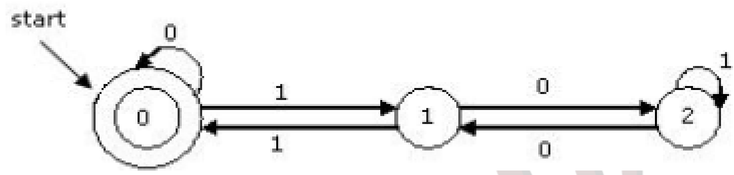
(A) ((a+b)(a* (bb)*)*b(λ+a))*

(B) (a(a*(bb)*)*b+b(a*(bb)*)*a)

(C) (a+b)(a*(bb)*)*a

(D)None

Q123. How many of the following regular expressions that denotes a subset of the language recognized by the given DFA? ___________



(1) 0*(11)*0*

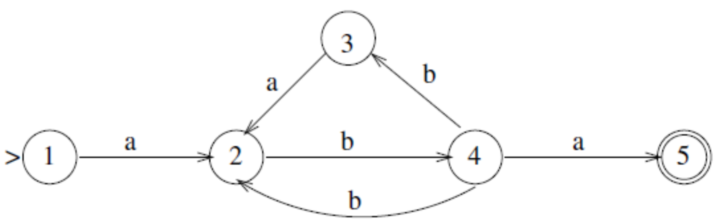
(2) 0*1(10*1)*1

(3) 0*1(10*1)*10*

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

(5) (0*1(10*1)*10* + 0*)*

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

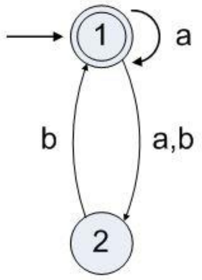
(B)ii and iii only

(C)All of these

(D)i and iii only

Q125. **[MSQ]**

What will be the regular expression for following automata?



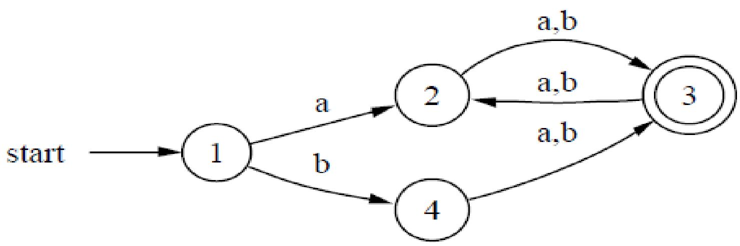
(A) a*(a+b)b

(B) a*(a+b)ba*

(C) a*{((a+b)b)*a* + λ}

(D) (a +(a+b)b)*

Q126. What is the language accepted by following automata?



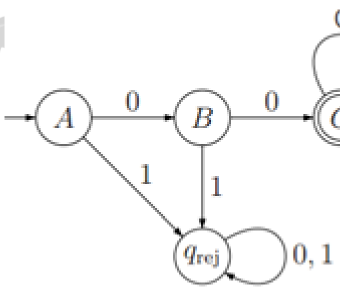
(A) Any string starts or ends with b

(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

Q127. The language accepted by the following DFA is:



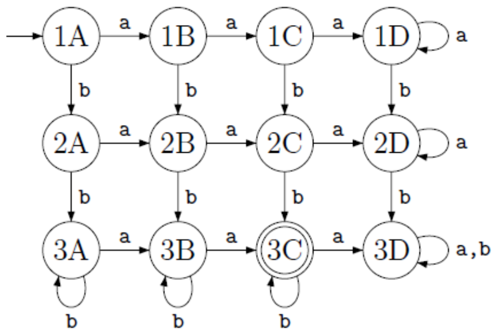
(A) All strings of the form 0^+w, where w contains an even number of ones.

(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.

Q128. The language accepted by the following DFA is:



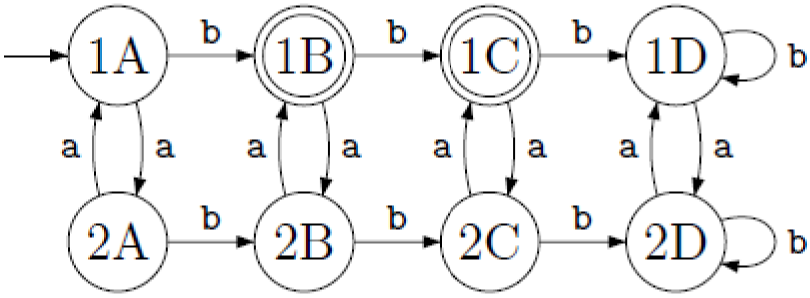
(A) L= {w | w has number of 'a' divisible of 4 and number of 'b' divisible of 3}

(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}

Q129. The language accepted by the following DFA is:



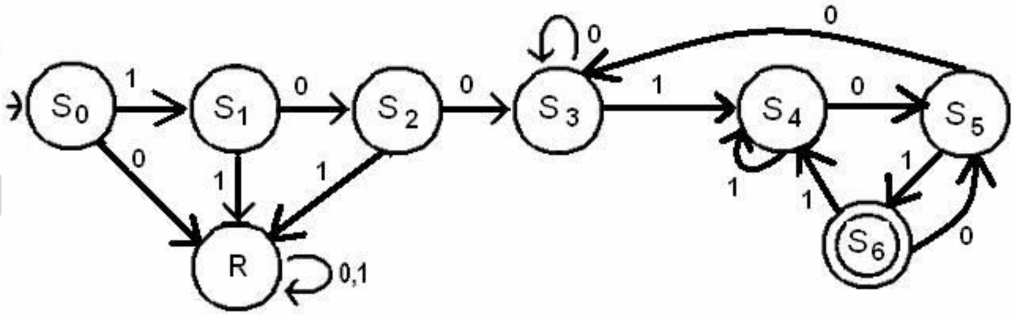
(A)L= {w | w has an even number of a's and one or two b's}

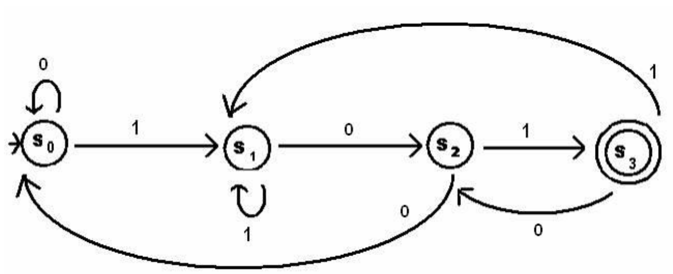
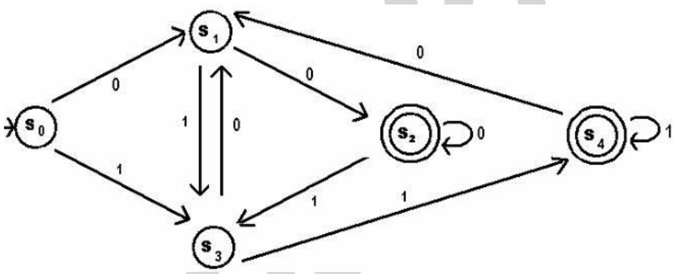
(B)L= {w | w has an even number of a's and at least two b's}

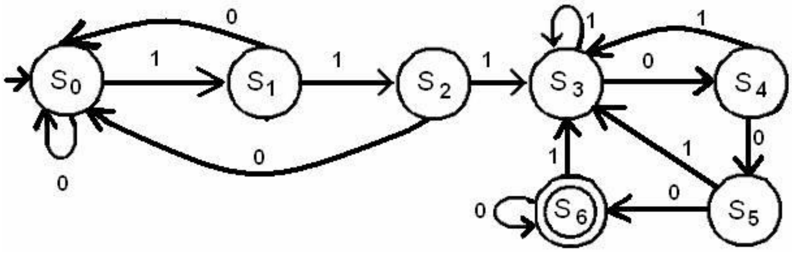
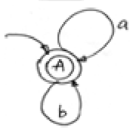
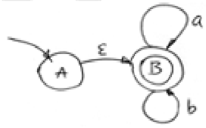
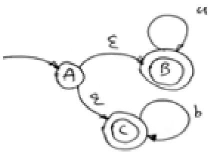
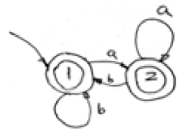
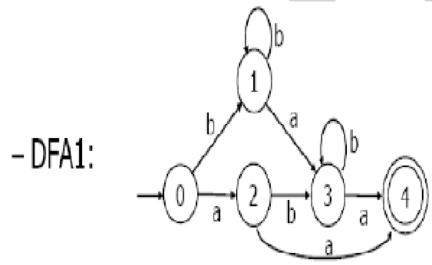
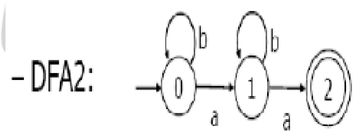
(C)L= {w | w has an at least two a's and one or two b's}

(D)L= {w | w has an at least two a's and one or two b's}

Q130. Consider the following DFA D:

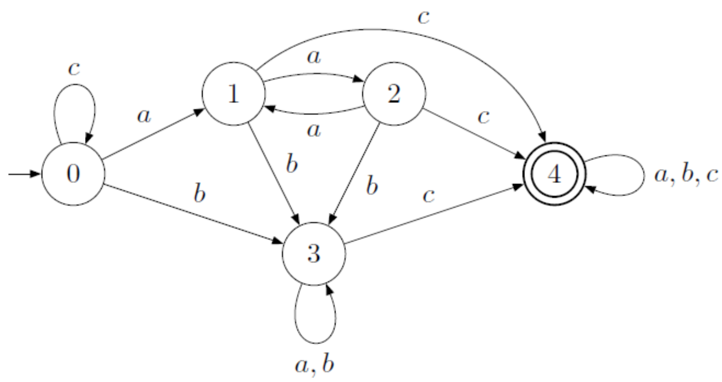


	If L(D) is language accepted by DFA D, then which of the following language is exactly equivalent to L(D)? (A) All the strings containing substring 100101 (B) All the strings start with 10 and end with 01 (C) All the strings start with 100 and end with 101 (D) All the strings of length greater than or equal to six.
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
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

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.
Q134.	Which of the following finite automata accepts different language than other three?  a)  b)  c)  d)
Q135.	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

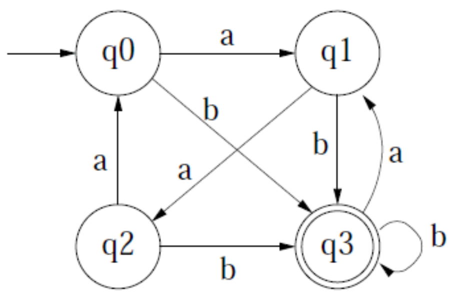
Q136.	Minimum number of states in a deterministic finite state automaton (FSA) that recognizes all bit strings with a multiple of three 1's. (For example, the following strings are in the language: 111, 111111, 1110, 0111, 10011, but not 1, 11, 1111, 0110. ______
Q137.	Minimum number of states in a deterministic 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}__________
Q138.	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 __________
Q139.	Minimum number of states in a DFA for the language L = {ab^na^m | n>3, m>2 } is___
Q140.	The minimum number of state in the DFA for the language L = {w |($n_a(w)$+ $2n_b(w)$) mod 3 < 2} is ______
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 (ϕ*)*_________

Q142. Consider the following DFA D over the alphabet Σ = {a, b, c}:



The number of state states in minimized DFA will be _______

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



How many states does the minimized DFA have? _________

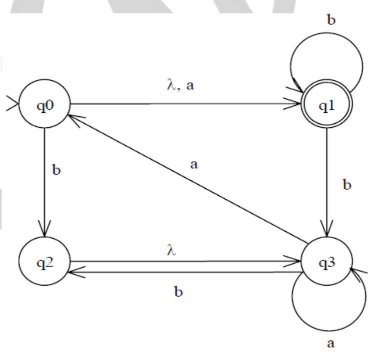
Q144. Consider the finite automaton MDL = ({S, S1, S2, S3, D1, D2}, {a, b, c} δ, S,{D1,D2},

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		

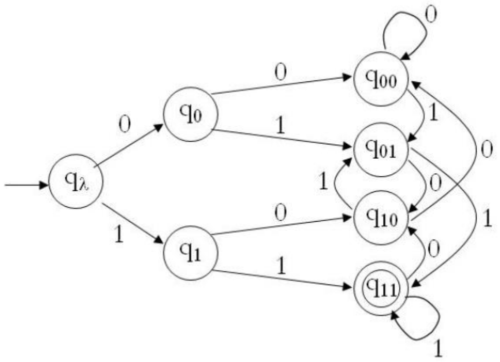
Minimum number of states in DFA of given MDL is___________

Q145. Consider the following NFA



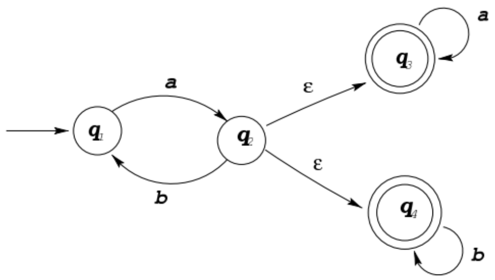
The number of states in the equivalent minimized DFA will be? ____________

Q146. Consider the following NFA



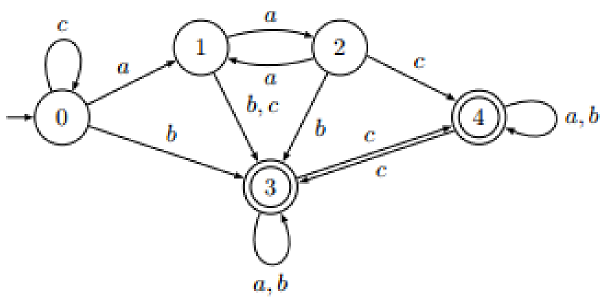
The number of states in the equivalent minimized DFA will be? ___________

Q147. Consider the following NFA



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

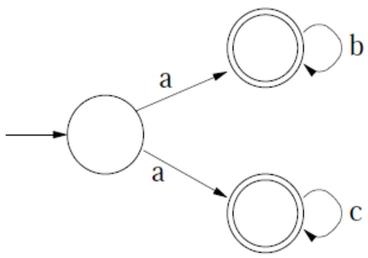
Q148. Consider the following DFA D over the alphabet ΣD = {a, b, c}:



The numbers of states in the equivalent minimized DFA is__________

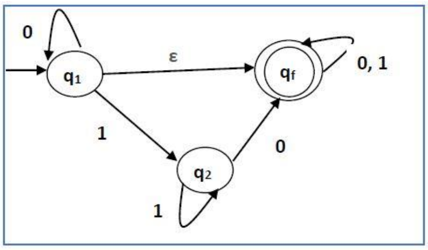
Q149. Find out how many states exist when we draw minimized DFA for the regular language given below L = {w *x* w^r | w∈(a+b)$^+$ and x∈(a+b)*} ?__________

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

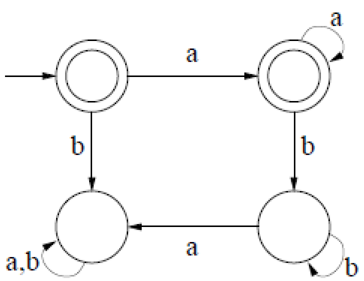


(A) 2 (B) 3 (C) 4 (D) 5

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



Q152. Suppose we 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

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

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
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.
Q156.	Let A = $\{0^n1^m \mid n<=m\}$ and B = $\{0^n1^m \mid m<=n\}$ 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
Q157.	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}.
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

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) $\{ a^m b^n \mid m \le n\}$;

(iii) $\{ a^m b^n \mid m + n \le 4\}$;

(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

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) $L2 = \{a^k \mid k$ is multiple of $4\}$

(iii) $L3 = \{a^k \mid k \bmod 6 = 1$ 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

Q161. For which of the following languages over the alphabet {a, b} is/are regular?

(i) $L_1 = \{ ww \mid w \in \{a\}^*\}$

(ii) $L_2 = \{ ww \mid w \in \{a, b\}^*\}$

(iii) $L_3 = \{ w_1 w_2 \mid w_1 \in \{a\}^* \ and \ w_2 \in \{b\}^*\}$

(iv) $L_4 = \{w \mid w \in \{a, b\}^*$ and w contains the same number of a's and b's$\}$

(v) $L_5 = \{w \mid w \in \{a, b\}^*$ 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

Q162. Which of the following languages is/are regular?

(A) $L1 = \{wz: |w| = |z|, w \in (a + b)^*$ 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}.

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
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
Q165.	Which of the following languages is/are regular? i) L1 = $\{ a^nb^l : n \geq 100, l \leq 100 \}$. 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
Q166.	Which of the following languages is/are regular? L1 = $\{uww^Rv: u, v, w \epsilon\{a,b\}^+\}$ L2 = $\{uww^Rv: u,v, w\epsilon\{a,b\}^+, \|u\|\geq\|v\|\}$ L3 = $\{ww^Rv: v,w\epsilon\{a,b\}^+\}$ (A) L1 only (B) L2 and L3 only (C) L1 and L2only (D) L1 and L3 only
Q167.	Which of the following language are not regular? L1 = $\{a^nb^la^k: k\geq n+l\}$ L2 = $\{a^nb^l: n+l\geq 0\}$ L3 = $\{a^nb^k: n\geq 100 \text{ and } k\leq 100\}$ (A) L1 only (B) L2 and L3 only (C) L1 and L2 only (D) L1 and L3 only

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Q168.	Which of the following languages is/are regular? L1=$\{a^k b^k: k\geq1\}\cup\{a^k b^l: k\geq1, l\geq1\}$ L2 = $\{a^{k+1}b^{k+1}: k\geq0\}\cup(a^{k+1}b^{k+3}:k\geq 0\}$ L3 = $\{ww: w\epsilon \{a\}^+\}$ (A) All the above (B) L2 and L3 only (C) L1 and L2 only (D) L1 and L3 only
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 = $\{a^n b^m : m\neq n \text{ and } m\leq10, n \geq 0\}$ (A) 2 only (B) 2 & 3 only (C) 1 only (D) none of these
Q170.	Which of the following language is/ are not regular? 1. L = $\{xy : x\in L1 \text{ and } y\notin L1; \text{ where L1 is regular}\}$ 2. L = $\{w1w2 : w1, w2 \in L2; \text{ where L2 is regular}\}$ 3. L = $\{a^{i^3} : i \geq 0 \;\; and\; \Sigma = \{a\}\}$ (A)1& 3 only (B) 2 only (C) 3 only (D)All
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 : $\{ a^n b^{2m} \mid m\leq1000 \text{ or } n\geq1000 \}$ (C) L3 : $\{ a^p b^q c^r \mid p<10 \text{ and } q>100 \text{ and } r \geq 0 \}$ (D) L4 : $\{a^n b^n w \mid n >= 0 \text{ and } w \in \{a, b\}^*\}$

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 = $\{w x w : w, x \in \Sigma^+\}$
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 = $\{a^i b^j c^k : i = j \text{ or } j \neq k\}$
Q174.	If L1 = $\{1^P : P \text{ is a prime number}\}$ 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
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 = $\{x \in \Sigma^* \mid xy \in L1 \text{ and } \lvert x \rvert = \lvert y \rvert\}$

Q176. Which of the following language is regular?

