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1 Theory Of Computation

1.1 Multiple Choice Questions

1. **[Regular-Language | GATE 2019]** If L is a regular language over $\Sigma = \{ a,b \}$, which one of the following languages is NOT regular?

   (a) Suffix (L) = $\{ y \in \Sigma^* \text{ such that } xy \in L \}$

   (b) $\{ ww^R \mid w \in L \}$

   (c) Prefix (L) = $\{ x \in \Sigma^* \mid \exists\, y \in \Sigma^* \text{ such that } xy \in L \}$

   (d) $L \,.\, L^R = \{ xy \mid x \in L, y^R \in L \}$

2. **[Regular-Language | GATE 2019]** For $\Sigma = \{ a,b \}$, let us consider the regular language $L = \{ x \mid x = a^{2+3k} \text{ or } x = b^{10+12k}, k \geq 0 \}$. Which one of the following can be a pumping length (the constant guaranteed by the pumping lemma) for L?

   (a) 3

   (b) 9

   (c) 5

   (d) 24

3. **[Countability | GATE 2019]** Consider the following sets:

   S1. Set of all recursively enumerable languages over the alphabet $\{ 0,1 \}$
   S2. Set of all syntactically valid C programs
   S3. Set of all languages over the alphabet $\{ 0,1 \}$
   S4. Set of all non-regular languages over the alphabet $\{ 0,1 \}$

   Which of the above sets are uncountable?

   (a) S2 and S3

   (b) S3 and S4

   (c) S1 and S4

   (d) S1 and S2

4. **[Context-Free-Language | GATE 2019]** Which one of the following languages over $\Sigma = \{ a,b \}$ is NOT context-free?

   (a) $\{ ww^R \mid w \in \{ a,b \}^* \}$

   (b) $\{ wa^n w^R b^n \mid w \in \{ a,b \}^*, n \geq 0 \}$

   (c) $\{ a^n b^i \mid i \in \{ n, 3n, 5n \}, n \geq 0 \}$

(d) $\{ wa^n b^n w^R \mid w \in \{a,b\}^*, n \geq 0\}$

5. **[Finite-Automata | GATE 2019]** Let Σ be the set of all bijections from $\{1, ..., 5\}$ to $\{1, ..., 5\}$, where id denotes the identity function i.e. id(j) = j,$\forall$ j. Let ^{o} denote composition on functions. For a string $x = x_1 x_2 ... x_n \in \Sigma^n$, $n \geq 0$. Let $\pi(x) = x_1 \,^{o}\, x_2 \,^{o} ... ^{o}\, x_n$.

   Consider the language $L = \{ x \in \Sigma^* \mid \pi(x) = id\}$. The minimum number of states in any DFA accepting L is ______.

   (a) 120

   (b) 136

   (c) 125

   (d) 132

6. **[Finite-Automata | GATE 2018]** Let N be an NFA with n states. Let k be the number of states of a minimal DFA which is equivalent to N. Which one of the following is necessarily true?

   (a) $k \geq 2^n$

   (b) $k \geq n$

   (c) $k \leq n^2$

   (d) $k \leq 2^n$

7. **[Closure-Property | GATE 2018]** The set of all recursively enumerable languages is

   (a) closed under complementation.

   (b) closed under intersection.

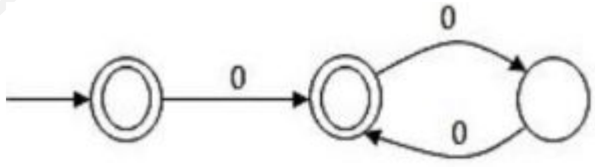
   (c) a subset of the set of all recursive languages.

   (d) an uncountable set.

8. **[Finite-Automata | GATE 2018]** Given a language L, define L^i as follows:

   $L^0 = \{ \in \}$ $L^i = L^{i-1}.L$ for all $i > 0$ The order of a language L is defined as the smallest k such that $L^k = L^{k+1}$.

   Consider the language L_1 (over alphabet 0) accepted by the following automaton.



   The order of L_1 is ______.

   (a) 2

   (b) 3

   (c) 4

   (d) 5

9. **[Context-Free-Language | GATE 2018]** Consider the following languages:

   I. { a^m b^n c^p d^q | m + p = n + q, where m, n, p, q ≥ 0}
   II. { a^m b^n c^p d^q | m = n and p = q, where m, n, p, q ≥ 0}
   III. { a^m b^n c^p d^q | m = n = p and p $\neq$ q, where m, n, p, q ≥ 0}
   IV. { a^m b^n c^p d^q | mn = p + q, where m, n, p, q ≥ 0}

   Which of the above languages are context-free?

   (a) I and IV only
   (b) I and II only
   (c) II and III only
   (d) II and IV only

10. **[Decidability-and-Undecidability | GATE 2018]** Consider the following problems. L(G) denotes the language generated by a grammar G. L(M) denotes the language accepted by a machine M.

    (I) For an unrestricted grammar G and a string w, whether w$\in$ L(G)
    (II) Given a Turing machine M, whether L(M) is regular
    (III) Given two grammar G_1 and G_2 , whether L(G_1) = L(G_2)
    (IV) Given an NFA N, whether there is a deterministic PDA P such that N and P accept the same language

    Which one of the following statement is correct?

    (a) Only I and II are undecidable
    (b) Only III is undecidable
    (c) Only II and IV are undecidable
    (d) Only I, II and III are undecidable

11. **[Finite-Automata | GATE 2017 [Set-1]]** Consider the language *L* given by the regular expression (a+b)*b(a+b) over the alphabet { a,b} . The smallest number of states needed in deterministic finite-state automation (DFA) accepting *L* is _________.