(A) L = {a^k : k is not perfect square}

(B) L = {a^k : k is perfect cube}

(C) L = {a^k : k is either prime or product of two or more prime numbers}

(D) L = {a^k : k = 2^i for some $i \geq 0$}

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 and k >i}

(C) L= {a^ib^j: i+2j is a prime number}

(D) L = {a^ib^j : $|i - j| = 3$}

Q178. **[MSQ]**

Which of the following language/s is are regular?

(A) L = {a^ib^j : i =j or i<j or i>j}

(B) L = {a^nb^n : n≥1}U {a^nb^m : n, m ≥1}

(C) L = {w1w2: w1 = w2 and w1, w2 $\in\Sigma^*$}$\cap${a^nb^n : n≥1}

(D) L = {a^n: n = k^3 for some k≥0}

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 ≤ 1000 and n is prime}. A DFA accepting L may have less than 900 states.

Q180. Which of the following languages are not regular?

1. L = {$wwww^R$: $w\in${a, b}*}

2. L = {$w\in${a, b}*| w = w^R}

3. L = { $w\in${a, b}*| 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

Q181. Given that L is regular and

$L1 = \{wx: w \in \Sigma^* \text{ and } x \in L\}$,

$L2 = \{w: wx \in L \text{ and } |w| = |x|\}$, and

$L3 = \{w: wx \in L1, \text{ for some } x \in L2\}$

Which of the above language is/are regular?

(A) L1, L2 only

(B) L2, L3 only

(C) L1, L3 only

(D) All are regular

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 $B \subseteq A$, 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

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 $L \cup R$ 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

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
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
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 (C) Both S1&S2 (D) Neither S1 nor 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

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.
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.
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
Q191.	Consider the following statements 1. If L is regular then so is $\{xx : x \in \mathrm{L}\}$. 2. If L is regular then so is $\{xy : x, y \in \mathrm{L}\}$. 3. Let A = $\{1^{2^p}$: p 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

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.
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
Q194.	Let L1 and L2 are two languages over Σ 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 $\cup \overline{L1}$ is regular. (C) L1, L2 $\subseteq \Sigma^*$ (D) L1$\cup$L2 contain infinitely many strings.
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)*

Q196.	The set of non-regular languages is closed under which of the following operations? (A) Complement (B) Union (C) Intersection (D) Concatenation
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)Σ^* - $\{a^nb^nc^n \mid n>=0\}$ (C) $\{a^nb^nc^n \mid n>=0\}$ (D) a*b*c*
Q198.	The right quotient of a language L1 with respect to L2 is defined as L1/L2 = {x: y$\in$L2, xy$\in$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
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
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
Q201.	If L = {001, 1101, 101} then the prefix of L is (A) $\{\lambda, 0, 00, 001, 1, 11, 110, 1101, 1, 10, 101\}$ (B) $\{\lambda, 0, 00, 001, 1, 11, 110, 1101, 10, 101\}$ (C) {λ, 1, 01, 001, 101, 1101} (D) None of the above

Q202. If L = {001, 1101, 101} then the suffix of L is

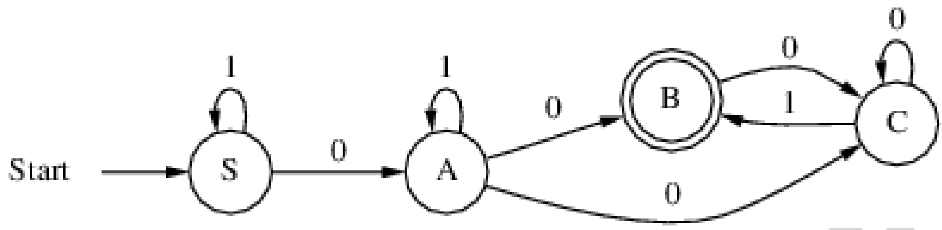
(A) {λ, 0, 00, 001, 1, 11, 110, 1101, 1, 10, 101}

(B) {λ, 1, 01, 001, 101, 1101, 10, 110}

(C) {λ, 1, 01, 001, 101, 1101}

(D) None of the above

Q203. Consider the following NFA:



Which of the following grammar generates the language accepted by NFA given above?

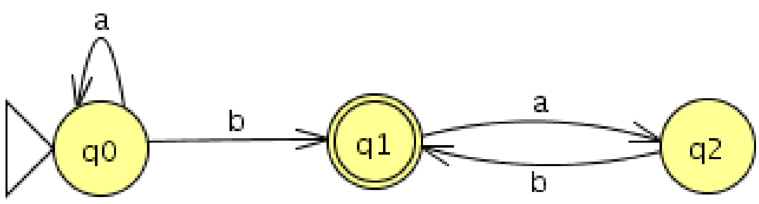
(A) S →1S/0A, A→1A/0B/0C, B→0C, C→1B/0C

(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

Q204. Consider the following NFA



Which Regular grammar corresponds to the following NFA?

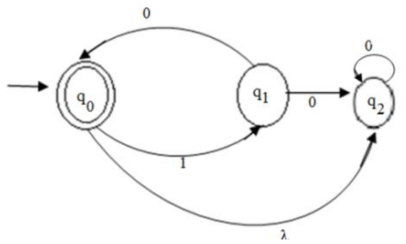
(A) S → bA | aS, A→ aB | λ, B→bA

(B) S → bA | aS, A→ bB | λ, B→bA

(C)S → Ba, A → aB | λ, B → bA

(D)None

Q205. Consider the following NFA.



Which of the following is a left linear grammar for the language accepted by M?

(A) $S \rightarrow 1S0 \mid \lambda$

(B) $S \rightarrow 10S \mid \lambda$

(C) $S \rightarrow 1A \mid \lambda,\ A \rightarrow 0S$

(D) $S \rightarrow A0 \mid \lambda$, $A \rightarrow S1$

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.

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

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
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
Q210.	Consider following grammar G $S \to aA \mid bB \mid \lambda$, $A \to bC \mid aS$, $B \to aC \mid Bs$ $C \to aB \mid bA$ Which of the following language is generated by G? (A) $L = \{w : n_a(w) + n_b(w) \text{ is even}\}$ (B) $L = \{w : \|n_a(w) - n_b(w)\| \text{ is even}\}$ (C) $L = \{w : n_a(w) \text{ and } n_b(w) \text{ are both even}\}$ (D) $L = \{w : n_a(w) \text{ and } n_b(w) \text{ are both odd}\}$
Q211.	Consider following grammar G $S \to aA \mid bB$ $A \to abA \mid \lambda$ $B \to ccB \mid \lambda$ 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) $a(ab)^++b(cc)^+$

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

Q213. Consider the following grammar G:

$S \rightarrow XY$

$X \rightarrow aX \mid bX \mid a$

$Y \rightarrow Y\,a \mid Y\,b \mid b$

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

For the next two questions: Let $\Sigma1 =\{0, 1, 2\}$ and $\Sigma2 = \{a, b, c, d\}$ 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}

Q215. Let h(L) = {aabaabaabccccdaab, cccdaabccccdaabaabc} then L will be

(A){00020, 21201}

(B){00120, 20201}

(C){00120, 21201}

(D) {00020, 20201}

Q216.	Let $A = \{xx \mid x \in \{a, b\}^*\}$. Consider homomorphism $h : \{a, b\}^* \to \{0, 1\}^*$ 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
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
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
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
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

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.
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) $(ab)^n a$
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.
Q224.	Consider the language L= $\{w \in: \Sigma^*$ 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
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

Q226.	Let L be the regular language (11)*0*1* and L' = $\{(11)^n 1 0^m 1^m \mid n, m >= 0\}$. 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'
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 ∈Σ* with |w| ≥2 } is not regular. 3. The language {w ∈ {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∈ {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.

CONTEXT FREE LANGUAGE

Q1. Which of the following languages is/are context free languages?

(I) $L = \{a^n b^j \mid n \le j^2\}$

(II) $L = \{a^n b^j c^k \mid k = j * n\}$

(III) $L = \{a^n b^j c^k \mid n < j, n \le k \le j\}$

(A) I & II only
(B) II & III only
(C) I & III only
(D) None of the above

Q2. Which of the following language is/are NCFL?

(I) $L = \{a^m b^n c^p d^q \mid n = q \text{ or } m \le p \text{ and } m + n = p + q\}$

(II) $L = \{a^m b^n c^p \mid m = n \text{ or } n = p \text{ or } m = p\}$

(III) $L = \{a^m b^n c^p \mid m = n \text{ and } n = p \text{ and } m = p\}$

(IV) $L = \{a^m b^n c^p \mid m \ne n \text{ or } n \ne p \text{ or } m \ne p\}$

(A) II & IV only
(B) I & IV only
(C) I & II only
(D) None of above

Q3. Which of the following language is/are context free?

$L1 = \{a^n b^j \mid n \le j^2\}$

$L2 = \{a^n \mid n \text{ is prime}\}$

$L3 = \{a^n w w^R a^n \mid n \ge 0 \text{ and } w \in \{a, b\}^*\}$

$L4 = \{a^n b^j a^j b^n \mid n \le j\}$

$L5 = \{xy \mid x, y \in \{0, 1\}^* \text{ and } x \ne y\}$

(A) L3 and L4 only
(B) L1 and L4 only
(C) L2 and L5 only
(D) L3 and L5 only

Q4. Which of the following language is/are context free?

$L1 = \{a^n b^n a^n b^n : n \ge 0\}, \Sigma = \{a, b\}$.

$L2 = \{w^R \# z : w \text{ is a substring of } z, w, z \in \{a, b\}*\}, \Sigma = \{a, b, \#\}$.

$L3 = \{w \# z : w \text{ is a substring of } z, w, z \in \{a, b\}*\}, \Sigma = \{a, b, \#\}$.

$L4 = \{x+y=z : x + y = z \text{ in unary where } x, y, z \in 11*\}, \Sigma = \{1, +, =\}$.

(A) L3 and L4 only
(B) L2 and L4 only
(C) L4 only
(D) None

Q5. Which of the following language is/are NCFL but not DCFL?

L1 = $\{wyw^R$: the length of y is even$\}$, $\Sigma = \{a, b\}$.

L2 = {w : w has the same number of a’s b’s and c’s together}, $\Sigma = \{a, b, c\}$.

L3 = $\{a^i b^j c^k : i > j \text{ or } j > k, \text{ where } i, j, k \geq 0\}$, $\Sigma = \{a, b, c\}$.

L4 = $\{xy : |x| = |y| \text{ and } x \neq y\}$, $\Sigma = \{a, b\}$.

(A) L3 only
(B) L1 and L2 only
(C) L2 and L4 only
(D) L1, L3 and L4 only

Q6. Which of the following language is/are DCFL?

L1 = $\{ww^R \mid w \in a^*b^*\}$

L2 = $\{w \mid w \in \{a, b\}^*$ and each prefix of w has at least as many a’s as b’s$\}$

L3 = $\{w \mid w \in \{a, b\}^*$ and $m \times n_a(w) = k \times n_b(w)$ for arbitrary constants m and k$\}$

(A) Only L2
(B) L2 and L3
(C) L1 and L3
(D) All of the above

Q7. Which of the following language is/are NCFL?

(i) $\{0^n 1^n \mid n > 0\} \cup \{0^n 1^{2n} \mid n \geq 0\}$

(ii) $\{1^n 0^n 1^m \mid m, n > 0\} \cup \{1^m 0^n 1^{2n} \mid m, n \geq 0\}$

(iii) $\{0^n 1^n \mid n > 0\} \cup \{1^{2n} 0^n \mid n \geq 0\}$

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

Q8. Which of the following language is/are context free?

(i) L = $\{a^n b^n : n \geq 0$ *and n is not a multiple of 5*$\}$

(ii) $\{1^k 0^i 1^i 0^j 1^j 0^k \mid i, j, k > 0\}$

(iii) $\{w\#x \mid w$ is a substring of x, where w, x are in $\{0,1\}^*\}$.

(iv) $\{0^i 1^i 0^j 1^i \mid i, j > 0\}$

(v) $\{(0^n 1^n)^m \mid m, n > 0\}$.

(vi) Complement of $\{(0^n 1^n)^m \mid m, n > 0\}$.

(A) i, ii and vi only
(B) i and ii only
(C) iii and v only
(D) i, ii, iii and v only

Q9.	Which of the following language is/are context free? $L1 = \{w \in \{a, b, c\}^* \mid n_a(w) = n_b(w) \le n_c(w)\}$ $L2 = \{a^n b^m \mid$ n and m are both prime$\}$ $L3 = \{a^n b^j a^k b^l \mid n \le k, j \le l\}$ $L4 = \{w \in \{a, b\}^* \mid n_a(w) = n_b(w)$, w does not contain a substring aab$\}$ (A)L2 only (B)L1 and L3 only (C)L4 only (D)None	
Q10.	The language $L = \{(a+b+c)^* wcw^R$, where $w \in (a+b)^+\}$ is (A) Regular (B) Deterministic CFL (C) Non- Deterministic CFL (D) Not a CFL	
Q11.	The language $L = \{w^R cw\, (a + b + c)^*$, where $w \in (a+b)^+\}$ is (A) Regular (B) Deterministic CFL (C) Non- Deterministic CFL (D) Not a CFL	
Q12.	Which of the following is/are not CFL? (i) $L = \{www \mid w \in \{0, 1\}\}$ (ii) $L = \{0^n \mid$ n is perfect square$\}$ (iii) $L = \{0^n \mid$ n is either prime number or odd number or both$\}$ (iv) $L = \{0^n \mid$ n is not perfect cube$\}$ (A) i only (B) ii and iv only (C) ii, iii and iv only (D) i and iv only	
Q13.	**[MSQ]** Which of the following language is/are context free? (a) $L = \{a^n b^n: n \ge 0$ and n is neither prime nor composite$\}$ (b) $L = \{a^p \mid$ p is prime number or p = 0$\}$. $\{a^p \mid$ p is not a prime number$\}$ (c) $L = \{0^i 1^i 0^i 1^i \mid$ i is a prime number and $0 < i < 100\}$ (d) $L = \{(0^n 1^m)^k \mid m, n >= 0\}$.	

Q14.	**[MSQ]** Which of the following language is/are context free? (A) $L1 = \{w \in \{a, b, c\} \mid n_a(w) = n_b(w) = nc(w)\}$ (B) $L2 = \{a^n b^m \mid n/m$ is integer ;where n & m are prime numbers$\}$ (C) $L3 = \{a^n b^j a^k b^l \mid n = k$ and $j = 2l\}$ (D) $L4 = \{ww \mid w \in \{a, b\}^*$and $n_a(w) < 2n_b(w)) < 100\}$
Q15.	**[MSQ]** Which of the following language is/are context free? (A) $L1 = \{a^n b^j \mid n = j^2\}$ (B) $L2 = \{a^n \mid n$ is multiple of a prime$\}$ (C) $L3 = \{www^R w^R \mid w \in \{a\}^*\}$ (D) $L4 = \{a^j a^n b^j b^n \mid n = j$ and $n, j >= 0\}$
Q16.	**[MSQ]** Which of the following language is/are DCFL? (A) $L = \{wxcx^R \mid w \in \{a, b, c\}^*$ and $x \in \{a, b\}^*\}$ (B) $L = \{xcx^R w \mid w \in \{a, b, c\}^*$ and $x \in \{a, b\}^*\}$ (C) $L = \{xwx^R \mid w \in \{a, b, c\}^*$ and $x \in \{a, b\}^*\}$ (D) $L = \{xcx^R w \mid w, x \in \{a, b\}^*\}$
Q17.	Which of the following language is/are DCFL? 1. $L = \{www \mid w \in 0^*\}$ 2. $L = \{wxw \mid w \in 0^*1^*$ and $x \in \{0, 1\}^*\}$ 3. $L = \{wxw^R \mid w \in 0^*1^*$ and $x \in \{0, 1\}^*\}$ (A) 1 only (B) 1 & 2 only (C) 2 & 3 only (D) All the above

Q18.	Which of the following descriptions best fits the language L = {x ∈ {a b, c }* | #a(x) = #b(x) + #c(x) } (A) L is a regular language (B) L is a context-free language that is not regular (C) L is a context-sensitive language that is not context-free (D) L is not a context-sensitive language
Q19.	[**MSQ**] Let L1 be a context-free language and L2 ⊆ L1 then which of the following statement is/are true? (A) L2 is definitely context-free. (B) L2 may not be a context-free language. (C) L1 ∪ L2 is definitely context-free. (D) L_1^R is context sensitive.
Q20.	Let L language collection of strings over {0, 1} containing ten more 0 than 1. These language is (A) Regular (B) Context free but not regular (C) Recursive but not contexts free (D) Recursively enumerable but not recursive
Q21.	Let L language collection of strings over {0, 1} containing ten more 0 than 1 or containing ten more 1 than 0. These language is (A) Regular (B)Context free but not regular (C) Recursive but not context free (D) Recursively enumerable but not recursive

Q22.	Which of the following languages is/are context free? 1. $\{a^i \mid i \text{ is prime}\}$ 2. $\{(a^n b)^n \mid n \geq 1\}$ 3. $\{(a^n b)^m \mid m, n \geq 1\}$ (A)Only 1&2 (B)Only 2&3 (C)Only 1&3 (D)None
Q23.	Consider the following language $L = \{a^n b^n a^n b^n : n \geq 0\}$.Which of the following statement is true about L? (A) Regular (B) Context-free but not regular, (C) Context-sensitive but not context-free, (D) Recursively enumerable but not context-sensitive.
Q24.	Which of the following languages is/ are not context free? (i) $L = \{a^i b^j c^k d^l \mid i+j = k+l \text{ and } i, j, k, l \in N\}$ (ii) $L = \{0^n \# 0^{2n} \# 0^{3n} \mid n>=0\}$ (iii) $L = \{uawb \mid u, w \in \{a,b\}^* \text{ and } \lvert u \rvert = \lvert w \rvert\}$ (iv) $L = \{w \in \{a, b\}^*$: w has twice as many b's as a's$\}$ (v) $L = \{a^m b^{2n} c^{3n} d^p : p > m, \text{ and } m, n \geq 1\}$. (A) iv and v only (B) ii only (C) ii and v only (D) i, iii, iv, v
Q25.	Which of the following languages is/are CFLs? $L1 = \{0^i 1^j 2^k \mid i<j<k\}$. $L2 = \{w \in (0+1+2)^* \mid$ w does not contain the same number of all 3 symbols$\}$. $L3 = \{uawb \mid u,w \in (a+b)^*, \lvert u \rvert = \lvert w \rvert\}$ $L4 = \{b_i \# b_{i+1} \mid b_i$ is i in binary $i \geq 1\}$. The alphabet here is $\{0,1,\#\}$. (A)L1 and L2 only (B) L2, L3 and L4 only (C) L3 only (D) L3 and L4 only

Q26.	Which of the following languages is/are context free? L1 = $\{a^i b^k c^j \mid j = \max(i, k)\}$ L2 = {x ∈ {a, b}* : |x| is even and the first half of x has one more 'a' than does the second half}. L3 = {w ∈ {a, b}* : the first, middle, and last characters of w are identical}. L4 = $\{a^i b^j \mid i = kj$ for some positive integer k$\}$ (A) L2 only (B) L3 only (C) L1 & L2 (D) L2 & L3
Q27.	Consider the following language L = $\{w^R\#z$: w is a substring of z, and w, z $\in \{a,b\}^*\}$. Which of the Following is true about L? (A) Regular (B) Context-free but not regular, (C) Context-sensitive but not context-free, (D) Recursively enumerable but not context-sensitive.
Q28.	Consider the following language L = {w#z: w is a substring of z and w, z ∈ {a, b}*}. Which of the Following is true about L? (A) Regular (B) Context-free but not regular (C) Context-sensitive but not context-free (d) Recursively enumerable but not context-sensitive.
Q29.	The language L = $\{0^i 1^j 2^i 3^j \mid i, j \geq 0\}$ is (A) Regular (B) Deterministic CFL (B) Non-Deterministic CFL (D) Not a CFL
Q30.	The language L = $\{0^i 1^j 2^j 3^i \mid i, j \geq 0\}$ is (A) Regular (B) Deterministic CFL (C) Non-Deterministic CFL (D) Not a CFL

Q31. The language $L = \{0^i 1^j \mid i, j \geq 0 \text{ and } i = 3j\}$ is

(A) Regular (B) Deterministic CFL

(C) Non-Deterministic CFL (D) Not a CFL

Q32. Which of the following language/s is/are not CFL?