    (a) 4
    (b) 5
    (c) 6
    (d) 7

12. **[Membership-Function | GATE 2017 [Set-1]]** If G is a grammar with productions

    S $\rightarrow$ SaS | aSb | bSa | SS | $\in$

    where S is the start variable, then which one of the following strings is not generated by G?

    (a) abab
    (b) aaab
    (c) abbaa
    (d) babba

13. **[Context-Free-Language | GATE 2017 [Set-1]]** Consider the context-free grammars over the alphabet { a, b, c} given below. S and T are non-terminals.

    G_1 : S → aSb| T, T → cT| ∈
    G_2 : S → bSa| T, T → cT| ∈

    The language $L(G_1) \cap L(G_2)$ is

    (a) Finite

    (b) Not finite but regular

    (c) Context-Free but not regular

    (d) Recursive but not context-free

14. **[Context-Free-Language | GATE 2017 [Set-1]]** Consider the following languages over the alphabet Σ = { a, b, c} .

    Let $L_1 = \{ a^n b^n c^m \mid m,n \geq 0\}$ and $L_2 = \{ a^m b^n c^n \mid m,n \geq 0\}$

    Which of the following are context-free languages?

    I. $L_1 \cup L_2$
    II. $L_1 \cap L_2$

    (a) I only

    (b) II only

    (c) I and II

    (d) Neither I nor II

15. **[Computability-and-Decidability | GATE 2017 [Set-1]]** Let A and B be finite alphabets and let # be a symbol outside both A and B. Let f be a total function from A* to B*. We say f is computable if there exists a Turing machine M which given an input x in A*, always halts with f(x) on its tape. Let L_f denote the language { x # f(x)| x ∈ A*} . Which of the following statements is true:

    (a) f is computable if and only if L_f is recursive.

    (b) f is computable if and only if L_f is recursively enumerable.

    (c) If f is computable then L_f is recursive, but not conversely.

    (d) If f is computable then L_f is recursively enumerable, but not conversely.

16. **[Context-Free-Language | GATE 2017 [Set-2]]** Let L_1 , L_2 be any two context-free languages and *R* be any regular language. Then which of the following is/are CORRECT?

    I. $L_1 \cup L_2$ is context free.
    II. $\overline{L_1}$ is context − free.
    III. $L_1 - R$ is context − free.
    IV. $L_1 \cap L_2$ is context − free.

    (a) I, II and IV only

    (b) I and III only

(c) II and IV only

(d) I only

17. **[Finite-Automata | GATE 2017 [Set-2]]** Identify the language generated by the following grammar, where S is the start variable.

$$\begin{aligned} S &\rightarrow XY \\ X &\rightarrow aX|\ a \\ Y &\rightarrow aYb|\ \in \end{aligned}$$

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

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

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

(d) $\{ a^m\ b^n \mid m > n, n > 0\}$

18. **[DFA | GATE 2017 [Set-2]]** The minimum possible number of a deterministic finite automation that accepts the regular language $L = \{ w_1\ aw_2 \mid w_1\ , w_2 \in \{ a,b\}\ ^*, \mid w_1 \mid = 2,\mid w_2 \mid \geq$ is ________.

(a) 8

(b) 9

(c) 10

(d) 11

19. **[NFA | GATE 2017 [Set-2]]** Let δ denote the transition function and

$$\hat{\delta}$$

denote the extended transition function of the $\in$ -NFA whose transition table is given below:

δ	ϵ	a	b
$\rightarrow q_0$	$\{q_2\}$	$\{q_1\}$	$\{q_0\}$
q_1	$\{q_2\}$	$\{q_2\}$	$\{q_3\}$
q_2	$\{q_0\}$	$\emptyset$	$\emptyset$
q_3	$\emptyset$	$\emptyset$	$\{q_2\}$

Then

$$\hat{\delta}(q_2, aba)$$

is

(a) ϕ

(b) $\{ q_0\ ,q_1\ ,q_3\ \}$

(c) $\{ q_0\ ,q_1\ ,q_2\ \}$

(d) $\{ q_0\ ,q_2\ ,q_3\ \}$

20. **[Context-Free-Language** | **GATE 2017** [**Set-2**] **]** Consider the following languages:

L_1 = { a^p | p is a prime number}
L_2 = { a^n b^m c^{2m} | $n \geq 0$, $m \geq 0$}
L_3 = { a^n b^n c^{2n} | $n \geq 0$}
L_4 = { a^n b^n | $n \geq 1$}

Which of the following are CORRECT?

I. L_1 is context-free but not regular.
II. L_2 is not context-free.
III. L_3 is not context-free but recursive.
IV. L_4 is deterministic context-free.

(a) I, II and IV only

(b) II and III only

(c) I and IV only

(d) III and IV only

21. **[Decidability-and-Undecidability** | **GATE 2017** [**Set-2**] **]** Let L(R) be the language represented by regular expression R. Let L(G) be the language generated by a context free grammar G. Let L(M) be the language accepted by a Turing machine M.

Which of the following decision problems are undecidable?

I. Given a regular expression R and a string w, is w ∈ L(R)?
II. Given a context-free grammar G, is L(G) = ϕ ?
III. Given a context-free grammar G, is L(G) = Σ * for some alphabet Σ ?
IV. Given a Turing machine M and a string w, is w ∈ L(M)?