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

2. $L = \{a^n b^m c^n \mid n = 3m \ \& \ n \geq 0, m \geq 0\}$

3. $L = \{a^m b^n c^m \# w w^R \# w c w^R \mid w \in \{a, b\}^*$ and w^R is reverse string of $w\}$

(A)1 only (B)2 & 3 only

(C)1&2 only (D)none

Q33. Let $L1 = \{w: w$ is palindrome & $w \in \{a, b\}^*\}$ and $L2 = \{ww^R\#w : w \in \{a, b\}^*\}$, then.

Which of the following statement is not true?

(A) L1 is CFL but L2 is DCFL.

(B) L1 is DCFL but L1 is not DCFL.

(C) Both L1 and L2 are CFL.

(D) L1 is CFL but L2 is not CFL.

Q34. Which of the following languages on $\Sigma = \{a, b\}$ is/are context- free?

(i) $L = \{a^i b^j \mid i \leq j^3\}$

(ii) $L = \{a^i b^j \mid i + j$ is an even number$\}$

(iii) $L = \{a^i b^j \mid i * j$ is composite number$\}$

(iv) $L = \{a^i b^j \mid i + j$ is an odd number$\}$

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

(C) Only i, ii and iv (D) all

Q35. Which of the following languages on $\Sigma = \{a, b\}$ is/are not context- free?

(i) $L = \{a^i b^j \mid i$ and j are both prime$\}$

(ii) $L = \{a^i b^j \mid i$ is prime or j is prime$\}$

(iii) $L = \{a^i b^j \mid i$ is prime but j is not prime$\}$

(iv) $L = \{a^i b^j \mid$ neither i is prime nor j is prime$\}$

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

(C)ii, iv only (D) All the above

Q36.	Which of the following language is/are DCFL? (A) L = $\{a^n b^m \mid n \neq m\}$ (B) L = $\{w\#w^R \mid w^R$ is reverse of w$\}$ (C) L = $\{a^n b^m \mid n \leq m \leq 3n\}$ (D) both a & b
Q37.	Which of the following language is/are not CFL? 1. L = $\{a^n b^m c^k \mid k = HCF(m, n)\}$ 2. L = $\{a^n b^m c^k \mid k = LCM(m, n)\}$ 3. L = $\{a^n b^m c^k \mid k = max(m, n)\}$ 4. L = $\{a^n b^m c^k \mid k = min(m, n)\}$ (A)1 & 2 only (B) 3 & 4 only (C)2 & 4 only (D) All the above
Q38.	Which of the following language/s is/are CFL? 1. If L1 = $\{ww^R \mid w^R$ is reverse of w$\}$ then L1.L1.L1 is CFL. 2. If L2 = $\{ww^R ww^R ww^R \mid w^R$ is reverse of w$\}$ then L2 is CFL. 3. If L3 = $\{ww^R \mid w^R$ is reverse of w$\}$, then complement of L3 is NCFL. (A)1 only (B)1 & 3 only (C)2 & 3 only (D)All the above
Q39.	Which of the following language is/are DCFL? 1. L = $\{uv : u \neq v^R$ where u, v $\in \Sigma^*$ and v^R is reverse of v$\}$. 2. L = {uv : u contains even number of 0 and v contains odd number of 1; Where u, v $\in \{0, 1\}^*\}$. 3. L = $\{uv : u \in L_1 \& v \notin L_1$; where L_1 is DCFL $\}$ 4. 1. L = $\{u\#v : u \neq v^R$ where u, v $\in \Sigma^*$ and v^R is reverse of v$\}$. (A) 1, 3 only (B) 1, 3, 4 only (C) 2, 3, 4 only (D) All the above

Q40.	Which of the following languages are NOT context-free? $L_1 = \{0^{n+m}1^n0^m \mid n, m \geq 0\}$, $L_2 = \{0^{n+m}1^{n+m}0^m \mid n, m \geq 0\}$, and $L_3 = \{0^{n+m}1^n0^{n+m} \mid n, m \geq 0\}$ (A) L_1 only (B) L_3 only (C) L_1 and L_2 (D) L_2 and L_3
Q41.	A context-free grammar G is ambiguous if and only if (A) Some string $w \in L(G)$ has at least two different derivations. (B) Some string $w \in L(G)$ has at least two different parse trees. (C) Every string $w \in L(G)$ has at least two different parse trees. (D) Every string $w \in L(G)$ has at least two different derivations.
Q42.	Consider the following grammar: (Assume starting symbol is S) <table><tr><th>G1</th><th>G2</th></tr><tr><td>$S \rightarrow aA \mid bB \mid cS \mid aS$ $A \rightarrow bAa \mid \lambda$ $B \rightarrow bB \mid a$</td><td>$S \rightarrow aS \mid bSa \mid aSb \mid bS \mid \lambda$</td></tr></table>Which of the following grammar is/are ambiguous? (a) G1 only (b) G2 only (c) Both G1 & G2 (d) Neither G1 nor G2
Q43.	**[MSQ]** Which of the following grammars have more than one parse tree for the string **'1001'**? <table><tr><th>(a)</th><th>(b)</th><th>(c)</th><th>(d)</th></tr><tr><td>$S \rightarrow XY$ $X \rightarrow 0X \mid 1X \mid \lambda$ $Y \rightarrow 1Y1 \mid 0Y0 \mid \lambda$</td><td>$S \rightarrow XY$ $X \rightarrow 0X1 \mid 1X0 \mid \lambda$ $Y \rightarrow 1Y \mid 0Y \mid \lambda$</td><td>$S \rightarrow 0S \mid 1S \mid SS$ $S \rightarrow 0 \mid 1$</td><td>$S \rightarrow 1S0S$ $S \rightarrow 0S1S$ $S \rightarrow \lambda$</td></tr></table>

Q44. **[MSQ]**

Consider the following grammar G with starting symbol S:

$S \rightarrow aSb \mid bSa \mid aSa \mid bSb \mid AB \mid BA$

$A \rightarrow aA \mid \lambda$

$B \rightarrow bB \mid \lambda$

For which of the following string(s), G has more than one parse tree?

(A) ab

(B) aabb

(C) abba

(D) abab

Q45. Consider the following grammar G with starting symbol S:

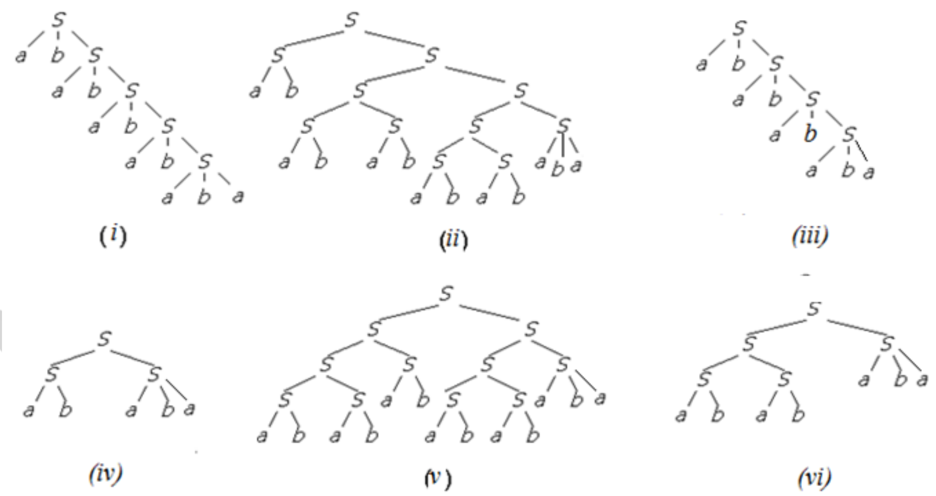
$S \rightarrow aSb \mid bSa \mid aSa \mid bSb \mid AB \mid BA$

$A \rightarrow aA \mid \lambda$

$B \rightarrow bB \mid \lambda$

How many different parse trees are possible for string '**abba**'? ___________

Q46. Which of the parse trees below yield the same word?

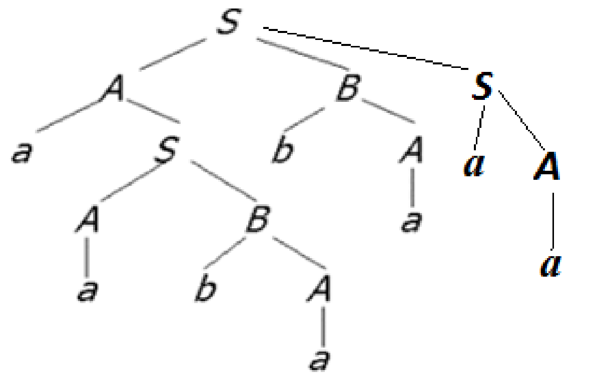
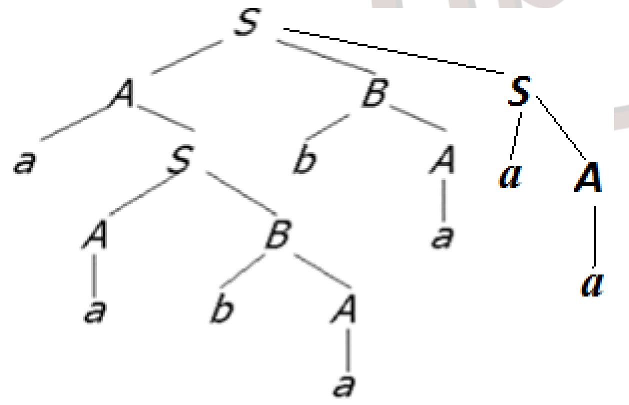


(A) iii and iv only

(B) i, ii and v only

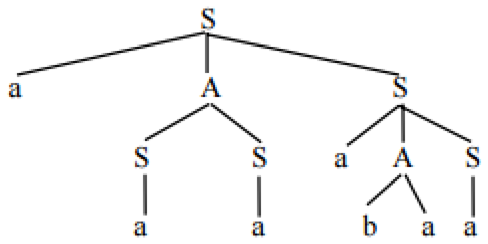
(C) ii and v only

(D) iii, iv and vi only

Q47.	Here is a parse tree that is derived from some unknown grammar G.  Which of the following productions is not surely for grammar G? (A) S → ABS (B) A → aB (C) S → AB (D) S → aA
Q48.	The parse tree below represents a rightmost derivation according to the grammar S → ABS | AB | aA, A → aS | a, B → bA  Which of the following is a right-sentential form in this derivation? (I) ABaA (II) bAba (III) aaBB (IV) aabAba (A) I & II only (B) III & IV only (C) I only (D) All except III

Q49. Consider the following context free grammar: G = ({S, A, a, b}, {a, b}, R, S),

where R = {S →aAS S → a A→SbA A →SS A→ba } and parse tree for the string "aaaabaa" is shown below:



Which of the following are left-sentential forms corresponding to this derivation?

(i) aAS

(ii) aSS

(iii) aaSS

(iv) aaS

(v) aaaaAS

(A)i, iii and v only

(B)ii and iv only

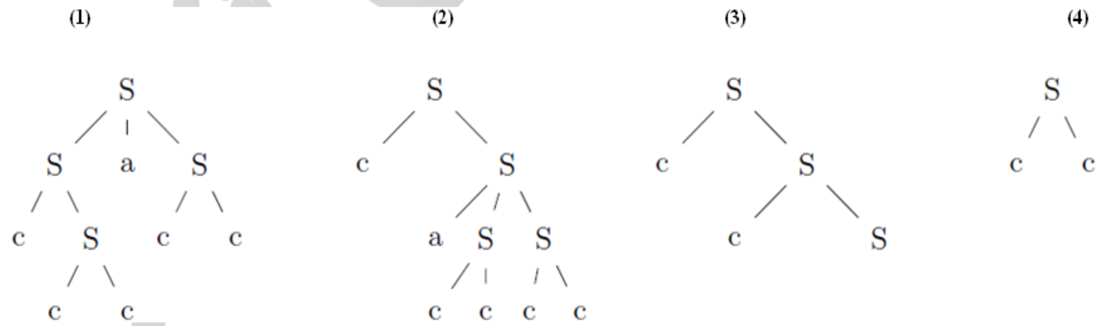
(C)ii, iii and v only

(D)All the above

Q50. Consider the grammar (with start variable S and terminals a and c).

S → SaS | cS | cc

Which of following parse trees matches the grammar?



(A) i ,iii,iv

(B)iii,iv

(C)ii

(D)i and iv

Q51. Consider the following CFG

S → aB | bA

B → b | bS| aBB

A → a| aS| bAA

Now consider the following derivation of above CFG

S ⇒ aB ⇒ aaBB ⇒ aaBb ⇒ aabSb ⇒ aabbAb ⇒ aabbab

This derivation is

(A) a leftmost derivation

(B)a rightmost derivation

(C)both leftmost and rightmost derivation

(D)neither leftmost nor rightmost derivation

Q52. Given the simple CFG with non-terminals {S,A,B}, terminals {a,b}, and productions

S → AB, A → AB | a, B → BA | b.

Which of the following derivation is NOT a derivation of the string abab?

(A) S ⇒ AB ⇒ Ab ⇒ABb ⇒ ABAb ⇒ AbAb ⇒ Abab ⇒ abab

(B) S ⇒ AB ⇒ ABB ⇒ ABAB ⇒ aBaB ⇒ abab

(C) S ⇒ AB ⇒ ABA ⇒ ABAB ⇒ ABAb ⇒ AbAb ⇒ Abab ⇒ abab

(D) S ⇒ AB ⇒ aB ⇒ aBA ⇒ abA ⇒ abAB ⇒ abaB ⇒ abab

Q53. Consider the following grammar G with start symbol *S*:

S →if id then S else S

S → if id then S

S → id

Which of following is/are true?

(i) G is Type 3 grammar.

(ii) G is Type 2 grammar

(iii) G is unambiguous grammar.

(iv) G is ambiguous grammar.

(A) i, ii and iv only (b) ii and iv only

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

Gate@zeal

For the next two questions: Consider the following grammar G $S \rightarrow 0A \mid 1B \mid \lambda$ $A \rightarrow 0AA \mid 1S \mid 1$ $B \rightarrow 1BB \mid 0S \mid 0$ Let L (G) is the language accepted by G.	
Q54.	Which of the following statements is/are true about G? (i) G is Type 2. (ii) G is ambiguous. (iii) $0011010110 \notin L(G)$ and $1111100101000 \in L(G)$. (A) i& ii only (B)ii & iii only (C) i only (D)All are true
Q55.	The language generated by G is (A) The set of all the strings that don't contain substring 00. (B) The set of all the strings that contains equal numbers of zero's followed by equal number of one's or equal numbers of one's followed by equal number of zero's i.e. $L(G) = \{0^n 1^n \mid n>0\} \cup \{0^n 1^n \mid n>0\}$ (C) The set of all the strings which have equal number of zero's and one's. (D)None of these
Q56.	Consider the following statements about the context free grammar G = {S -> SS, S ->ab, S ->ba, S -> ε} Which of the following statements is/are true about G I. G is ambiguous. II. G produces all strings with equal number of a's and b's. III. L (G) can be accepted by a deterministic PDA. (A) I only (B) I and III only (C) II and III only (D) I, II and III

Q57.	Consider the grammar G given by the productions $S \rightarrow aSa \mid aBa \mid b \mid \lambda$ $B \rightarrow bB \mid b$ Then which of the following is/are true about G? (i)G is context sensitive grammar. (ii)G accept the language L where L = $\{a^i b^j a^k \mid i = k \text{ and } i, j, k \geq 0\}$. (iii) G is not unambiguous. (A) ii only (B) ii & iii only (C) i & ii only (D) All are true
Q58.	Consider the following grammar G $S \rightarrow TC \mid AR$ $T \rightarrow aTb \mid \lambda$ $C \rightarrow Cc \mid \lambda$ $R \rightarrow bRc \mid C$ $A \rightarrow Aa \mid \lambda$ The language is generated by G is : (Assume i, j, k>=0) (A) L = $\{a^i b^j c^k \mid k = j \text{ and } i>=j\}$ (B) L = $\{a^i b^j c^k \mid i = j \text{ and } k>=j\}$ (C) L = $\{a^i b^j c^k \mid i = j \text{ or } k>=0\}$ (D) L = $\{a^i b^j c^k \mid i = j \text{ or } k>=j\}$
Q59.	Consider three language L1, L2, L3 and three grammar G1, G2, G3: L1 = $\{a^i b^j c^k \mid k = i + 2*j\}$ L2 = $\{a^i b^i c^k \mid k>=3\}$, L3 = $\{a^i b^j c^k \mid k = i + j\}$ G1: $S \rightarrow aSc \mid T$, $T \rightarrow bTc \mid \lambda$ G2: $S \rightarrow aSc \mid T$, $T \rightarrow bTcc \mid \lambda$ G3: $S \rightarrow TC$, $T \rightarrow aTb \mid \lambda$, $C \rightarrow Cc \mid ccc$ Which of the following language, grammar pair (L, G) are equivalent? (a)(L1, G1), (L2, G2), (L3, G3) (b)(L1, G3), (L2, G2), (L3, G1) (c)(L1, G2), (L2, G2), (L3, G3) (d) (L1, G2), (L2, G3), (L3, G1)

Q60.	Match the column which CFG corresponds to which language?

Language	Grammar
1. $\{0^n1^n \mid n>0\} \cup \{0^n1^{2n} \mid n>0\}$	i. $S \rightarrow 0A1 \mid 0B11$ $A \rightarrow 0A1 \mid \lambda$ $B \rightarrow 0B11 \mid \lambda$
2. Binary strings with twice as many 1s as 0s.	ii. $S \rightarrow 0A0 \mid 1A1$ $A \rightarrow 0A \mid 1A \mid \lambda$
3. $\{w \in \{0,1\}^* \mid$ w starts and ends with the same symbol$\}$	iii. $S \rightarrow 0A11 \mid \lambda$ $A \rightarrow 0A11 \mid \lambda$

(A) 1-i, 2-iii, 3-ii

(B) 1-ii, 2-i, 3-iii

(C) 1-ii, 2-iii,3-I

(D) 1-i, 2-ii, 3-iii

Q61. Let $V = \{S\}$, $\Sigma = \{a, b\}$. Which of the following grammars is such that the language Generated by it is $\{ww^r : w \in \{a, b\}^*\}$.