(a) I and IV only

(b) II and III only

(c) II, III and IV only

(d) III and IV only

22. **[Regular-Language** | **GATE 2016** [**Set-1**] **]** Which of the following languages is generated by the given grammar?

S→ aS| bS| ∈

(a) { a^n b^m | n,m ≥ 0}

(b) { w ∈ { a,b} * | w has equal number of a's and b's}

(c) { a^n | $n \geq 0$} ∪ { b^n | $n \geq 0$} ∪ { a^n b(sup> n| $n \geq 0$}

(d) { a,b} *

23. **[Decidability-and-Undecidability** | **GATE 2016** [**Set-1**] **]** Which of the following decision problems are undecidable?

I. Given NFAs N_1 and N_2 , is L(N_1) ∩ L(N_2) = Φ ?
II. Given a CFG G = (N,Σ ,P,S) and a string x ∈ Σ *, does x ∈ L(G)?
III. Given CFGs G_1 and G_2 , is L(G_1) = L(G_2)?
IV. Given a TM M, is L(M) = Φ ?

(a) I and IV only

(b) II and III only

(c) III and IV only

(d) II and IV only

24. **[Regular-Expressions | GATE 2016 [Set-1]]** Which one of the following regular expressions represents the language: *the set of all binary strings having two consecutive* 0*s and two consecutive* 1*s* ?

(a) (0 + 1)* 0011(0 + 1)* + (0 + 1)* 1100(0 + 1)*

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

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

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

25. **[Membership-Function | GATE 2016 [Set-1]]** Consider the following context-free grammars:

G_1 : $S \rightarrow aS|\ B,\ B \rightarrow b|\ bB$
G_2 : $S \rightarrow aA|\ bB,\ A \rightarrow aA|\ B|\ \in\ ,\ B \rightarrow bB|\ \in$

Which one of the following pairs of languages is generated by G_1 and G_2 , respectively?

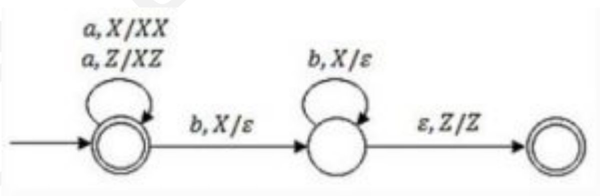
(a) $\{ a^m b^n \mid m > 0 \text{ or } n > 0\}$ and $\{ a^m b^n \mid m > 0 \text{ and } n > 0\}$

(b) $\{ a^m b^n \mid m > 0 \text{ and } n > 0\}$ and $\{ a^m b^n \mid m > 0 \text{ or } n \geq 0\}$

(c) $\{ a^m b^n \mid m \geq 0 \text{ or } n > 0\}$ and $\{ a^m b^n \mid m > 0 \text{ and } n > 0\}$

(d) $\{ a^m b^n \mid m \geq 0 \text{ and } n > 0\}$ and $\{ a^m b^n \mid m > 0 \text{ or } n > 0\}$

26. **[Push-Down-Automata | GATE 2016 [Set-1]]** Consider the transition diagram of a PDA given below with input alphabet $\Sigma = \{ a,b\}$ and stack alphabet $\Gamma = \{ X,Z\}$. Z is the initial stack symbol. Let L denote the language accepted by the PDA.



Which one of the following is **TRUE** ?

(a) $L = \{ a^n b^n \mid n \geq 0\}$ and is not accepted by any finite automata

(b) $L = \{ a^n \mid n \geq 0\} \cup \{ a^n b^n \mid n \geq 0\}$ and is not accepted by any deterministic PDA

(c) L is not accepted by any Turing machine that halts on every input

(d) $L = \{ a^n \mid n \geq 0\} \cup \{ a^n b^n \mid n \geq 0\}$ and is deterministic context-free

27. **[Recursive-Enumerable-Languages | GATE 2016 [Set-1]]** Let X be a recursive language and Y be a recursively enumerable but not recursive language. Let W and Z be two languages such that

$$\overline{Y}$$

reduces to W, and Z reduces to

$$\overline{X}$$

(reduction means the standard many-one reduction). Which one of the following statements is **TRUE** ?

(a) W can be recursively enumerable and Z is recursive.

(b) W can be recursive and Z is recursively enumerable.

(c) W is not recursively enumerable and Z is recursive.

(d) W is not recursively enumerable and Z is not recursive.

28. **[DFA | GATE 2016 [Set-2]]** The number of states in the minimum sized DFA that accepts the language defined by the regular expression

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

is_________.

(a) 2

(b) 3

(c) 4

(d) 5

29. **[Regular-Language | GATE 2016 [Set-2]]** Language L_1 is defined by the grammar: $S_1 \rightarrow aS_1 b| \in$
Language L_2 is defined by the grammar: $S_2 \rightarrow abS_2 \mid \in$

Consider the following statements:

P: L_1 is regular
Q: L_2 is regular

Which one of the following is **TRUE** ?

(a) Both P and Q are true

(b) P is true and Q is false

(c) P is false and Q is true

(d) Both P and Q are false

30. **[Closure-Property | GATE 2016 [Set-2]]** Consider the following types of languages: L_1 : Regular, L_2 : Context-free, L_3 : Recursive, L_4 : Recursively enumerable. Which of the following is/are **TRUE** ?

I. $\overline{L_3} \cup L_4$ is recursively enumerable
II. $\overline{L_2} \cup L_3$ is recursive
III. $L_1{}^* \cap L_2$ is context-free
IV. $L_1 \cup \overline{L_2}$ is context-free

(a) I only

(b) I and III only

(c) I and IV only

(d) I, II and III only

31. **[Regular-and-Finite-Automata | GATE 2016 [Set-2]]** Consider the following two statements:

I. If all states of an NFA are accepting states then the language accepted by the NFA is Σ *.
II. There exists a regular language A such that for all languages B, A $\cap$ B is regular.

Which one of the following is **CORRECT** ?

(a) Only **I** is true

(b) Only **II** is true

(c) Both **I** and **II** are true

(d) Both **I** and **II** are false

32. **[Context-Free-Language | GATE 2016 [Set-2]]** Consider the following languages:

$L_1 = \{ a^n\ b^m\ c^{n+m} : m,n \geq 1\}$
$L_2 = \{ a^n\ b^n\ c^{2n} : n \geq 1\}$

Which one of the following is **TRUE** ?

(a) Both L_1 and L_2 are context-free.

(b) L_1 is context-free while L_2 is not context-free.

(c) L_2 is context-free while L_1 is not context-free.

(d) Neither L_1 nor L_2 is context-free.

33. **[Turing Machine | GATE 2016 [Set-2]]** Consider the following languages.

L_1 = { (M)| M takes at least 2016 steps on some input} ,
L_2 = { (M)| M takes at least 2016 steps on all inputs} and
L_3 = { (M)| M accepts $\in$ } ,

where for each Turing machine M, (M) denotes a specific encoding of M. Which one of the following is **TRUE** ?

(a) L_1 is recursive and L_2 , L_3 are not recursive

(b) L_2 is recursive and L_1 , L_3 are not recursive

(c) L_1 , L_2 are recursive and L_3 is not recursive

(d) L_1 , L_2 , L_3 are recursive

34. **[Membership-Function | GATE 2016 [Set-2]]** A student wrote two context-free grammars **G1** and **G2** for generating a single C-like array declaration. The dimension of the array is at least one. For example,

int a[10] [3] ;

The grammars use D as the start symbol, and use six terminal symbols **int; id**[ ] **num**
.

Grammar **G1**	Grammar **G2**
D $\rightarrow$ **int** L ;	D $\rightarrow$ **int** L ;
L $\rightarrow$ **id** [E	L $\rightarrow$ **id** E
E $\rightarrow$ **num**]	E $\rightarrow$ E[**num**]
E $\rightarrow$ **num**] [E	E $\rightarrow$ [**num**]

Which of the grammars correctly generate the declaration mentioned above?

(a) Both **G1** and **G2**

(b) Only **G1**

(c) Only **G2**

(d) Neither **G1** nor **G2**

35. **[Closure-Property | GATE 2015 [Set-1]]** For any two languages L_1 and L_2 such that L_1 is context-free and L_2 is recursively enumerable but not recursive, which of the following is/are necessarily true?

I. $\overline{L_1}$ (complement of L_1) is recursive
II. $\overline{L_2}$ (complement of L_2) is recursive
III. $\overline{L_1}$ is context-free
IV. $\overline{L_1} \cup L_2$ is recursively enumerable

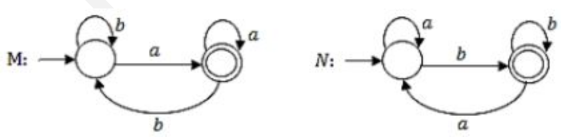
(a) I only

(b) III only

(c) III and IV only

(d) I and IV only

36. **[DFA | GATE 2015 [Set-1]]**



Consider the DFAs M and N given above. The number of states in a minimal DFA that accepts the language L(M) $\cap$ L(N) is __________.

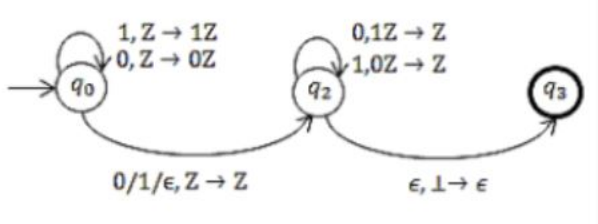
(a) 1

(b) 2

(c) 3

(d) 4

37. **[PDA | GATE 2015 [Set-1]]** Consider the NPDA (Q = { q0, q1, q2} , Σ = { 0, 1} , Γ = { 0, 1, $\perp$ } , δ , q0, $\perp$, F = { q2}), where (as per usual convention) Q is the set of states, Σ is the input alphabet, Γ is stack alphabet, δ is the state transition function, q0 is the initial state, $\perp$ is the initial stack symbol, and F is the set of accepting states, The state transition is as follows:



(a) 10110

(b) 10010

(c) 01010

(d) 01001

38. **[P-NP | GATE 2015 [Set-2]]** Consider two decision problems Q_1 , Q_2 such that Q_1 reduces in polynomial time to 3-SAT and 3 -SAT reduces in polynomial time to Q_2 . Then which one of following is consistent with the above statement?

(a) Q_1 is in NP, Q_2 in NP hard

(b) Q_1 is in NP, Q_2 is NP hard

(c) Both Q_1 and Q_2 are in NP

(d) Both Q_1 and Q_2 are NP hard

39. **[Decidability-and-Undecidability | GATE 2015 [Set-2]]** Consider the following statements:

I. The complement of every Turning decidable language is Turning decidable
II. There exists some language which is in NP but is not Turing decidable
III. If L is a language in NP, L is Turing decidable

Which of the above statements is/are True?