(A) $G1 = (V, \Sigma, R1, S)$, where $R1 = \{(S \rightarrow aSa), (S \rightarrow bSb), (S \rightarrow \lambda)\}$

(B)$G2 = (V, \Sigma, R2, S)$, where $R2=\{(S \rightarrow aSa), (S \rightarrow bSb), (S \rightarrow a), (S \rightarrow b), (S \rightarrow \lambda)\}$

(C) $G3 = (V, \Sigma, R3, S)$, where $R3 = \{(S \rightarrow Sa), (S \rightarrow Sb), (S \rightarrow \lambda)\}$

(D) $G4 = (V, \Sigma, R3, S)$, where $R3 = \{(S \rightarrow aSb), (S \rightarrow \lambda)\}$

Q62. Which of the following CFG generates all the strings contains more 1's than 0's?

(A)$S \rightarrow 0T \mid 11T \quad T \rightarrow 0S \mid 11S \mid \lambda$

(B)$S \rightarrow 0S1 \mid 1S0 \mid 1S1 \mid 1$

(C) $S \rightarrow TS \mid 1T \mid 1S \quad T \rightarrow TT \mid 0T1 \mid 1T0 \mid \lambda$

(D) $S \rightarrow TS \mid 1T \mid 11 \quad T \rightarrow TT \mid 0T1 \mid 1T0 \mid 1$

Q63. Consider the following Pushdown Automaton (PDA) P1:

P1 = (Q = {q0, q1}, Σ = {a, b, c}, Γ = {0, 1, #}, δ, q0, Z0 = #, F = {q1}) where the transition function δ is given by

δ(q0, a, #) = {(q0, 0#), (q0, 11#)}

δ(q0, a, 0) = {(q0, 00), (q0, 110)}

δ(q0, a, 1) = {(q0, 01), (q0, 111)}

δ(q0, b, 0) = {(q0, λ)}

δ(q0, c, 1) = {(q0, λ)}

δ(q0, λ, #) = {(q1, #)}

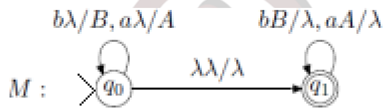
δ(q, w, z) = ∅ everywhere else Acceptance is by final state.

Which of the following words are accepted by the PDA P1?

(i) ab (ii) aababcc (iii) ac

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

Q64. Let M be the PDA



Which of the following strings are accepted by M?

(A) aaaa (B) baab (C) aaa (D) ab

Q65. Consider the pushdown automaton with the following transition rules:

$\delta(q,0,Z_0) = \{(q,XZ_0)\}$

$\delta(q,0,X) = \{(q,XX)\}$

$\delta(q,1,X) = \{(q,X)\}$

$\delta(q,\varepsilon,X) = \{(p,\varepsilon)\}$

$\delta(p,\varepsilon,X) = \{(p,\varepsilon)\}$

$\delta(p,1,X) = \{(p,XX)\}$

$\delta(p,1,Z_0) = \{(p,\varepsilon)\}$

The start state is *q*. For which of the following inputs can the PDA first enter state *p* with the input empty and the stack containing XXZ_0 [i.e., the ID (p,ε,XXZ_0)]?

(A) 001111 (B) 0101010

(C) 001110 (D) 111001

Q66.	Here are the transitions of a deterministic pushdown automaton. The start state is q_0, and *f* is the accepting state.

State-Symbol	a	b	ε
q_0-Z_0	(q_1,AAZ_0)	(q_2,BZ_0)	(f,ε)
q_1-A	(q_1,AAA)	(q_1,ε)	-
q_1-Z_0	-	-	(q_0,Z_0)
q_2-B	(q_3,ε)	(q_2,BB)	-
q_2-Z_0	-	-	(q_0,Z_0)
q_3-B	-	-	(q_2,ε)
q_3-Z_0	-	-	(q_1,AZ_0)

Identify below the one input string that the PDA accepts.

(A) bbbab

(B)abbbab

(C)abbbabb

(D) bbaabab

Q67. Consider the pushdown automaton with the following transition rules:

$\delta(q,0,Z_0) = \{(q,XZ_0)\}$; $\delta(q,0,X) = \{(q,XX)\}$; $\delta(q,1,X) = \{(q,X)\}$

$\delta(q,\varepsilon,X) = \{(p,\varepsilon)\}$

$\delta(p,\varepsilon,X) = \{(p,\varepsilon)\}$

$\delta(p,1,X) = \{(p,XX)\}$

$\delta(p,1,Z_0) = \{(p,\varepsilon)\}$

From the (p, 1101, XXZ0), which of the following states can NOT be reached?

(A) $(p,101,XXZ_0)$

(B) $(p,1101,XZ_0)$

(C) (p,ε,XZ_0)

(D)$(p,101,XXXZ_0)$

PDA to Language

Q68. Let M be the PDA defined by

$Q = \{q0, q1, q2\}$ $\Sigma = \{a, b\}$ $\Gamma = \{A\}$ $F = \{q1, q2\}$

$\delta(q0, a, \lambda) = \{[q0, A]\}$

$\delta(q0, \lambda, \lambda) = \{[q1, \lambda]\}$

$\delta(q0, b, A) = \{[q2, \lambda]\}$

$\delta(q1, \lambda, A) = \{[q1, \lambda]\}$

$\delta(q2, b, A) = \{[q2, \lambda]\}$

$\delta(q2, \lambda, A) = \{[q2, \lambda]\}$

The language accepted by M is?

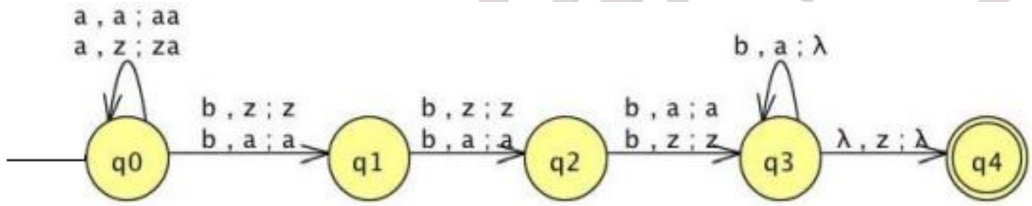
(A) The PDA M accepts the language $\{a^i b^j \mid 0 \leq i, j\}$

(B) The PDA M accepts the language $\{a^i b^j \mid 0 \leq i \leq j\}$

(C) The PDA M accepts the language $\{a^i b^j \mid 0 \leq j \leq i\}$

(D) The PDA M accepts the language $\{a^i b^j \mid i = j\}$

Q69. The language accepted by following PDA is



(A) $L1 = \{a^n b^{3n} \mid n \geq 0\}$

(B) $L2 = \{a^n b^n \mid n \geq 0\}$

(C) $L3 = \{a^n b^{n+3} \mid n \geq 0\}$

(D) $L4 = \{a^n b^m \mid n \geq 0, m > n + 3\}$

Q70. Let M be the PDA defined by

$Q = \{q0, q1, q2\}\Sigma = \{a, b\}\Gamma = \{A\}F = \{q1, q2\}$

$\delta(q0, a, \lambda) = \{[q0,A]\}$

$\delta(q0, \lambda, \lambda) = \{[q1, \lambda]\}$

$\delta(q0, b,A) = \{[q2, \lambda]\}$

$\delta(q1, \lambda,A) = \{[q1, \lambda]\}$

$\delta(q2, b,A) = \{[q2, \lambda]\}$

$\delta(q2, \lambda,A) = \{[q2, \lambda]\}$

The language accepted by M is:

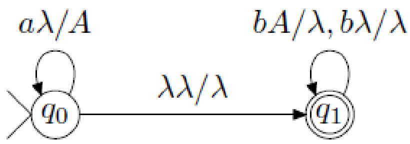
(A)$\{a^i b^j \mid 0 \leq j \leq i\}$

(B)$\{a^i b^j \mid 0 \leq i \leq j\}$

(C)$\{a^n b^n \mid n \geq 0\}$

(D)$\{(ab)^n \mid n \geq 0\}$

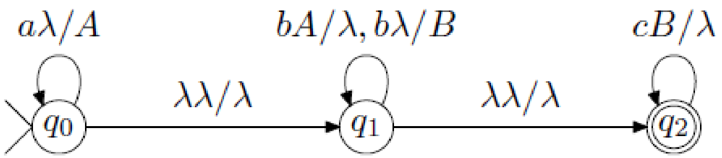
Q71. The language accepted by following PDA is:



(A)$\{a^ib^j \mid 0 \le j \le i\}$ (B)$\{a^ib^j \mid 0 \le i \le j\}$

(C)$\{a^nb^n \mid n \ge 0\}$ (D)$\{(ab)^n \mid n \ge 0\}$

Q72. The language accepted by following PDA



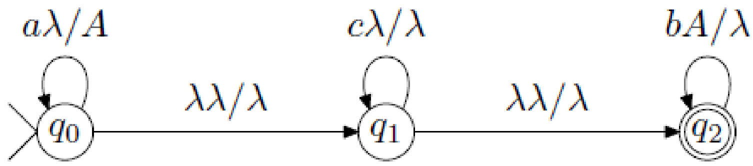
(A)$\{a^ib^jc^k \mid i + k = j\}$

(B) $\{a^ib^jc^k \mid i<j=k\}$

(C) $\{a^ib^jc^i \mid i=j\}$

(D) $\{a^ib^jc^k \mid i<j \text{ and } k>0\}$

Q73. The language accepted by following PDA is:



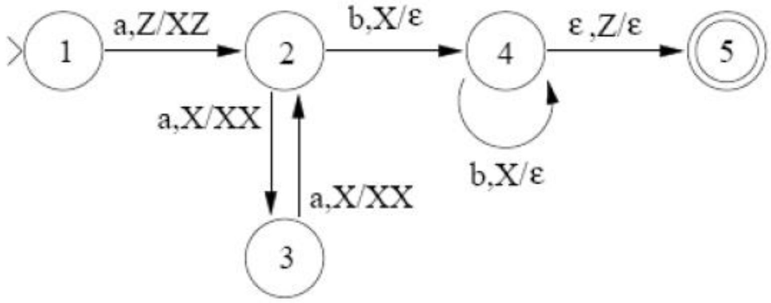
(A)$\{a^ic^jb^i \mid i,j \ge 0\}$

(B) $\{a^ic^jb^k \mid i, j, k \ge 0\}$

(C) $\{a^ic^jb^i \mid i, j > 0\}$

(D) $\{a^ib^i \mid i \ge 0\}$

Q74. The language accepted by following PDA is



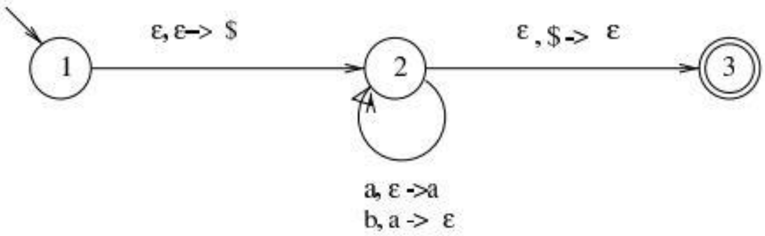
(A)L(G)={$a^{2n}b^{2n}$, n≥ 1}

(B)L(G)={$a^{2n+1}b^{2n+1}$, n≥ 1}

(C)L(G)={$a^{2n}b^{2n}$, n≥ 0}

(D)L(G)={$a^{2n+1}b^{2n+1}$, n≥ 0}

Q75. Consider the following PDA



Which of the following grammar is equivalent to given PDA?

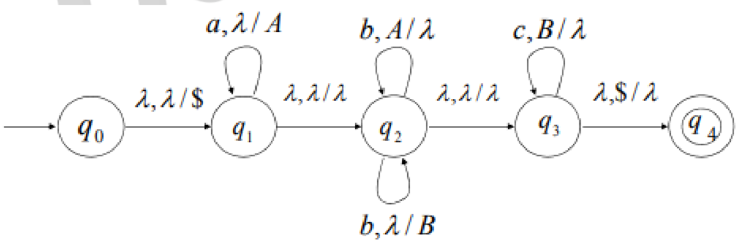
(A) $S \rightarrow SS \mid aSb \mid ab$

(B) $S \rightarrow SS \mid ab \mid \lambda$

(C) $S \rightarrow SS \mid aSb \mid \lambda$

(D) $S \rightarrow aSb \mid \lambda$

Q76. The language accepted by following automata is

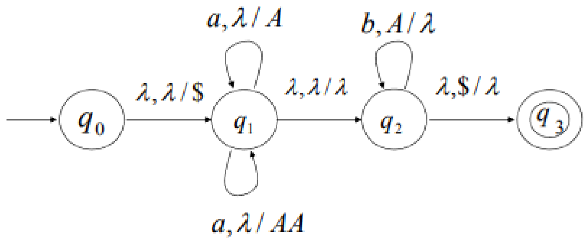
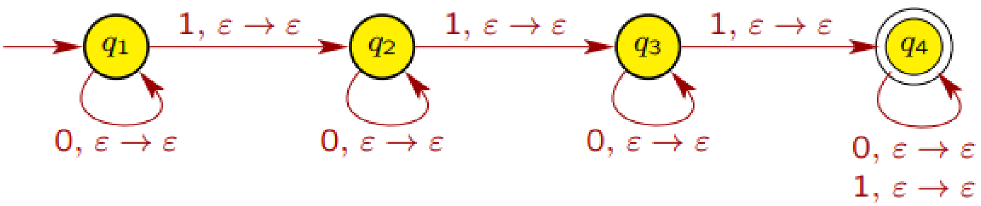
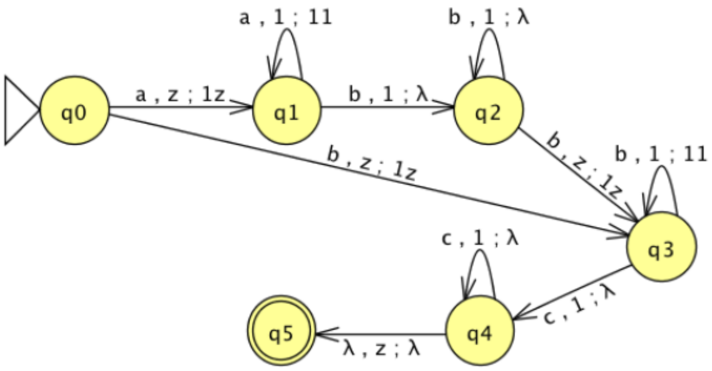


(A) L = {$a^ib^jc^k$ | i= j or j = k}

(B) L = {$a^ib^jc^k$ | i = j and j = k}

(C) L = {$a^ib^jc^k$ | i= j + k}

(D) L = {$a^ib^jc^k$ | j = i + k}

Q77.	The language accepted by following automata is  (A) L = $\{a^ib^j \mid i= j\}$ (B) L = $\{a^ib^j \mid i = 2*j\}$ (C) L = $\{a^ib^j \mid i= j \text{ and } i =2*j\}$ (D) L = $\{a^ib^j \mid i \leq j \leq 2i\}$
Q78.	The language accepted by following automata is  (A) set of all strings over {0, 1} which contain at most three 1's (B) set of all strings over {0, 1} which contain exactly three 1's (C) set of all strings over {0, 1} which contain at least three 1's (D) set of all strings over {0, 1}
Q79.	Consider the following PDA  The language accepted by following PDA is? (A) L = $\{a^nb^nc^m : n>=0, m>=0\}$ (B)L = $\{a^nb^mc^m : n>=0, m>=0\}$ (C) L = $\{a^nb^{m+n}c^m : n>=0, m>=0\}$ (D)L = $\{a^nb^nc^m : n>=0, m>=0\}$

Q80. The language is accepted by the following PDA is

$M = (q0, q1, \ldots, q5\}, \{a, b\}, \{0,1,a,z\}, \delta, z, q0, \{q5\})$,

$\delta(q0,b,z)=\{(q1,1z)\}$,

$\delta(q1,b,1)=\{(q1,11)\}$,

$\delta(q2,a,1)=\{(q3,\lambda)\}$,

$\delta(q3,a,1)=\{(q4,\lambda)\}$

$\delta(q4,a,z)=\{(q4,z),(q5,z)\}$

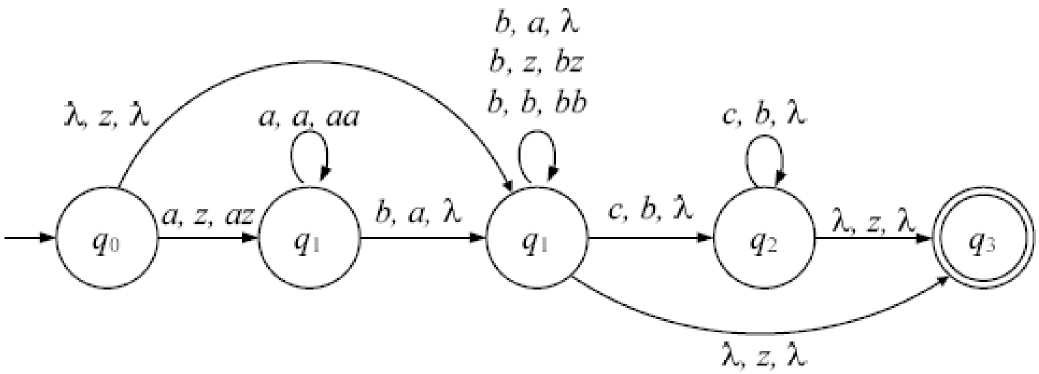
(A) $\{b^i a^{j+3} \mid i \geq 1, j \geq 0\}$

(B) $\{b^i a^{j+3} \mid i \geq 1, j \geq 1\}$

(C) $\{\lambda\}$

(D) $\emptyset$

Q81. The language accepted by following PDA is



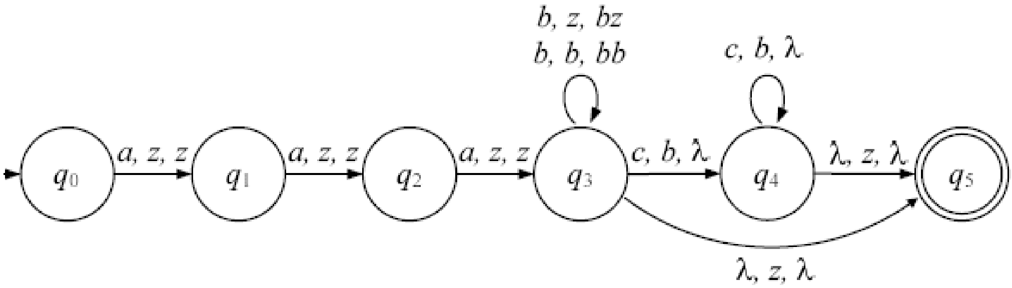
(A) $L = \{a^n b^m c^{n+m} \ n \geq 0, m \geq 0\}$.