(a) Only II

(b) Only III

(c) Only I and II

(d) Only I and III

40. **[Regular-Language | GATE 2015 [Set-2]]** Which of the following language is/are regular ?

L1: $\{ wxw^R \mid w, x \in \{ a, b\}^* \text{ and } |w| , |x| > 0\}$ w^R is the reverse of string w
L2: $\{ a^n b^m \mid m \neq n \text{ and } m, n \geq 0\}$
L3: $\{ a^p b^q c^r \mid p, q, r \geq 0\}$

(a) L_1 and L_3 only

(b) L_2 only

(c) L_2 and L_3 only

(d) L_3 only

41. **[DFA | GATE 2015 [Set-2]]** The number of states in the minimal deterministic finite automaton corresponding to the regular expression (0 + 1) * (10) is __________.

(a) 3

(b) 4

(c) 5

(d) 6

42. **[Regular-Grammar | GATE 2015 [Set-2]]** Consider alphabet $\Sigma = \{0, 1\}$, the null/empty string λ and the sets of strings X_0, X_1 and X_2 generated by the corresponding non-terminals of a regular grammar. X_0, X_1 and X_2 are related as follows:

$X_0 = 1\ X_1$
$X_1 = 0\ X_1 + 1\ X_2$
$X_2 = 0\ X_1 + \{\lambda\}$

Which one of the following choices precisely represents the strings in X_0 ?

(a) 10(0* + (10*)* 1

(b) 10(0* + (10)*)* 1

(c) 1(0 + 10)* 1

(d) 10(0 + 10)* 1 + 110(0 + 10)* 1

43. **[Regular-Expressions | GATE 2015 [Set-3]]** Let L be the language represented by the regular expression Σ *0011Σ * where $\Sigma = \{0,1\}$. What is the minimum number of states in a DFA that recognizes

$$\bar{L}$$

(complement of L)?

(a) 4

(b) 5

(c) 6

(d) 8

44. **[Reducibility | GATE 2015 [Set-3]]** Language L1 is polynomial time reducible to language L2. Language L3 is polynomial time reducible to L2, which in turn is polynomial time reducible to language L4. Which of the following is/are True?

I. If L4 $\in$ P, L2 $\in$ P
II. If L1 $\in$ P or L3 $\in$ P, then L2 $\in$ P
III. L1 $\in$ P, if and only if L3 $\in$ P
IV. If L4 $\in$ P, then L1 $\in$ P and L3 $\in$ P

(a) II only

(b) III only

(c) I and IV only

(d) I only

45. **[Context-Free-Language | GATE 2015 [Set-3]]** Which of the following languages are context-free?

L1 = { a^m b^n a^n b^m | m, n $\geq$ 1}
L2 = { a^m b^n a^m b^n | m, n $\geq$ 1}
L3 = { a^m b^n | m = 2n + 1}

(a) L_1 and L_2 only

(b) L_1 and L_3 only

(c) L_2 and L_3 only

(d) L_3 only

46. **[Regular Languages | GATE 2014 [Set-1]]** Which one of the following is TRUE?

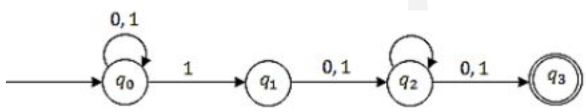
(a) The language L={ a^n b^n | n$\geq$ 0} is regular.

(b) The language L={ a^n | n is prime} is regular.

(c) The language L={ w| w has 3k+1b's for some k$\in$ N with Σ ={ a,b} } is regular.

(d) The language L={ ww| w$\in$ Σ * with Σ ={ 0,1} } is regular.

47. **[Finite-Automata | GATE 2014 [Set-1]]** Consider the finite automaton in the following figure.



What is the set of reachable states for the input string 0011?

(a) { q_0 , q_1 , q_2 }

(b) { q_0 , q_1 }

(c) { q_0 , q_1 , q_2 , q_3 }

(d) { q_3 }

48. **[Regular Languages | GATE 2014 [Set-2]]** If L_1 = { a^n | n$\geq$ 0} and L_2 = { b^n | n$\geq$ 0} , consider

(I) $L_1 \cdot L_2$ is a regular language
(II) $L_1 \cdot L_2$ = { a^n b^n | n$\geq$ 0}

Which one of the following is CORRECT?

(a) Only (I)

(b) Only (II)

(c) Both (I) and (II)

(d) Neither (I) nor (II)

49. **[Reducibility | GATE 2014 [Set-2]]** Let A$\leq_m$ B denotes that language A is mapping reducible (also known as many-to-one reducible) to language B. Which one of the following is FALSE?

(a) If A$\leq_m$ B and B is recursive then A is recursive.

(b) If A$\leq_m$ Band A is undecidable then B is undecidable.

(c) If A$\leq_m$ Band B is recursively enumerable then A is recursively enumerable.

(d) If A$\leq_m$ B and B is not recursively enumerable then A is not recursively enumerable.

50. **[Turing Machine | GATE 2014 [Set-2]]** Let $<$ M$>$ be the encoding of a Turing machine as a string over Σ = { 0, 1} . Let L = { $<$ M$>$ | M is a Turing machine that accepts a string of length 2014} . Then, L is

    (a) decidable and recursively enumerable

    (b) undecidable but recursively enumerable

    (c) undecidable and not recursively enumerable

    (d) decidable but not recursively enumerable

51. **[Regular languages | GATE 2014 [Set-2]]** Let L_1 = { w $\in$ { 0,1} * | w has at least as many occurrences of (110)'s as (011)'s} . Let L_2 = { w $\in$ { 0,1} *| w has at least as many occurrences of (000)'s as (111)'s} . Which one of the following is TRUE?

    (a) L_1 is regular but not L_2

    (b) L_2 is regular but not L_1

    (c) Both L_1 and L_2 are regular

    (d) Neither nor L_1 are L_2 regular

52. **[Regular Languages and Finite Automata | GATE 2014 [Set-3]]** The length of the shortest string NOT in the language (over Σ = { a b,} of the following regular is expression is ______________.

    a∗b∗(ba)∗a∗
    %%}} p

    (a) 3

    (b) 4

    (c) 5

    (d) 6

53. **[Unecidability | GATE 2014 [Set-3]]** Which one of the following problems is undecidable?

    (a) Deciding if a given context-free grammar is ambiguous.

    (b) Deciding if a given string is generated by a given context-free grammar.

    (c) Deciding if the language generated by a given context-free grammar is empty.

    (d) Deciding if the language generated by a given context-free grammar is finite.

54. **[Time-Complexity | GATE 2014 [Set-3]]** Suppose you want to move from 0 to 100 on the number line. In each step, you either move right by a unit distance or you take a shortcut. A shortcut is simply a pre-specified pair of integers i, j with i $<$ j. Given a shortcut i, j if you are at position i on the number line, you may directly move to j. Suppose T(k) denotes the smallest number of steps needed to move from k to 100. Suppose further that there is at most 1 shortcut involving any number, and in particular from 9 there is a shortcut to 15. Let y and z be such that T(9) = 1 + min(T(y),T(z)). Then the value of the product yz is _____.

    (a) 150

(b) 151

(c) 152

(d) 153

55. **[Context-Free-and-pushdown-Automata | GATE 2014 [Set-3]]** Consider the following languages over the alphabet Σ = { 0,1,c} :

L_1 = { 0^n 1^n | n$\geq$ 0}
L_2 = { w^c w^r | w$\in$ { 0,1} *}
L_3 = { ww^r | w$\in$ { 0,1} *} Here, w^r is the reverse of the string . Which of these languages are deterministic Context-free languages?

(a) None of the languages

(b) Only L_1

(c) Only L_1 and L_2

(d) All the three languages

56. **[NP-Complete | GATE 2014 [Set-3]]** Consider the decision problem 2CNFSAT defined as follows:

{ Φ | Φ is a satisfiable propositional formula in CNF with atmost two literals per clause}
For example, is a Boolean formula and it is in 2CNFSAT. The decision problem 2CNFSAT is

(a) NP-Complete.

(b) solvable in polynomial time by reduction to directed graph reachability.

(c) solvable in constant time since any input instance is satisfiable.

(d) NP-hard, but not NP-complete.

57. **[REL&Turing-Machines | GATE 2013]** Which of the following statements is/are FALSE?

1. For every non-deterministic Turing machine, there exists an equivalent deterministic Turing machine.
2. Turing recognizable languages are closed under union and complementation.
3. Turing decidable languages are closed under intersection and complementation.
4. Turing recognizable languages are closed under union and intersection.

(a) 1 and 4 only

(b) 1 and 3 only

(c) 2 only

(d) 3 only

58. **[NP-Complete | GATE 2013]** Which of the following statements are TRUE?

1. The problem of determining whether there exists a cycle in an undirected graph is in P.
2. The problem of determining whether there exists a cycle in an undirected graph is in NP.

3. If a problem A is NP-Complete, there exists a non-deterministic polynomial time algorithm to solve A.

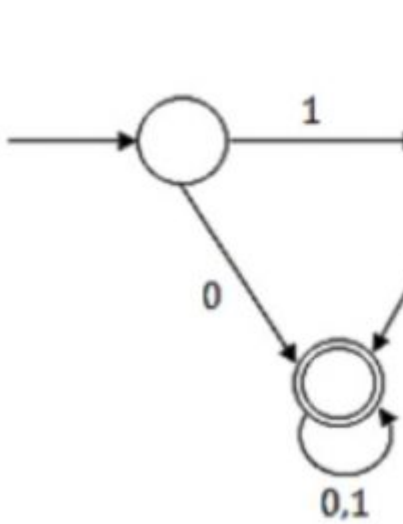
(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

59. **[Regular Languages and Finite Automata | GATE 2013]** Consider the DFA given.



Which of the following are FALSE?

Which of the following are FALSE?

1. Complement of L(A) is context-free.
2. L(A) = L((11*0+0)(0 + 1)*0*1*)
3. For the language accepted by A, A is the minimal DFA.
4. A accepts all strings over { 0, 1} of length at least 2.

(a) 1 and 3 only

(b) 2 and 4 only

(c) 2 and 3 only

(d) 3 and 4 only

60. **[Undecidability | GATE 2013]** Which of the following is/are undecidable?

1. G is a CFG. Is L(G) = Φ ?
2. G is a CFG. Is L(G) = Σ *?
3. M is a Turing machine. Is L(M) regular?
4. A is a DFA and N is an NFA. Is L(A) = L(N)?

(a) 3 only

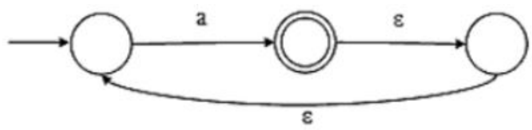
(b) 3 and 4 only

(c) 1, 2 and 3 only

(d) 2 and 3 only

61. **[Finite-Automata | GATE 2012]** What is the complement of the language accepted by the NFA shown below?