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

(C) $L = \{a^n b^m c^m \ n \geq 0, m \geq 0$

(D) $L = \{a^n b^m c^n \ n \geq 0, m \geq 1\}$

Q82. The language accepted by following PDA is



(A) $L = \{a^n b^m c^m \ n \geq 0, m \geq 0\}$

(B) $L = \{a^3 b^m c^m \ m \geq 0\}$

(C) $L = \{a^{3n} b^m c^m \ n \geq 0, m \geq 0\}$

(D) None

For next two Question: Push down automata for

$P = \{Q = \{q_0, q_0\}, \Sigma = \{[,]\}, \Gamma = \{A, B\}, q_0, F = \{q_1\}, \delta\}$

$\delta(q_0, [, \varepsilon) = \{(q_0, A)\}$

$\delta(q_0,], \varepsilon) = \{(q_0, B)\}$

$\delta(q_0, \varepsilon, \varepsilon) = \{(q_1, \varepsilon)\}$

$\delta(q_1, [, A) = \{(q_1, \varepsilon)\}$

$\delta(q_1,], B) = \{(q_1, \varepsilon)\}$

$\delta(q, a, x) = \emptyset$ otherwise

Q83. Suppose the current instantaneous description of P is $< q_1, AAAAA>$ and the unread portion of the input is [ ]] [. The instantaneous description after one step is

(A) The machine crashes

(B) $< q_1, AAAAAA>$

(C) $< q_1, AAAA>$

(D) $< q_1, AAA>$

Q84. The language recognized by PDA is

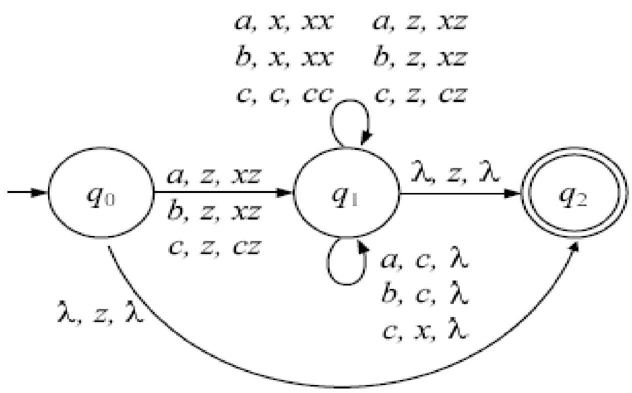
(A) $\{[^n]^n \mid n \geq 0\}$

(B) $\{[^i]^j : i \geq j \geq 0\}$

(C) $\{wu \mid w, u \in \{[,]\}^*$ and u is prefix of $w^R\}$

(D) None of these

Q85. The language accepted by following PDA is



(A) $L = \{ n_a(w) + n_b(w) = n_c(w) \}$

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

(C) $L = \{ n_a(w) + n_c(w) = n_b(w) \}$

(D) None

Closure properties of CFL, DCFL, (DPDA, NPDA)

Q86. Let L1 be a context-free language and let $L2 \subseteq L1$.

(A) L2 is definitely context-free.

(B) L2 may be a context free language.

(C) L1 and L2 is definitely not context-free.

(D) L2 never be a regular

Q87.	Let L1 and L2 be two DCFL's. Then L1 $\cap$ L2 is guaranteed to be: (A) Context-Free (B)Deterministic Context-Free (C) Regular (D)can't say
Q88.	Let L1 and L2 be two DCFL's. Then L1 U L2 is guaranteed to be: (A) Context-Free (B)Deterministic Context-Free (C) Regular (D)can't say
Q89.	Let L be a DCFL. Then Σ*- L is guaranteed to be (A) Non-Deterministic Context-Free (B)Deterministic Context-Free (C)Regular (D)can't say
Q90.	Which of following is/are correct? S1: If $L1$ and $L1\ U\ L2$ are context free, then $L2$ must be context free. S2: If $L1$ is context free and $L2$ is regular, then $L1 - L2$ is context free. (A)Only S1 (B)Only S2 (C)Both S1&S2 (D)None of them
Q91.	Which of following is/are correct? S1: If $L1$ is regular and $L2$ is context free, then $L1 - L2$ is context free. S2: If $L1$ is regular and $L2$ is context-free, then $L1 \cap L2$ must be a CFL. (A)Only S1 (B)Only S2 (C)Both S1&S2 (D)None of them
Q92.	Which of following is/are correct? S1: Every infinite set of strings over a single letter alphabet $\sum=\{a\}$ contains an infinite Context free subset. S2: Every infinite context-free set contains an infinite regular subset. (A)Only S1 (B) Only S2 (C) Both S1&S2 (D) Neither S1 nor S2

Q93. Which of following is/are correct?

S1: If both L and $\bar{L}$ are context-free, then L must be regular.

S2: There is a language L which is context-free but not regular such that $\bar{L}$ is also Context-free.

(A) Only S1 (B) Only S2

(C) Both S1&S2 (D) Neither S1 nor S2

Q94. Consider the CFL L1 = $\{a^n b^m c^m \mid m,n > 0\}$. Choose a context-free language L2 that ensures that L1 $\cap$ L2 is not context free?

(A) L2 = $\{a^n b^m c^n \mid n,m > 0\}$ (B) L2 = $\{a\}^* \cup \{b\}^* \cup \{c\}$

(C) L2 = $\{a,b\}^*$L1 (D) L2 = $\{a^n b^n c^n \mid n > 0\}$

Q95. Which of following is/are correct statement?

(i) The language $\{0^n 1^n \cup 0^m 1^m \mid 0 \leq n \leq 1000, m>0\}$ is regular.

(ii) If a language is context-free, then it must be regular

(iii) If a language is regular, then it may be infinite.

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

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

Q96. The language L = $\{0^i 1^i \cup 1^i 0^i \mid i \geq 0\}$ is

(A) Regular (B) Deterministic CFL

(C) Non-Deterministic CFL (D) Not a CFL

Q97. Let L1 = $\{b^n a^n \mid n \geq 0\}$ and L2 = $\{(ba)^n \mid n \geq 1\}$. What is $|L1 \cap L2|$?

(A) 0 (B) 1 (C) 2 (D) infinite

Q98. Let L1 = $\{b^n \mid n \geq 1\}$. What is L1.L1?

(A) $\{b^n b^n \mid n \geq 1\}$ (B)$\{b^n \mid n > 1\}$

(C) $\{b^n b^m \mid m, n > 1\}$ (D) $(bb)^+$

Q99. Let L1 = $\{a^n b^n : n >= 0\}$. Then L1.L1 is:

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

(C)$\{a^{2n} b^{2n} : n >= 0\}$ (D)$\{a^n b^n a^n b^n : n >= 0\}$

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Q100. Let L1 = $\{a^n b^n : n >= 0\}$, and L2 = $\{b^n a^n : n >=0\}$. Then L1.L2 is:

(A) $\{a^n b^{2m} a^n : n, m>=0\}$

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

(C) $\{a^m b^{2m} a^m : m>=0\}$

(D) $\{a^n b^{n+m} a^m : m, n >=0\}$

Q101. Let L1 = $\{w \mid w \in \Sigma^*$ and $w = w^r, \Sigma = \{a, b\}\}$ and L2= a*b*a* . Then L1 $\cap$ L2=

(A) $\{a^n b^n a^m \mid n, m \geq 0\}$

(B) $\{a^n b^m a^n \mid n, m \geq 0\}$

(C) $\{a^m b^n a^n \mid n, m \geq 0\}$

(D) $\{a^n b^n a^n \mid n, m \geq 0\}$

Q102. Let L1 = $\{(ab)^n a \mid n \geq 0\}$ and L2 = $\{a(ba)^n \mid n \geq 0\}$. What is $|L1 \cap \overline{L2}|$?

(A) 0

(B) 1

(C) 2

(D) infinite

Q103. Let L be a language. Then symmetric (L) = $\{w: w \in L$ and $w^r \in L\}$.

Which of the following two statements is/are true?

S1: If L is regular, symmetric (L) is also regular.

S2: If L is context-free, symmetric (L) is also context-free.

(A) Only S1

(B) Only S2

(C) both S1 and S2

(D) Neither S1 nor S2

Q104. Let L1 = $\{a^n b^n c^p \mid n, p \geq 0\}$ and L2 = $\{a^m b^n c^n \mid m, n \geq 0\}$ then $\overline{(L1\ U\ L2)}$ will be

(A) $\varnothing$

(B) a*b*c*

(C) $a^n b^n c^n$

(D) $\{\Sigma^* - a^*b^*c^*\} \cup \{a^i b^j c^k \mid i \neq j \text{ and } j \neq k\}$

Q105. Let L1 = $\{a^n b^n c^p \mid n, p \geq 0\}$ and L2 = $\{a^m b^n c^n \mid m, n \geq 0\}$ then L1 $\cap$ L2 is

(A) $\varnothing$

(B) a*b*c*

(C) $a^n b^n c^n$

(D) $\{\Sigma^* - a^*b^*c^*\}$

Q106. Let L1 = $\{w1w2 : |w1| = |w2|\ w1 \in (a, b)^*$ and $w2 \in (c, d)^*\}$ and L2 = $\{a, c\}^*$.

Then L1 $\cap$ L2 will be:

(A) $\varnothing$

(B) (a + c)*

(C) a*c*

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

Q107.	Suppose L1 is a context-free language and L2 is a non-context-free language, such that $L1 \cap L2 = \varnothing$ Then L1 U L2 is (A) Necessarily context-free (B) Necessarily non-context-free (C) May or may not be context-free (D)None of above
Q108.	Select the correct statement (i) If L1 is context-free and L2 is regular, then L1 − L2 is context free. (ii) If L1 is regular and L2 is context free, then L1 − L2 is context free. (iii) L1 = L2 if and only if L1* = L2* (A) Only i (B) ii & iii (C) i & iii (D) None
Q109.	Select the correct statement (Assume that L1, L2, L3 are TM acceptable) (I) For any languages L1, L2 and L3, $L1(L2 \cap L3) \subseteq (L1L2) \cap (L1L3)$ (II) For any languages L1, L2 and L3, $(L1L2) \cap (L1L3) \subseteq L1(L2 \cap L3)$. (A)only I (B)only II (C)Both I&II (D)None of them
Q110.	Let A and B be two languages over {0,1} such that A is a subset of B. Consider the following statements: (1) If B is finite, then A is finite. (2) If B is context-free, A is context-free. (3) If the complement of B is context-free, then the complement of A is context-free. 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
Q111.	How many of the following is/are correct statement? (i) For any CFG G there's a CFG G0 such that G0 is not ambiguous and L (G) = L (G0). (ii) The CFLs are closed under symmetric difference. (iii) If L is context free, the even-length strings of L are context free. (iv) If the prime-length strings of L are context free and the composite-length strings of L are context free then L itself is context free.

Q112.	Which one of the following statements is FALSE? (A) There exist context-free languages such that all the context-free grammars generating them are ambiguous. (B) An unambiguous context free grammar always has a unique parse tree for each string of the language generated by it (C) Both deterministic and non-deterministic pushdown automata always accept the same set of languages (D) A finite set of string from one alphabet is always a context-free language.
Q113.	Consider the set of grammars in which every rule that has two symbols on the RHS Must have exactly one variable and one terminal. These grammars can generates (A) It generates all regular languages but no others. (B) It generates some languages that are not context-free. (C) It generates all regular languages and some others, but not all of the CFLs. (D) It can generates all CFLs
Q114.	Which of the following statement is/are true? S1: Any regular language can be generated by a context-free grammar S2: Some non-regular languages cannot be generated by any CFG S3: The intersection of a CFL and regular set is a CFL S4: All non-regular languages can be generated by CFGs (A) S1, S2 and S4 only (B) S1, S3 and S4 only (C) S2, S3 and S4 only (D) S1, S2 and S3 only
Q115.	Which of the following statements is true? (A) Both the regular languages and the context-free languages are closed under the reverse operation. (B) Neither the regular languages nor the context-free languages is closed under the reverse operation. (C) The regular languages are closed under the reverse operation but the context-free Languages are not. (D)The context-free languages are closed under the reverse operation but the regular languages are not.

Q116.	Which of the following is true? (A) If L is context free, then L* must be regular. (B) If L is an infinite context-free language, then in any context-free grammar generating L there exists at least one recursive rule. (C) Both a and b are true. (D) None of these.
Q117.	Which of the following statement is correct? (A) If there is no pushdown automaton accepting L, then L cannot be regular. (B) If L is accepted by a deterministic PDA, then L' (the complement of L) must be Regular. (C) If, for a given L in {a, b}*, there exist x, y, z, such that $y \neq \varepsilon$ and $xy^nz \in L$ for all $n \geq 0$, then L must be regular. (D) If L is regular and $L = L1 \cap L2$ for some L1 and L2, then at least one of L1 and L2 must be regular.
Q118.	Which of the following is false? (A) If L is an infinite context-free language, then there is some context-free grammar generating L that has no rule of the form $A \rightarrow B$, where A and B are nonterminal symbols. (B) Every context-free grammar can be converted into an equivalent regular grammar. (C) Given a context-free grammar generating L, every string in L has a right-most derivation. (D) All are false.
Q119.	Select the correct statements (i) Language {0, 11} is context-free. (ii) There is a deterministic Push-down automaton for the language of even length Palindromes. (iii) There are some ambiguous context-free grammars that can be disambiguated (rewritten to become unambiguous). (iv) Every context-free grammar can be disambiguated. (A) i only (B) i and iii only (C)ii and iii only (D)All are true

Q120.	For every context-free grammar, there is a (i) Language equivalent left-linear context-free grammar. (ii) Language equivalent deterministic finite automaton. (iii) Language equivalent push down automaton. (iv) Language equivalent Turing machine. (A) i and iii only (B) i, iii and iv only (C)iii and iv only (D) all except i
Q121.	Which of the following statement is /are true for an arbitrary context free language? (i) Every context-free language A is regular. (ii) Every context-free language is recursive enumerable. (iii) Every context-free language is recursively enumerable but not recursive. (iv) Every context-free language is recursive. (A) ii and iv only (B) i, ii and iv only (C) ii and iii only (D)None
Grammar to PDA,	
Q122.	Consider the following grammar G: $S \rightarrow aSb \mid aSbb \mid ab$ Suppose you want to construct PDA M (Q, Σ, Γ, δ, z, F) for language generated by given grammar G. M is defined by Q = {q0, q1, qf}, Σ = {a, b} $\Gamma = \{S, A, B, z\}$, F = {qf} and δ is not known. Which of the following is correct transition rule (δ) for M? (a) δ (q0, λ, S) = {(q1, Sz)}, δ (q1, a, S) = {(q1, SB), (q1, SBB), (q1, B)}, δ (q1, b, B)= {(q1, λ)}, δ (q1, λ, z) = {(q1, z)} (b) δ (q0, λ, S) = {(q1, Sz)}, δ (q1, a, S) = {(q1, SB), (q1, SBB), (q1, B)}, δ (q1, b, B) = {(q1, λ)}, δ (q1, λ, z) = {(qf, z)} (c) δ (q0, λ, S) = {(q1, Sz)}, δ (q1, a, S) = {(q1, SB), (q1, SBB)}, δ (q1, b, B) = {(q1, λ)}, δ (q1, λ, z) = {(qf, z)} (d) None of the above

Q123.	Consider the following grammar G: (Assume S is a starting symbol of G)

$$\begin{array}{|l|}\hline s \rightarrow aA \mid bBC \mid cC \\ A \rightarrow a \\ B \rightarrow bB \mid b \\ C \rightarrow cC \mid d \\ \hline\end{array}$$

Suppose you want to construct PDA M (Q, Σ, Γ, δ, z, F) for language generated by given grammar G. M is defined by Q = {q0, q1, qf}, Σ = {a, b} Γ = $\{S, A, B, C, a, b, c, d, z\}$, F = {qf} and δ is not known.Which of the following is correct transition rule (δ) for M?

(A) $\delta\ (q_0, \lambda, z) = \{(\mathrm{q_1, Sz})\}$, $\delta\ (q_1, \lambda, S) = \{(q_1, \mathrm{aA}), (q_1, \mathrm{bBC}), (q_1, \mathrm{cC})\}$, $\delta\ (q_1, \lambda, A) = \{(q_1, a)\}$, $\delta\ (q_1, \lambda, B) = \{(q_1, bB), (q_1, b)\}$, $\delta\ (q_1, \lambda, C) = \{(q_1, cC), (q_1, c)\}$, $\delta\ (q_1, a, a) = \{(q_1, \lambda), \}$, $\delta\ (q_1, c, c) = \{(q_1, \lambda), \}$ $\delta\ (q_1, d, d) = \{(q_1, \lambda), \}$, $\delta\ (q_1, b, b) = \{(q_1, \lambda), \}$
(B) $\delta\ (q_0, \lambda, z) = \{(\mathrm{q_1, Sz})\}$, $\delta\ (q_1, \lambda, S) = \{(q_1, \mathrm{aA}), (q_1, \mathrm{bBC}), (q_1, \mathrm{cC})\}$, $\delta\ (q_1, \lambda, A) = \{(q_1, a)\}$, $\delta\ (q_1, \lambda, B) = \{(q_1, bB), (q_1, b)\}$, $\delta\ (q_1, \lambda, C) = \{(q_1, cC), (q_1, d)\}$, $\delta\ (q_1, \lambda, z) = \{(q_f, z)\}$
(C) $\delta\ (q_0, \lambda, z) = \{(\mathrm{q_1, Sz})\}$, $\delta\ (q_1, \lambda, S) = \{(q_1, \mathrm{aA}), (q_1, \mathrm{bBC}), (q_1, \mathrm{cC})\}$, $\delta\ (q_1, \lambda, A) = \{(q_1, a)\}$, $\delta\ (q_1, \lambda, B) = \{(q_1, bB), (q_1, b)\}$, $\delta\ (q_1, \lambda, C) = \{(q_1, cC), (q_1, d)\}$, $\delta\ (q_1, \lambda, z) = \{(q_f, z)\}$, $\delta\ (q_1, a, a) = \{(q_1, \lambda), \}$, $\delta\ (q_1, b, b) = \{(q_1, \lambda), \}$, $\delta\ (q_1, c, c) = \{(q_1, \lambda), \}$ $\delta\ (q_1, d, d) = \{(q_1, \lambda), \}$
(D) none of the above

PDA of grammar to string

Q124. Consider the following PDA M (Q, Σ, Γ, δ, z, F) for a grammar G:

M is defined by Q = {q0, q1, qf}, Σ = {a, b}, Γ = $\{S, A, B, z\}$, F = {qf} and the transition rules (δ) are:

$\delta(q_0,\ \lambda,\ z) = (q_1, Sz)$, $\delta(q_1,\ \lambda,\ S) = \{(q_1, aA), (q_1,\ bB)\}$,

$\delta(q_1,\ \lambda,\ A) = \{(q_1, aA), (q_1,\ a)\}$, $\delta(q_1,\ \lambda,\ B) = \{(q_1, bB), (q_1,\ b)\}$,

$\delta(q_1,\ a,\ a) = (q_1, \lambda)$, $\delta(q_1,\ b,\ b) = (q_1, \lambda)$,

$\delta(q_1, \lambda, z) = (q_f, z)$

Which of the following string is not accepted by M?

(A) aaaaa (B) b

(C) bbaa (D) bbb

Data for next three questions: Consider the following PDA M (Q, Σ, Γ, δ, z, F) for a grammar G: M is defined by Q = {q0, q1, qf}, Σ = {a, b}, Γ = $\{S, A, B, C, z\}$, F = {qf} and the transition rules (δ) are:

$\delta(q_0,\ \lambda,\ z) = \{(q_1, Sz)\}$, $\delta(q_1,\ a,\ S) = \{(q_1, A)\}$,

$\delta(q_1,\ a,\ A) = \{(q_1, ABC), (q_1, \lambda)\}$, $\delta(q_1,\ b,\ B) = \{(q_1, \lambda)\}$,

$\delta(q_1,\ b,\ A) = \{(q_1, B)\}$, $\delta(q_1,\ c,\ C) = \{(q_1, \lambda)\}$, $\delta(q_1, \lambda, z) = (q_f, z)$

Q125. How many of the following string is/are accepted by M? ________

(i) aaabc (ii) aabbc (iii) aabc (iv) aac (v) aa

Q126. **[MSQ]**

Which of the following grammar is/are equivalent to G?