Assume Σ ={ a} and ∈ is the empty string.



(a) ϕ

(b) { ∈ }

(c) a*

(d) { a ,∈ }

62. **[Decidability-and-Undecidability | GATE 2012]** Which of the following problems are decidable?

1) Does a given program ever produce an output?

2) If L is a context-free language, then, is

$$\bar{L}$$

also context-free?

3) If L is a regular language, then, is

$$\bar{L}$$

also regular?

4) If L is a recursive language, then, is

$$\bar{L}$$

also recursive?

(a) 1, 2, 3, 4

(b) 1, 2

(c) 2, 3, 4

(d) 3, 4

63. **[Regular Languages | GATE 2012]** Given the language L ={ ab,aa,baa} , which of the following strings are in L *?

1) abaabaaabaa
2) aaaabaaaa
3) baaaaabaaaab
4) baaaaabaa

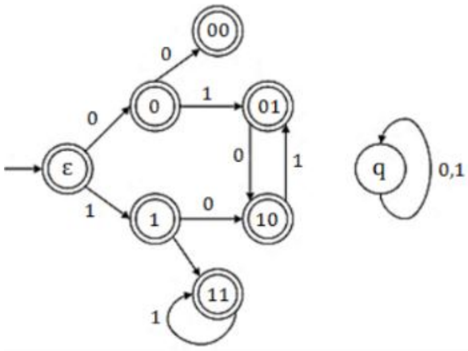
(a) 1, 2 and 3

(b) 2, 3 and 4

(c) 1, 2 and 4

(d) 1, 3 and 4

64. **[Finite-Automata | GATE 2012]** Consider the set of strings on { 0,1} in which, every substring of 3 symbols has at most two zeros. For example, 001110 and 011001 are in the language, but 100010 is not. All strings of length less than 3 are also in the language. A partially completed DFA that accepts this language is shown below.



The missing arcs in the DFA are

	00	01	10	11	q
00	1	0			
01				1	
10	0				
11			0		

(a)

	00	01	10	11	q
00		0			1
01		1			
10				0	
11		0			

(b)

	00	01	10	11	q
00		1			0
01		1			
10			0		
11		0			

(c)

	00	01	10	11	q
00		1			0
01				1	
10	0				
11			0		

(d)

65. **[Regular-Language | GATE 2011]** Let P be a regular language and Q be a context-free language such that Q ⊆ P. (For example, let P be the language represented by the regular expression p*q* and Q be [p^n q^n | n ∈ N]). Then which of the following is ALWAYS regular?
   (a) P ∩ Q
   (b) P - Q
   (c) Σ * - P
   (d) Σ * - Q
66. **[NFA | GATE 2011]** Which of the following pairs have DIFFERENT expressive power?
   (a) Deterministic finite automata (DFA) and Non-deterministic finite automata (NFA)
   (b) Deterministic push down automata (DPDA) and Non-deterministic push down automata (NFDA)
   (c) Deterministic single-tape Turning machine and Non-deterministic single tape Turning machine
   (d) Single-tape Turning machine and multi-tape Turning machine
67. **[Finite-Automata | GATE 2011]** Definition of a language L with alphabet { a} is given as following.
   L = { a^{nk} | k> 0, and n is a positive integer constant}
   What is the minimum number of states needed in a DFA to recognize L?
   (a) k+1
   (b) n+1
   (c) 2^{n+1}
   (d) 2^{k+1}
68. **[Identify-Class-Language | GATE 2011]** Consider the languages L1,L2 and L3 as given below.
   L1 = { 0^p 1^q | p,q∈ N} ,
   L2 = { 0^p 1^q | p,q∈ N and p=q} and
   L3 = { 0^p 1^q 0^r | p,q,r∈ N and p=q=r} . Which of the following statements is NOT TRUE ?
   (a) Push Down Automate (PDA) can be used to recognize L1 and L2
   (b) L1 is a regular language

(c) All the three languages are context free

(d) Turing machines can be used to recognize all the languages

69. **[Recursive-Enumerable-Languages | GATE 2010]** Let L1 be a recursive language. Let L2 and L3 be languages that are recursively enumerable but not recursive. Which of the following statements is not necessarily true?

(a) L2 - L1 is recursively enumerable

(b) L1 - L3 is recursively enumerable

(c) L2 $\cap$ L1 is recursively enumerable

(d) L2 $\cup$ L1 is recursively enumerable

70. **[Regular-Expressions | GATE 2010]** Let L = { w $\in$ (0 + 1)* | w has even number of 1s} , i.e. L is the set of all bit strings with even number of 1s. Which one of the regular expression below represents L?

(a) (0*10*1)*

(b) 0*(10*10*)*

(c) 0*(10*1*)*0*

(d) 0*1(10*1)*10*

71. **[Context-Free-Language | GATE 2010]** Consider the languages

L1 = { 0^i 1^j | i != j} .
L2 = { 0^i 1^j | i = j} .
L3 = { 0^i 1^j | i = 2j+1} .
L4 = { 0^i 1^j | i != 2j} . Which one of the following statements is true?

(a) Only L2 is context free

(b) Only L2 and L3 are context free

(c) Only L1 and L2 are context free

(d) All are context free

72. **[Finite-Automata | GATE 2010]** Let w be any string of length n is { 0, 1} *. Let L be the set of all substrings of w. What is the minimum number of states in a non-deterministic finite automaton that accepts L?