(a) S → aA, A → aAbc | bb | a

(b) S → aA, A → aABc | bB | a, B → b

(c) S → aA, A → aABC | bB | a, B → b, C → c

(d) S → aS | aSbc | bb | a

Q127. Which of the following language is equivalent to language generated by G?

(A) L = $\{aa^*(a + bb)(bc)^*\}$

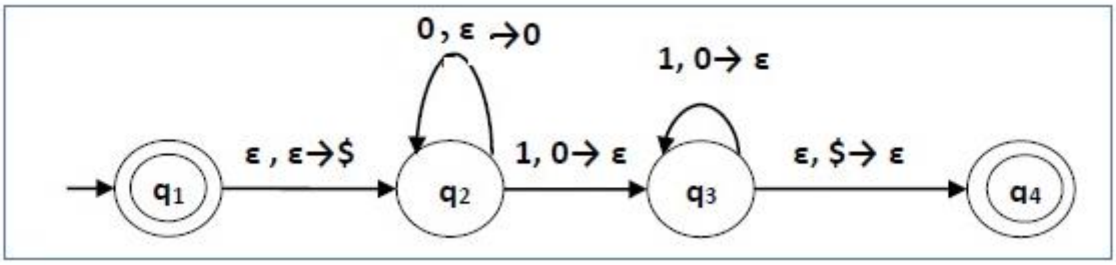
(B) L = $\{aa^k w(bc)^k \mid k \geq 0\ and\ w = \{a, bb\}\}$

(C) L = $\{a^k abb(bc)^k \mid k \geq 0\}$

(D) None of these

PDA to Grammar

Q128. Consider the following PDA M (Q, Σ, Γ, δ, z



Which of the following grammar is/are equivalent to given PDA?

(A) $S \to 0S1 \mid \lambda$ (B) $S \to 0S1 \mid 01$

(C) $S \to 0S1 \mid 0011$ (D) None of the above

(CNF and GNF)

Q129. Which of the following grammar doesn't have useless production?

(A) $S \to aAa \mid BC$, $A \to aa \mid Aa$, $B \to cC \mid c$

(B) $S \to aAb \mid Bc \mid aA$, $A \to BC$, $B \to bB \mid AC$, $C \to cC \mid c$

(C) $S \to ABb \mid aA$, $A \to BC \mid c$, $B \to bB \mid AC$, $C \to cC \mid CC$

(D) $S \to aSb \mid \lambda \mid aA$, $A \to BC \mid \lambda$, $B \to bB \mid AC \mid b$, $C \to cC \mid \lambda$

Q130. Consider following grammar G with productions

$S \to aS \mid BA \mid CD$, $A \to a \mid Da$, $B \to aa \mid aC$, $C \to aCb \mid cC \mid CC$

After removing all useless production from G, which of the following grammar is equivalent to G?

(A) $S \to aS \mid a \mid aa$ (B) $S \to aS \mid aaa$

(C) $S \to aS \mid aA$, $A \to aa$ (D) b& c

Q131. Consider following grammar G with productions

$S \to Aa \mid C$, $A \to bA \mid B$, $B \to aB \mid C \mid b$, $C \to cC \mid c$

After removing all unit-production from G, which of the following grammar is Equivalent to G?

(A) $S \to Aa \mid c$, $A \to bA \mid aB \mid cC \mid b \mid c$, $B \to aB \mid cC \mid b \mid c$, $C \to cC \mid c$

(B) $S \to Aa \mid cC \mid c$, $A \to bA \mid aB \mid cC \mid b \mid c$, $B \to aB \mid cC \mid b \mid c$

(C) $S \to Aa \mid cC \mid c$, $A \to bA \mid aB \mid b \mid c$, $B \to aB \mid cC \mid b \mid c$, $C \to cC \mid c$

(D) $S \to Aa \mid cC \mid c$, $A \to bA \mid aB \mid cC \mid b \mid c$, $B \to aB \mid cC \mid b \mid c$, $C \to cC \mid c$

Q132.	Consider following grammar G with productions $S \rightarrow AaB \mid aaB, A \rightarrow \lambda, B \rightarrow bbA \mid \lambda$ After removing all λ-production from G, which of the following grammar is equivalent to G? (A)$S \rightarrow aB \mid aaB, B \rightarrow bb$ (B)$S \rightarrow a \mid aaB \mid aa, B \rightarrow bb$ (C)$S \rightarrow aB \mid aaB \mid bb, B \rightarrow bb \mid \lambda$ (D) $S \rightarrow aB \mid aaB \mid a \mid aa, B \rightarrow bb$
Q133.	Consider following grammar G with productions $S \rightarrow aA \mid aBB \mid AB, A \rightarrow aaA \mid \lambda, B \rightarrow bB \mid bbC, C \rightarrow B \mid \lambda$ After removing all unit-production, all useless production and all λ-production from G, which of the following grammar is equivalent to G? (A) $S \rightarrow aA \mid aBB \mid AB \mid a \mid bb, A \rightarrow aaA \mid aa, B \rightarrow bB \mid bbC \mid bb, C \rightarrow bB \mid bbC \mid bb$ (B) $S \rightarrow aA \mid aBB \mid AB \mid bB \mid bbC \mid a \mid bb, A \rightarrow aaA \mid aa, B \rightarrow bB \mid bbB \mid bb,$ (C) $S \rightarrow aA \mid aBB \mid AB \mid bB \mid bbC \mid a \mid bb, A \rightarrow aaA \mid aa, B \rightarrow bB \mid bb, C \rightarrow bB \mid bbC \mid bb$ (D) $S \rightarrow aA \mid aBB \mid AB \mid bB \mid bbC \mid a \mid bb \mid aB, A \rightarrow aaA \mid aa, B \rightarrow bB \mid bbC \mid bb,$ $C \rightarrow bB \mid bbC \mid b$
Q134.	Convert the following grammar into Chomsky normal form: $S \rightarrow ABa \mid bC, A \rightarrow a \mid \lambda, B \rightarrow b \mid C, C \rightarrow c \mid \lambda$ (A)$S \rightarrow ABa \mid bC \mid Ba \mid Aa \mid a \mid b, A \rightarrow a, B \rightarrow b \mid c, C \rightarrow c$ (B) $S \rightarrow DA \mid BC \mid BA \mid AA \mid a \mid b, A \rightarrow a, B \rightarrow b, C \rightarrow c, D \rightarrow BA$ (C)$S \rightarrow AD \mid BC \mid D \mid AA \mid a \mid b, A \rightarrow a, B \rightarrow b, C \rightarrow c, D \rightarrow AB$ (D) $S \rightarrow DA \mid BC \mid BA \mid AA \mid a \mid b, A \rightarrow a, B \rightarrow b \mid c, C \rightarrow c, D \rightarrow AB$
Q135.	Convert the following grammar G into Greibach normal form: $S \rightarrow abc \mid aSb \mid aaSc \mid bSc$ (A)$S \rightarrow aABC \mid aSB \mid AaSc \mid bSc, A \rightarrow a, B \rightarrow b, C \rightarrow c,$ (B)$S \rightarrow aBC \mid aSB \mid aASc \mid bSC, A \rightarrow a, B \rightarrow b, C \rightarrow c$ (C) $S \rightarrow aBC \mid aSB \mid aASC \mid bSC, A \rightarrow a, B \rightarrow b, C \rightarrow c$ (D)$S \rightarrow aABC \mid aSb \mid aASC \mid bSC, A \rightarrow a, B \rightarrow b, C \rightarrow c$

Q136.	Let G be a grammar in Chomsky Normal Form. Let w1,w2 $\in$ L(G) such that |w1| = |w2|. Which of the following is true? (A) Any derivation of w1 has exactly the same number of steps as any derivation of w2. (B) Some derivations of w1 may be shorter than some derivations of w2. (C) Different derivations of w1 have different lengths. (D) Some derivations of w1 maybe longer than some derivations of w2.
Q137.	**[MSQ]** Which of the following rule(s) doesn't belong to CNF of any CFG? (A) $S \rightarrow BC$ (B) $B \rightarrow Bc$ (C) $B \rightarrow a$ (D) $S \rightarrow B$

For the next three questions, consider the following grammar:

G1 = ({S, T}, {a, b}, {$S \rightarrow aT$, $T \rightarrow aT$, $T \rightarrow b$}, S)

G2 = ({S, S_1, S_2}, {a, b}, {$S \rightarrow aS_1$, $S_1 \rightarrow aS_1$, $S_1 \rightarrow bS_2$, $S_2 \rightarrow a$}, S)

G3 = ({S, S_1, A, B}, {a, b}, {$S \rightarrow AS_1$, $S_1 \rightarrow AS_1$, $S_1 \rightarrow bB$, $A \rightarrow a$, $B \rightarrow b$}, S)

G4 = ({S, S_1, S_2, A, B}, {a, b}, {$S \rightarrow AS_1 \mid \lambda$, $S_1 \rightarrow AS_1 \mid BS_2$, $A \rightarrow a$, $B \rightarrow b$, $S_2 \rightarrow a$}, S)

Q138.	Which of the above grammars are regular grammars? (A) G1 and G2 (B) G2 and G3 (C) G3 and G4 (D) G4 and G1
Q139.	Which of the above grammars is in Greibach Normal Form? (A) G1 (B) G1 andG2 (C) G3 (D) G4
Q140.	Which of the above grammars is in Chomsky Normal Form? (A)G1 (B) G2 (C) G3 (D) G4

Q141.	Which of the following sets of productions is not in Chomsky normal form? G1 : S → AB A → AB | a B → Ba | b G2 : S → AB A → AB | a B → BA | b G3 : S →A | B A→ AB | a B → BA | b (A) G2 (B) G1, G2, G3 (C)G2 and G3 (D) G1 and G3
Q142.	Consider a grammar G S→abSb | bSaa | aa Which of the following grammar are in GNF and equivalent to G? (A)S→aBSb | bSAA | aA, A→a,B→b (B)S→aBSb | bSAa | aA, A→a, B→b (C)S→aBSB | bSAA | A, A→aa, B→b (D) S→aBSB | bSAA | aA, A→a, B→b

CYK Algorithm

For next four questions: Consider the following grammar G:

S → AB | BC
A → BA | a
B → CC | b
C → AB | a

We are applying CYK algorithm for the string 'baaba' and given grammar G. The incomplete triangular table is shown below:

1	{S, A, C}				
2		{S, A, C}			
3					
4	{S, A}	{B}	{S, C}	{S, A}	
5	{B}	{A, C}		{B}	{A, C}
	b	a	a	b	a
	1	2	3	4	5

For each of following questions select the correct one.

Q143.	The cell [2, 1] contains (A) {B} (B) {A, B} (C) ∅ (D) {S, A}

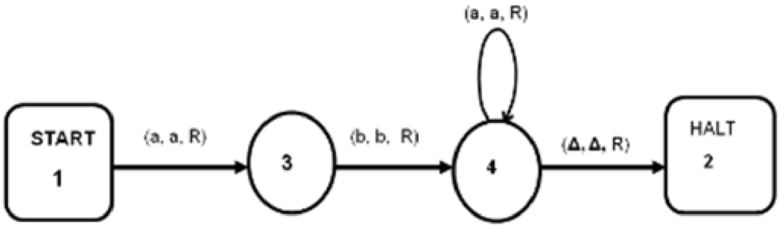
Q144.	The cell [3, 1] contains (A) {B} (B) {A, B} (C) ∅ (D) {S, A}
Q145.	The cell [3, 2] contains (A) {B} (B) {A, B} (C) ∅ (D) {S, A}
Q146.	The cell [5, 3] contains (A) {B} (B) {A, C} (C) ∅ (D) {S, A}
Pumping lemma for CFL	
Q147.	Consider the CFG used in the proof of the pumping lemma: we chose a string long enough so that it is accepted by the CFG and repeats a variable. What if such a string does not exist for this CFG? (A) There is no possibility of this happening: there always is such a string. (B) The CFG's language must be finite. (C) The CFG's language may or may not be infinite. (D) Then there is at most 1 variable that produces a single terminal in the CFG.
Q148.	Let L be a context free language and w = uvxyz is any string in L such that $\|w\| \geq m;$ where m is some constant positive integer then which of the following conditions must be satisfied in order to apply pumping lemma? (i) $\|vxy\| \leq m$ (ii) vy $\neq \varepsilon$ (iii)$\|vxy\| \geq m$ (iv) vy $= \varepsilon$ (A) i and ii only (B) iii and iv only (C) i and iv only (D) ii and iii only

Q149.	Consider the language L = $\{a^ib^ja^ib^j \mid i, j >= 0\}$. Consider the following "proof" that L satisfies the pumping lemma. Let p be the pumping length. Choose Z = a^pba^pb. Consider a division of Z, where u = a^{p-1}, v = a, w = b, x = a and y = $a^{p-1}b$. Clearly uv^iwx^iy is in L for every i. (A) This is an incorrect proof because all divisions of Z have not been considered. (B) This is an incorrect proof because all possible Z have not been considered. (C) This is a correct proof. (D)None of above
Q150.	Consider the language L = $\{a^nb^nc^n \mid n >= 0\}$. Consider the following "proof" that L does not satisfy the pumping lemma. Let p >= 1 be the pumping length. Choose z = $a^pb^pc^p$. Consider the division of z, where u = λ, v = a, w = λ, x = λ, and y = $a^{p-1}b^pc^p$. Clearly uv^0wx^0y is not in L. (A) This is an incorrect proof because all divisions of z have not been considered. (B) This is an incorrect proof because all possible z have not been considered. (C) This is a correct proof. (D)None of above
Q151.	Select the correct statements (I) Since the pumping lemma applies to all context-free languages, all context-free languages contain an infinite number of strings. (II) The stack alphabet of pushdown automata must be the same as the input alphabet. (III) The stack alphabet of pushdown automata must be different from the input alphabet. (IV) If a language L satisfies the conditions stated in the pumping lemma for CFLs, then L is context free. (A) Only I&II (B) Only I & III (C) Only III&IV (D)None of above
Decidability of CFL & CFG	
Q152.	Which of the following is/are decidable properties of context free? (I) For context-free grammar G find if string w $\in$ G (II) For context-free grammar G find if L (G) = $\varnothing$ (III) For context-free grammar G find if L (G) is infinite. (A) Only I (B) Only I&II (C) I, II & III (D) Only II & III

Q153.	Which of the following language is/are Turing decidable? 1. L = {<G1, G2> | G1 & G2 are regular grammar and L(G1) $\subseteq$ L(G2)} 2. L = {<G, R> | G is a CFG & R is a regular expression and L(G) $\subseteq$ L(R)} 3. L = {<G, R> | G is a CFG & R is a regular expression and L(R) $\subseteq$ L(G)} (A) 1 only (B) 1 & 2 only (C) 2 & 3 only (D) 1 & 3 only
Q154.	Which of the following language is/are NOT Turing decidable? 1. L = {<G1, G2> | G1 & G2 are CFG and L(G1) $\cap$ L(G2) is empty} 2. L = {<G1, G2> | G1 & G2 are CFG and L(G1) $\cap$ L(G2) is CFL} 3. L = {<G1, G2> | G1 & G2 are CFG and L(G1) $\cap$ L(G2) is regular} 4. L = {<G1, G2> | G1 & G2 are DCFG and L(G1) $\cap$ L(G2) is empty} (A) 1 & 2 only (B) 1, 2 & 3 only (C) 1, 2 & 4 only (D) All the above
Q155.	Which of the following language is/are not decidable? 1. L = {<G> | G is a CFG and $\lambda \notin$ L(G)} 2. L = {<G, w> | G is a CFG and w $\notin$ L(G)} 3. L = {<G> | G is a CFG and G is unambiguous} 4. L = {<G> | G is a CFG and L(G) $\neq \sum^*$} (A) 1 & 2 only (B) 3 & 4 only (C) 3 only (D) 4 only
Q156.	**[MSQ]** Which of the following languages are undecidable? (A) L = {<G, Σ> | L (G) = Σ^*; where G is a CFG and Σ is finite set of alphabets} (B) L = {<G, R> | L (G) = R; where G is CFG and R is regular language} (C) L = {<G_1, G_2> | L (G_1) = L (G_2); where G_1 and G_2 are two CFG's} (D) L = {<G_1, G_2> | L (G_1) $\subseteq$ L (G_2); where G_1 and G_2 are two CFG's}

TURING MACHINE

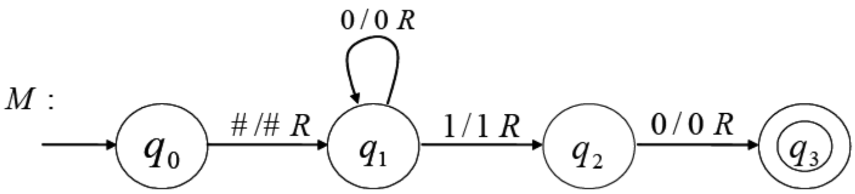
Q1. The language accepted by the following Turing machine is:



(A)a* (B)a*ba*

(C)ba* (D)aba*

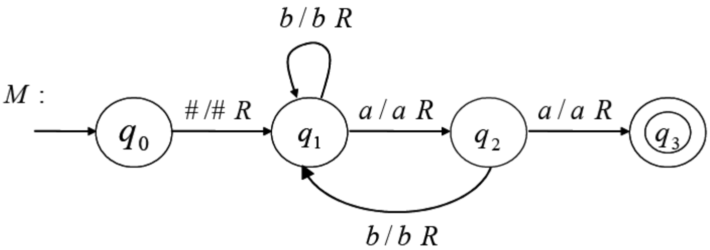
Q2. Given a Turing Machine M, what's *L (M)*?



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

(C) (0+1)* (D) ∅

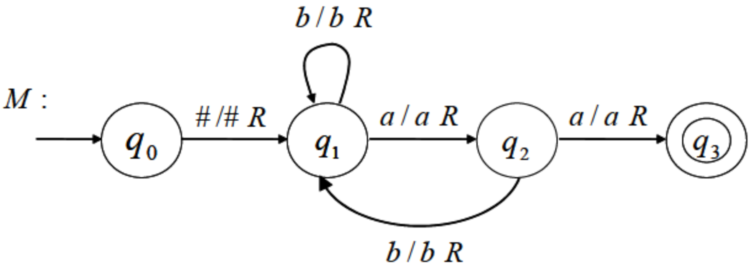
Q3. Given a Turing Machine M, what's *L (M)*?



(A) (b +ab)*aa (B) b*aa(a+b)*

(C) b*(ab)*aa(a+b)* (D) (b+ab)*aa(a+b)*

Q4. Given a Turing Machine M, what's *L (M)*?



(A)L(M) = (a+b)*aa(a+b)* (B)L(M) = (a+b)*aa

(C)L(M) = b*ab*a(a+b)* (D)L(M) = b*a(a+b)*a

Q5.	Consider the following Turing Machine: M =($\{q_0,q_1,q_2,q_{acc},q_{rej}\}$,{a,b},{a,b,B} ,$\delta$,q0,qacc,qrej),where δ (q_0, a) = (q_1, b, R) δ (q_1, b) = (q_2 , a, L) δ (q_2, b)= (q_0, b, R) δ (q_1, B)= (qacc , B,R) As always, we assume for cases not mentioned above δ (q , a)=(q_{rej} , B , R) What can we say about the Turing machine M? (A) M halts on all inputs (B) M never halts on some inputs (C) M does not halt on any input (D) None of these
Q6.	What language does the following Turing Machine (TM) accept? M = (Q = {q0, q1, q2}, Σ = {a, b}, Γ = {a, b, B}, δ, q0, B, F = {q2}); where the transition function δ is given by δ(q0, a) = {(q0, a, R)} δ(q0, b) = {(q1, b, R)} δ(q1, B) = {(q2, B, R)} δ (q, x) = stop everywhere else (A) a*b (B) aa*b (C) ∅ (D) a*b(a+b)*
Q7.	Consider the Turing machine M = (Q, Σ, Γ, δ, q0, qacc, qrej); where • Q = {q0, q1, q2, q3, qacc, qrej} • Σ = {0, 1}, and Γ = {0, 1, A, B, t} • δ is given as follows: δ(q0, 0) = (q1, A, R) δ(q0, B) = (q3, B, R) δ(q1, 0) = (q1, 0, R) δ(q1, B) = (q1, B, R) δ(q1, 1) = (q2, B, L) δ(q2, B) = (q2, B, L) δ(q2, 0) = (q2, 0, L) δ(q2, A) = (q0, A, R) δ(q3, B) = (q3, B, R) δ(q3, t) = (qacc, t, R) In all other cases, δ(q, X) = (qrej, t, R). So for example, δ(q0, 1) = (qrej, t, R). How many of the following strings are rejected by M? __________ i. 10001 ii. 111000 iii. 0010 iv. 10100 v. 101010

Q8. A Turing machine M with start state q_0 and accepting state q_f has the following transition function:

δ(q, a)	0	1	B
q_0	$(q_1, 0, R)$	-	-
q_1	-	$(q_0, 1, R)$	(q_f, B, R)
q_f	-	-	-

Which of the following strings are accepted by TM?

(A) 1110 (B) 0110

(C) 01011 (D) 0101

Q9. The language accepted by the following Turing machine is

M1 = ({q0, qaccept, qreject}, {0, 1}, {0, 1, Δ}, δ, q0, q accept, q reject)

δ(q0, 0) = (qaccept, 0, R)

δ(q0, 1) = (qreject, 1, R)

δ(q0,Δ) = (qreject, 1, R).

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

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

Q10. Consider the Turing machine M = (Q, Σ, Γ, δ, q0, qacc, qrej) where

- Q = {q0, q1, q2, q3, qacc, qrej}
- Σ = {0, 1}, and Γ = {0, 1, A, B, t}
- δ is given as follows

δ(q0, 0) = (q1, A, R) δ(q0, B) = (q3, B, R)

δ(q1, 0) = (q1, 0, R) δ(q1, B) = (q1, B, R)

δ(q1, 1) = (q2, B, L) δ(q2, B) = (q2, B, L)

δ(q2, 0) = (q2, 0, L) δ(q2, A) = (q0, A, R)

δ(q3, B) = (q3, B, R) δ(q3, t) = (qacc, t, R)

In all other cases, δ(q, X) = (qrej, t, R). So for example, δ(q0, 1) = (qrej, t, R). Which of the following strings are accepted by M?

i) 0011 ii)0101 iii)01 iv)10100 v) 1010

(A) i and iii (B) iii and v

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

Q11. The following Turing machine

M2 = ({q0, q1, qaccept, qreject}, {0, 1}, {0, 1, #,Δ}, δ, q0, qaccept, qreject)

δ(q0, 0) = (qaccept, 0, R)

δ(q0, 1) = (q1, 1, R)

δ(q0, #) = (qreject, 1, R)

δ(q0,Δ) = (qreject, 1, R).

δ(q1, 0) = (q1, #, R)

δ(q1, 1) = (q1, #, R)

δ(q1, #) = (q1, #, R)

δ(q1,Δ) = (q1, #, R)

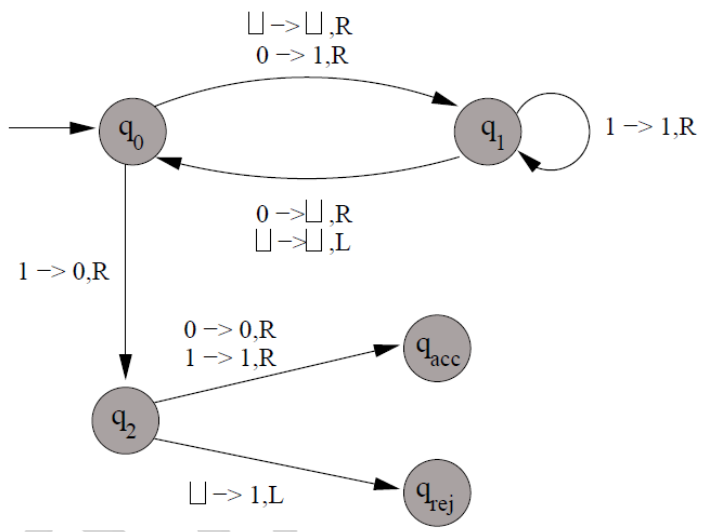
(A) halts on all the string starts with 0

(B) does not halts on λ

(C) halts on all the string starts with 1

(D) does not halts on any string.

Data for next two questions: Consider the following TM



Q12. The outcome of the computation of *M* on input '*00*' is

(A) ACCEPT (B) REJECT

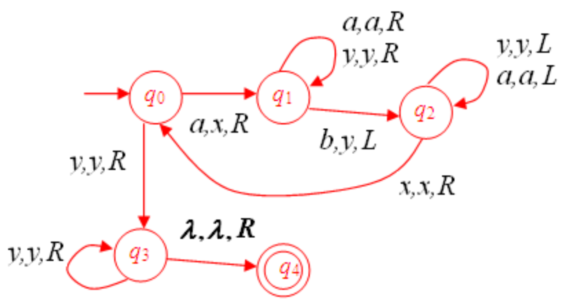
(C) LOOP (D) None

Q13. The outcome of the computation of *M* on input '*01*' is

(A)ACCEPT (B) REJECT

(C) LOOP (D) None

For Next Three Questions: Consider the Turing machine:



Q14. Determine what the Turing machine does when presented with the "aaabbbb".

(A) TM halt at final state

(B) TM does not halt and loop forever

(C) TM reject the input

(D) Cannot say about this input

Q15. Determine what the Turing machine does when presented with the "aaaaabbbbb".

(A) TM halt at final state

(B) TM does not halt and loop forever

(C) TM reject the input

(D) Cannot say about this input

Q16. Is there any input for which the Turing machine goes into an infinite loop?

(A) No.

(B) Yes, there is an input "abb" for which the Turing machine goes into an infinite loop.

(C) Yes, there is an input "aaaaaabbbbbbbbbb" for which the Turing machine goes into an infinite loop.

(D) None of the above.

Q17. What is the smallest number of states that a TM could have?

(A) 0 (B) 1

(C) 2 (D) 3

Q18. What is the smallest number of tape symbols that a TM with nonempty input alphabet could have?

(A) 0 (B) 1

(C) 2 (D) 3

Q19. Suppose that a Turing Machine is run on an input. Which of the following is false?

(A) Infinitely many configurations of the machine can occur.

(B) If a configuration of the machine arises twice in a computation on this input, the machine enters an infinite loop.

(C) Every configuration contains exactly one state of the machine.

(D) A configuration of the machine might have infinite length because the tape is infinite.

Q20. Consider a Turing machine which can move only left, at most 5 times in the course of computation on any input. Consider all TMs that have this property. What languages do they recognize?

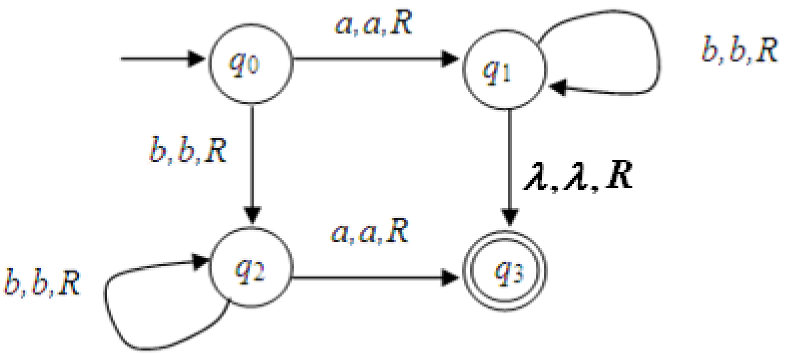
(A) Exactly the regular languages.

(B) Exactly the context-free languages.

(C) Exactly the decidable languages.

(D) Exactly the recognizable languages

Q21. What language is accepted by the Turing machine whose transition graph is shown below?



(A) The language of the machine is therefore ab^*b

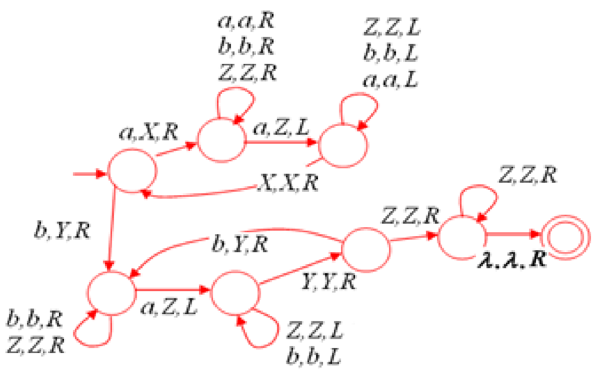
(B) The language of the machine is therefore $bb^*a(a+b)^*$

(C) The language of the machine is therefore $ab^* + bb^*a(a+b)^*$

(D) The language of the machine is therefore $ab^*b + bb^*a(a+b)^*$

Q22. **[MSQ]**

The language accepted by the following Turing machine is

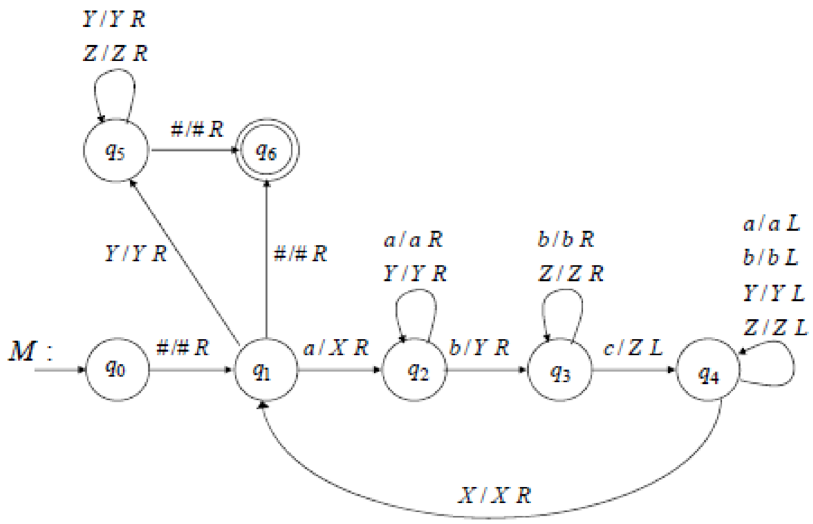
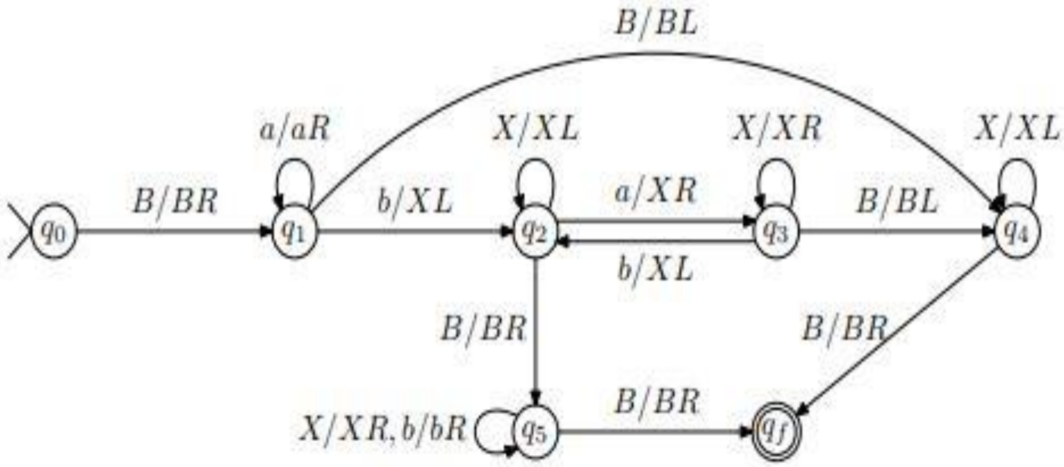


(A) $L = \{a^n b^m a^{n+m} : n \geq 0, m \geq 1\}$

(B) $L = \{a^m b^n a^{m+n} : m \geq 0, n \geq 1\}$

(C) $L = \{a^n b^m a^{n+m} : n \geq 1, m \geq 1\}$

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

Q23.	**[MSQ]** Which language does the following TM accept?  (A) $\{a^k b^k c^k \mid k \ge 0\}$ (B) $\{a^i b^j c^k \mid i, j, k \ge 0 \text{ and } i = k\}$ (C) $\{a^i b^j c^k \mid i, j, k \ge 0 \text{ and } i = k \text{ or } j = k\}$ (D) $\{a^i b^j c^k \mid i, j, k \ge 0 \ \& \ i = k \text{ and } j = k\}$
Q24.	Construct following Turing machine with input alphabet {a, b},  The language accepted by given Turing machine is (A) $L = \{a^i b^j \mid i \ge 0, j = i\}$ (B) $L = \{a^i b^j \mid i \ge 0, j < i\}$ (C) $L = \{a^i b^j \mid i \ge 0, j \le i\}$ (D) $L = \{a^i b^j \mid i \ge 0, j \ge i\}$

Q25.	The following language L1 = {<M>|M is a TM and there exists an input on which M halts in less than |<M>| steps} is: (A) recursive (B) recursively enumerable but not recursive (C) not recursively enumerable (D) Regular
Q26.	The language L2 = {<M>|M is a TM and |L(M)| ≤ 3} is: (A) recursive (B) recursively numerable but not recursive (C) not recursively enumerable (D) none of the above
Q27.	The following language L2 = {<M>|M is a TM and |L(M)| ≥ 3} is: (A) Recursive (B) recursively enumerable but not recursive (C) not recursively enumerable (D) none of the above
Q28.	The following language L4 = {<M>|M is a TM that accepts all even numbers}is: (A) recursive (B) recursively enumerable but not recursive (C) not recursively enumerable (D) none of these
Q29.	The following language L1 = {<M>|M is a TM and L(M) is finite}is: (A) recursive (B) recursively enumerable but not recursive (C) not recursively enumerable (D) context-Sensitive but not CFL

Q30.	The following language L1 = {<M>| there exist x, y ∈ Σ*such that either x ∈L(M) or y ∉ L(M)}. (A) recursive (B) recursively enumerable but not recursive (C) not recursively enumerable (D) context-Sensitive but not CFL
Q31.	The following language L1 = {<M, x, k>|M is a TM, and M does not halt on x within k steps}is: (A) Recursive (B) Recursively enumerable but not recursive (C) Not recursively enumerable (D) Not recursive
Q32.	The following language L1 = {<M>|M is a TM, and M accepts (at least) two strings of different lengths} is: (A) Recursive (B) Recursively enumerable but not recursive (C) Not recursively enumerable (D) Not recursive
Q33.	Let the language A_{TM}={<M,w> | M is a TM that accepts string w} then the complement of the language is (A) Decidable (B) Turing Recognizable (C) Not Turing Recognizable (D) None

Data for next ten questions: Consider the following languages **(Q34 to 43 - 2020)**

L1 = {<M> | M is a TM and M accepts at most 225 distinct inputs}

L2 = {<M> | M is a TM and M accepts at least 225 distinct inputs}

L3 = {<M> | M is a TM and M accepts exactly 225 distinct inputs}

L4 = {<M, w> | M is a TM and M doesn't halt on 'w'}.

L5 = {<M, w> | M is a TM and M halts on 'w'}

L6 = {<M, w> | M is a TM and M accepts 'w'}

L7 = {<M, w> | M is a TM and M rejects 'w'}

L8 = {<M> | M is a TM and M has exactly five states}

L9 = {<M> | M is a TM and M has exactly three tapes}

L10 = {<M> | M is a TM and L(M) = {001, 100}}

Q34. Then L1 is

(A) Recursive (B) RE (C) Not RE (D) finite

Q35. Then L2 is

(A) Recursive (B) RE (C) Not RE (D) finite

Q36. Then L3 is

(A) Recursive (B) RE (C) Not RE (D) finite

Q37. Then L4 is

(A) Recursive (B) RE (C) Not RE (D) finite

Q38. Then L5 is

(A) Recursive (B) RE (C) Not RE (D) finite

Q39. Then L6 is

(A) Recursive (B) RE (C) Not RE (D) finite

Q40. Then L7 is

(A) Recursive (B) RE (C) Not RE (D) finite

Q41. Then L8 is

(A) Recursive (B) RE (C) Not RE (D) Co-RE

Q42. Then L9 is

(A) Recursive (B) RE (C) Not RE (D) Co-RE

Q43. Then L10 is

(A) RE (B) Co-RE (C) Not RE (D) Both b & c

Q44.	**[MSQ]** The language $A_{DFA} = \{\langle D, w\rangle \mid D \text{ is DFA that accepts } w\}$is (A) Decidable (B) Turing Recognizable (C) Not Turing Recognizable (D) None
Q45.	The language $A_{CFG} = \{\langle G\rangle \mid G \text{ is CFG and } L(G) = \Sigma^*\}$is (A) Decidable (B) Turing Recognizable (C) Not Turing Recognizable (D) None
Q46.	**[MSQ]** The language $E_{CFG} = \{\langle G\rangle \mid G \text{ is a CFG and } L(G) = \emptyset\}$ is (A) Decidable (B) Turing Recognizable (C) Not Turing Recognizable (D) None
Q47.	$EQ_{TM} = \{\langle M1, M2\rangle \mid M_1, M_2 \text{ are TMs with } L(M_1) = L(M_2)\}$? (A) Decidable (B) Turing Recognizable (C) Not Turing Recognizable (D) None
Q48.	$EQ_{DFA}=\{\langle M_1,M_2\rangle \mid M_1,M_2 \text{ are DFAs with } L(M_1)=L(M_2)\}$? (A) Decidable (B) Turing Recognizable (C) Not Turing Recognizable (D) None
Q49.	Consider the following language $L = \{\langle M\rangle : M \text{ is TM such that } L(M) = \emptyset\}$. (A) Turing recognizable (B) Turing decidable (C) Not Turing recognizable (D) CO-RE
Q50.	Which of the following statements is true for every language $L \subseteq \{0, 1\}^*$? 1. L is non-empty. 2. L is decidable or L is infinite (or both). 3. L is accepted by some DFA with 42 states if and only if L is accepted by some NFA with 42 states. 4. L is decidable if and only if its complement L is undecidable. (A) 1 and 4 Only (B) 2 and 3 Only (C) 2 Only (D) 1, 2, 3 Only

Data for next two questions: Let M be a standard Turing machine (with a single one-track tape and a single head) that decides the regular language 0*1*.	
Q51.	Which of the following must be true? 1. Given an empty initial tape, M eventually halts. 2. M accepts the string 1111. 3. M rejects the string 0110. 4. M moves its head to the right at least once, given input 1100. (A) 2 & 3 only (B) 1 & 4 only (C) 2, 3 & 4 only (D) All are true
Q52.	Which of the following is /are not always true? 1. M moves its head to the right at least once, given input 0101. 2. M never accepts before reading a blank. 3. For some input string, M moves its head to the left at least once. 4. For some input string, M changes at least one symbol on the tape. (A) 2, 3 & 4 (B) 3 & 4 (C) 1 & 2 (D) All
Q53.	Which of the following problems about Turing machines is/are undecidable? 1. To determine, given a Turing machine M, a state q, and a string w, whether M ever reaches state q when started with input w from its initial state. 2. To determine, given a Turing machine M and a string w, whether M ever moves its head to the left when started with input w. 3. To determine, given Turing machine M and a string w, whether w is accepted by M within some given time constraint T. 4. To determine, given a Turing machine M, and a string w, whether M ever halt for input w. (A) 1 & 2 only (B) 2 and 4 only (C) 1, 2 & 4 only (D) all are undecidable

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Q54. Which of the following problems about context-free grammars are undecidable?

1. Given a context-free grammar G, is $\varepsilon \in L(G)$?

2. Given a context-free grammar G, is $\{\varepsilon\} = L(G)$?

3. Given two context-free grammars G1 and G2, is $L(G1) \subseteq L(G2)$.

(A) 1only (B) 2 only

(C) 3 only (D) 1, 2 and 3

Data for next two questions: Let G1 and G2 are CFGs and R denotes given regular expression.

Q55. Which of the following problems are undecidable?

1. $L(G1) \cap L(G2) \neq \emptyset$ 2. $L(G1) \neq L(G2)$ 3. $L(G1) \neq L(R)$

(A) 1only (B) 2 only

(C) 1, 3 only (D) 1, 2 and 3

Q56. Which of the following problems is/are decidable?

1. $L(G2) - L(G1) \neq \emptyset$?
2. $L(R) - L(G1) \neq \emptyset$
3. L (R) = finite
4. $L(G1 \cup G2) = \Sigma^*$

(A) 1 & 2 only (B) 3 & 4 only

(C) 1, 3 only (D) 3 only

Q57. How many of the following languages are Un-decidable? ________

1. L = {<M> | M is a TM and M accepts at least one string over {0, 1}}.

2. L = {<M> | M is a TM and M accept all strings over {0, 1}}.

3. L = {<M> | M is a TM and M accepts "Hello"}.

4. L = {<M_1, M_2> | M_1 and M_2 are TM's and M_1 accept more strings than M_2}.

5. L = {<M> | M is a TM and M take more than 1000 steps to process input w}.

6. L = {<M_1, M_2> | M_1 and M_2 are TM's and M_1 take more steps than M_2 to process input w}

Q58. Suppose that a Turing Machine is run on an input. Which of the following is false?

(A) Infinitely many configurations of the machine can occur.

(B) If a configuration of the machine arises twice in a computation on this input, the machine enters an infinite loop.

(C) Every configuration contains exactly one state of the machine.

(D) A configuration of the machine might have infinite length because the tape is infinite

Q59.	Which of the following statement is/are true? i. There is a language that is decidable and its complement is not decidable. ii. There is a language that is recognizable and its complement is not recognizable. iii. The problem of determining whether a TM accepts at least 7 strings is un decidable. iv. The problem of determining whether a TM has at least 7 states is un decidable. (A) i and iv only (B) ii and iii only (C) i, ii and iii only (D) iii and iv only
Q60.	Consider a Turing machine which can move only left, at most 5 times in the course of computation on any input. Consider all TMs that have this property. What languages do they recognize? (A) Exactly the regular languages. (B) Exactly the context-free languages. (C) Exactly the decidable languages. (D) Exactly the recognizable languages
Q61.	Select all the statements that are TRUE. The class of recursively enumerable languages : 1. Not closed under union 2. Closed under intersection 3. Closed under complement 4. Not closed under Kleen's star 5. Not closed under infinite union (A) 1, 2 and 4 only (B) 3 and 5 only (C) 2 and 5 only (D) 1and 4 only
Q62.	Which of the following statement/s is/are true? 1. If A is regular and B is regular, then A U B^c is always Recursive. 2. If A is context-free and B is regular, then A U B^c is always Recursively enumerable 3. If A is regular and B is context-free, then $A \cap B^c$ is regular. 4. If A is recursive and B is recursive, then $A \cap B^c$ is always Recursively enumerable but not recursive. (A) 1 only (B) 1 & 2 only (C) 1, 2 & 4 only (D) All the above

Q63.	Which of the following statement/s is/are false? 1. If A is recursive and B is Recursively enumerable (RE), then A U B^c is Recursively enumerable. 2. If A is recursively enumerable and B is recursive then A U B^c is Recursive. 3. If A is regular language and B is non-regular language then $A \cup B^c$ is always regular. 4. If A is RE and their complement is also RE then A is always Turing decidable. (A) 1 & 2 only (B) 1, 2 & 3 only (C) 4 only (D) All the above
Q64.	Which of the following statements about formal languages is false? (A) Every recursive language is recursively enumerable. (B) The complement of a recursive language is recursive. (C) The complement of a recursively enumerable language is recursively enumerable. (D) The union of two recursively enumerable languages is recursively enumerable
Q65.	Which of the following is/are not decidable? 1.A_{CFG} = {<G, w> : G is a CFG that generates string w} 2.E_{CFG} = {<G> : G is a CFG and L(G) = ϕ} 3. D_{CFG}= {<G> : G is a CFG and G is ambiguous} 4.U_{CFG}={<G>: L(G) $\neq \Sigma^*$ } (A) 3 and 4 only (B) 1 and 3 only (C)1, 2 and 4 only (D) 2, 3 and 4 only
Q66.	Consider an arbitrary language $L \subseteq \{0, 1\}^*$. Which of the following statements must be true? i) If L is decidable, then L is infinite. ii) If L is not decidable, then L is infinite. iii) If L is the union of two regular languages, then its complement L is context-free. iv) If L is context-free, then its complement L is context-free. v) If L is finite, then L is context-free. (A) iii and v only (B)i and ii only (C)ii, iv and v only (D)ii, iii and v only

Q67.	Consider the following sets of languages over the alphabet {0, 1}: • L_{DTM} is the set of all languages $L \subseteq \{0, 1\}*$ such that L is accepted by at least one deterministic Turing machine. • L_{NTM} is the set of all languages $L \subseteq \{0, 1\}*$ such that L is accepted by at least one non-deterministic Turing machine. Which of the following statements is/are true? (A) $L_{DTM} \subseteq L_{NTM}$ (B) $L_{DTM} \supseteq L_{NTM}$ (C) $L_{DTM} = L_{NTM}$ (D) Undecidable problem
Q68.	Which of the following statements are correct? i) For every recursive language L, there is a Turing machine M with $\bar{L}$ as its language. ii) For every non-deterministic push-down automaton, there is an equivalent deterministic push-down automaton. iii) Non-deterministic Turing machines are strictly more powerful than Deterministic Turing machines. (A) i only (B) ii only (C) iii only (D) i and iii only
Q69.	Which of the following statements are correct? i) DFA reads its input fully before accepting a string. ii) A multi-tape TM is equivalent to a single tape TM. iii) A DTM may accept a string without reading its input. iv) The number of configurations of an LBA is fixed by its number of states Q. (A)ii and iii only (B)ii only (C) i, ii and iii (D)All the above

Q70.	State which of the following statements are true? (I) If A is context-free, then A is Turing-recognizable. (II) Every language is Turing-recognizable. (III) For a Turing machine M and a string w, M either accepts or rejects w. (IV) The language $((01 \cup 10)^*0 \cup 1)^*$ is countable. (V) If language A is recognized by a 14-tape nondeterministic Turing machine, then there is a single-tape deterministic Turing machine that also recognizes A. (A) I, IV and V only (B) I and V only (C) All except II (D) All the above
For next five questions: Let $L1$ and $L2$ be languages in the respective language class, and let R be a regular language, and x be a given word over alphabet. Some problems are given in the questions identify the classes of languages for which the problem is decidable	
Q71.	$L1\ U\ L2 = \Sigma^*$ is decidable for i) regular languages ii) context-free languages iii) recursive languages iv) recursively enumerable languages (A)Only i & ii (B)Only i (C)Only ii & iv (D)Only iii & iv
Q72.	$x \in L1$ is decidable for i) regular languages ii) context-free languages iii) recursive languages iv) recursively enumerable languages (A)Only ii & iii (B)Only i, ii & iii (C)Only iii & iv (D)Only I & iv
Q73.	$R \subseteq L1$ is decidable for i) regular languages ii) context-free languages iii) recursive languages iv) recursively enumerable languages (A)Only ii & iii (B)Only I (C)Only ii & iv (D)Only iii & iv

Q74.	$L1 - R = \emptyset$ is decidable for i) regular languages ii) context-free languages iii) recursive languages iv) recursively enumerable languages (A)Only ii (B)Only i & ii (C)Only iii &iv (D)Only ii &iii
Q75.	$\exists y \in L1,\ \lvert y \rvert < 5$ is decidable for i)regular languages ii) context-free languages iii) recursive languages iv) recursively enumerable languages (A) Only iii & iv (B) Only ii & iii (C) Only i, ii & iii (D) Only i & iv
Q76.	Which of following is/are correct? S1: Deterministic two-stack automata are as powerful as Turing machines. S2: $\{\langle M \rangle \mid M$ is a Turing machine and M does not accept $101\}$ is recursively enumerable (A)Only S1 (B)Only S2 (C)Both S1&S2 (D)None of them
Q77.	Which of the following problem is undecidable? (A) membership problem for CFL (B) membership problem for regular sets (C) membership problem for CSL (D)membership problem for type 0 languages
Q78.	Which of the following is/are true about uncountable set? (i) If A is a subset of B and A is uncountable, then so is B. (ii) If A is infinite (even countably infinite) then the power set of A is uncountable (iii) If A is uncountable and B is any set, then the union $A \cup B$ is also uncountable. (iv) If A is uncountable and B is any set, then the Cartesian product $A \times B$ is also uncountable. (A) i, ii only (B) iii, iv only (C)ii, iii, iv only (D)All the above

Q79.	Which of the following statement is/are True? 1. The language $(0 \cup 1)^*$ is countable. 2. The set of all possible language over {a, b} is countable. 3. The set of recursively enumerable languages is countable. 4. The Cartesian product of a finite number of countable set is countable. (A) 1 & 4 only (B) 2 & 3 only (C) 1, 3 & 4 only (D) All the above
Q80.	Which of the following statement is/are NOT true? 1. Set of all prime numbers is countable. 2. Set of rational numbers is uncountable. 3. Set of Binary Sequences is uncountable. 4. Set of real Numbers is uncountable. 5. Set of all integers is countable. (A) 1 & 2 only (B) 3, 4 & 5 only (C) 2 only (D) 1, 2 & 3 only
Q81.	Which of the following statement is/are true? 1. The set of all pairs, (i, j) with i, j positive integers, is countable. 2. The set of all triplets, (i, j, k) with i, j, k positive integers, is countable. (A) 1 only (B) 2 only (C) Both 1 & 2 (D) Neither 1 nor 2
Q82.	If S1 and S2 are countable set, then how many of the following statement is/are true? 1. $S1 \cup S2$ is countable. 2. $S1 \cap S2$ is countable. 3. $S1 \oplus S2$ is countable. 4. S1 - S2 is countable.
Q83.	Which of the following statement is/are true? 1. Subset of infinite countable set is countable. 2. Superset of countable set may be uncountable. 3. There exists a countably infinite set which is subset of an uncountable set. 4. Power set of countably infinite set is always countable. (A) 1 & 2 only (B) 3 & 4 only (C) 1, 2 & 3 only (D) All the above

Closure Properties

operation	REG	DCFL	CFL	CSL	RC	RE
union	Y	N	Y	Y	Y	Y
intersection	Y	N	N	Y	Y	Y
set difference	Y	N	N	Y	Y	N
complementation	Y	Y	N	Y	Y	N
intersection with a regular language	Y	Y	Y	Y	Y	Y
concatenation	Y	N	Y	Y	Y	Y
Kleene star	Y	N	Y	Y	Y	Y
Kleene plus	Y	N	Y	Y	Y	Y
reversal	Y	Y	Y	Y	Y	Y

Closure properties of language families

Operation	Regular	DCFL	CFL	CSL	Recursive	RE
Union	yes	no	yes	yes	yes	yes
Intersection	yes	no	no	yes	yes	yes
Complement	yes	yes	no	yes	yes	no
Concatenation	yes	no	yes	yes	yes	yes
Kleene star	yes	no	yes	yes	yes	yes
Homomorphism	yes	no	yes	no	no	yes
ϵ-free Homomorphism	yes	no	yes	yes	yes	yes
Substitution (ϵ-free)	yes	no	yes	yes	no	yes
Inverse Homomorphism	yes	yes	yes	yes	yes	yes
Reverse	yes	no	yes	yes	yes	yes
Intersection with a regular language	yes	yes	yes	yes	yes	yes

List of theorems:

1. The class of regular languages is closed under union.
2. The class of regular languages is closed under concatenation.
3. Every NFA has an equivalent DFA.
4. The class of regular languages is closed under Kleene - star.
5. (Kleene's theorem) Language A is regular if A has a regular expression.
6. If A is finite language, then A is regular.
7. The class of regular languages is closed under intersection.
8. The class of regular languages is closed under complementation.
9. If A is regular language, then ∃ number p where, if s ∈ A with |s| > = p, then ∃ strings x, y, z such that
   s = xyz and (1) xy^iz ∈ A for each i > = 0, (2) |y | > 0, and (3) |xy | < = p
10. Every CFL can be described by a CFG G = (V, Σ, R, S) in Chomsky normal form, i.e., each rule in G has one of two form s: A → BC or A → x, where (A ∈ V), (B, C ∈ V – {S}), x ∈ Σ, and we also allow the rule S → ϵ.
11. If A is a regular language, then A is also a CFL.
12. A language is context free iff some PDA recognizes it.
13. (Pumping lemma for CFLs) For every CFL L, ∃ pumping length p such that ∀ strings s ∈ L with |s| > = p, we can writes s = uvxyz with (1) uv^ixy^iz ∈ L ∀ i > = 0, (2) |v y| > = 1, (3) |vxy | < = p.
14. The class of CFLs is closed under union.
15. The class of CFLs is close d under concatenation.
16. The class of CFLs is closed under Kleene- star.
17. For e very multi- tape TM M , there is a single- tape TM M such that L (M) = L (M')
18. Every NTM has an equivalent deterministic TM.
19. Language L is Turing-recognizable if an NTM recognizes it.
20. A language is enumerable if some enumerator enumerates it

Church-Turing Thesis The information of algorithm is the same as Turing machine algorithm

1. A_{DFA} = {<B, w> | B is a DFA that accepts string w} is Turing-decidable.
2. A_{NFA} = {<B, w> | B is an NFA that accepts string w} is Turing-decidable.
3. A_{REX} = {<R, w> | R is a regular expression that generates string w} is Turing-decidable.
4. E_{DFA} = {<B> | B is a DFA with L (B) = Ø} is Turing-decidable.

5. EQ_{DFA} = {<A, B> | A and B are DFAS with L (A) = L (B)} is Turing-decidable
6. A_{CFG}= {<G, w> | G is a CFG that generates string w} is Turing-decidable.
7. E= {G | G is a CFG with L (G) = Ø} is Turing-decidable.
8. Every CFL is Turing-decidable
9. A_{TM} = {<M, w> | M is a TM that accepts string w} is undecidable.
10. The set R of all real numbers is uncountable
11. Some languages are not Turing-recognizable.
12. A language is decidable if it is both Turing-recognizable and co-Turing- recognizable.
13. A_{TM} (bar) is not Turing-recognizable.
14. $HALT_{TM}$ = {<M, w> | M is a TM that halts on w} is undecidable.
15. ETM_{TM}= {<M> | M is a TM with L (M) = Ø} is undecidable.
16. REG_{TM}= {<M> is a TM and L (M) is regular} is undecidable.
17. EQ_{TM}= {<M_1, M_2> | M_1, M_2 are TMs with L (M_1) = L (M_2)} is undecidable.
18. (Rice's Thm.) Let P be any subset of the class of Turing-recognizable languages such that P ≠ Ø and
    P (bar) ≠ Ø. Then L_P = {<M> | L (M) ∈ P} is undecidable.
19. If A < =$_m$ B and B is Turing-decidable, then A is Turing-decidable.
20. If A < =$_m$ B and A is undecidable, then B is undecidable.
21. If A < =$_m$ B and B is Turing-recognizable, then A is Turing-recognizable.
22. If A < =$_m$ B and A is not Turing-recognizable, then B is not Turing-recognizable.
23. E_{TM}= {<M> is a TM with L (M) = Ø} is not Turing-recognizable.
24. EQ_{TM}= {<M_1, M_2> | M_1, M_2 are TMs with L (M_1) = L (M_2)} is neither Turing- recognizable nor co-Turing-recognizable.
25. Let t (n) be a function with t (n) > = n. Then any t (n)-time multi-tape TM has an equivalent O (t^2 (n))-time single-tape TM.
26. Let t (n) be a function with t (n) > = n. Then any t (n)-time NTM has an equivalent $2^{O\,(t\,(n))}$-time deterministic 1- tape TM.
27. PATH ∈ P.
28. REL PRIME ∈ P.
29. Every CFL is in P.
30. A language is in NP iff it is decided by some nondeterministic polynomial- time TM.
31. NP = $U_{k >= 0}$ NTIME(n^k)

32. CLIQUE ∈ NP.

33. SUBSET-SUM ∈ NP.

34. If A < $=_P$ PB and B ∈ P, then A ∈ P.

35. 3SAT is polynomial-time reducible to CLIQUE

36. If there is an NP-Complete problem B and B ∈ P, then P = NP.

37. If B is NP- Complete and B < $=_P$ C for C ∈ NP, the n C is NP- Complete.

38. SAT is NP- Complete.

39. SAT is NP- Complete

40. CLIQUE is NP- Complete.

41. ILP is NP-Complete.

Decidability/Undecidability

• Every question we've asked about the language of finite automata is decidable

Is w ∈ L(M)?, Is L(M)= ∅ , Is L(M)= finite , Is L(M)= ∑*

• Some questions about the languages of CFGs are decidable

Is L(G) = ∅, some aren't like Is L(G) = ∑*

• Everything we've tried for Turing machines is undecidable.

Is L(G) = ∅, L(G)= ∑* • Is the language semi decided by M regular? Context-free?

For Context free Grammar it is undecidable

- whether a CFG accepts the language of all strings
- whether two CFGs describe the same language
- whether CFG is ambiguous
- if a context-sensitive grammar describes a context-free language
- if a CFG, has an equivalent PDA that is deterministic
- if Given an ambiguous CFG, whether or not there is a different CFG that generates the same language but is not ambiguous
- whether the complement of a given CFL is context free?
- whether the intersection of two CFL's is context free?
- given two CFG's, how can we tell if they have a word in common?

Decidable Problem for CFG

- DPDA Equality is Decidable
- Membership is decidable