(a) n-1

(b) n

(c) n+1

(d) 2^{n-1}

73. **[Context-Free-Language | GATE 2009]** S$\rightarrow$ aSa| bSb| a| b The language generated by the above grammar over the alphabet { a,b} is the set of

(a) all palindromes.

(b) all odd length palindromes.

(c) strings that begin and end with the same symbol.

(d) all even length palindromes.

74. **[Regular-Expressions | GATE 2009]** Which one of the following languages over the alphabet { 0,1} is described by the regular expression: (0+1)*0(0+1)*0(0+1)*?

(a) The set of all strings containing the substring 00.

(b) The set of all strings containing at most two 0's.

(c) The set of all strings containing at least two 0's.

(d) The set of all strings that begin and end with either 0 or 1.

75. **[NFA | GATE 2009]** Which one of the following is FALSE?

(a) There is unique minimal DFA for every regular language.

(b) Every NFA can be converted to an equivalent PDA.

(c) Complement of every context-free language is recursive.

(d) Every non-deterministic PDA can be converted to an equivalent deterministic PDA.

76. **[Finite-Automata | GATE 2009]** Given the following state table of an FSM with two states A and B, one input and one output:

Present State A	Present State B	Input	Next State A	Next State B	Output
0	0	0	0	0	1
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	1	0	0
0	0	1	0	1	0
0	1	1	0	0	1
1	0	1	0	1	1
1	1	1	0	0	1

If the initial state is A = 0, B = 0, what is the minimum length of an input string which will take the machine to the state A = 0, B = 1 with Output = 1?

(a) 3

(b) 4

(c) 5

(d) 6

77. **[Identify-Class-Language | GATE 2009]** Let L = L1 ∩ L2, where L1 and L2 are languages as defined below:

L1 = { a^m b^m ca^n b^n | m,n $\geq$ 0 }
L2 = { a^i b^j c^k | i,j,k $\geq$ 0 } Then L is

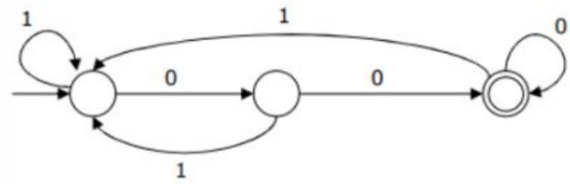
(a) Not recursive

(b) Regular

(c) Context free but not regular

(d) Recursively enumerable but not context free

78. **[Finite-Automata | GATE 2009]** The above DFA accepts the set of all strings over { 0,1} that



(a) begin either with 0 or 1

(b) end with 0

(c) end with 00

(d) contain the substring 00

79. **[Identify-Class-Language | GATE 2008]** Which of the following is true for the language $\{ a^p \mid p \text{ is a prime}\}$?

(a) It is not accepted by a Turing Machine

(b) It is regular but not context-free

(c) It is context-free but not regular

(d) It is neither regular nor context-free, but accepted by a Turing machine

80. **[Decidability-and-Undecidability | GATE 2008]** Which of the following are decidable?

I. Whether the intersection of two regular languages is infinite
II. Whether a given context-free language is regular
III. Whether two push-down automata accept the same language
IV. Whether a given grammar is context-free

(a) I and II

(b) I and IV

(c) II and III

(d) II and IV

81. **[Recursive-Enumerable-Languages | GATE 2008]** If L and

$$\bar{L}$$

are recursively enumerable, then L is

(a) regular

(b) context-free

(c) context-sensitive

(d) recursive

82. **[Recursive-Enumerable-Languages | GATE 2008]** Which of the following statements is false?

(a) Every NFA can be converted to an equivalent DFA

(b) Every non-deterministic Turing machine can be converted to an equivalent deterministic Turing machine

(c) Every regular language is also a context-free language

(d) Every subset of a recursively enumerable set is recursive

83. **[Finite-Automata | GATE 2008]** Given below are two finite state automata (→ indicates the start state and F indicates a final state)

Y:

	a	b
→1	1	2
2(F)	2	1

Z:

	a	b
→1	2	2
2(F)	1	1

Which of the following represents the product automaton Z*Y?

	a	b
→P	S	R
Q	R	S
R(F)	Q	P
S	Q	P

(a)

	a	b
→P	S	Q
Q	R	S
R(F)	Q	P
S	P	Q

(b)

	a	b
→P	Q	S
Q	R	S
R(F)	Q	P
S	Q	P

(c)

	a	b
→P	S	Q
Q	S	R
R(F)	Q	P
S	Q	P

(d)

84. **[Contest-Free-Grammar | GATE 2008]** Which of the following statements are true?

I. Every left-recursive grammar can be converted to a right-recursive grammar and vice-versa
II. All epsilon productions can be removed from any context-free grammar by suitable transformations
III. The language generated by a context-free grammar all of whose productions are of the form $X \rightarrow w$ or $X \rightarrow wY$ (where, w is a string of terminals and Y is a non-terminal), is always regular
IV. The derivation trees of strings generated by a context-free grammar in Chomsky Normal Form are always binary trees

(a) I, II, III and IV

(b) II, III and IV only

(c) I, III and IV only

(d) I, II and IV only

85. **[Match-the-Following | GATE 2008]** Match the following:

E.	Checking that identifiers are declared before their use	P.	$L = \{a^n b^m c^n d^m \mid n \geq 1, m \geq 1\}$
F.	Number of formal parameters in the declaration of a function agrees with the number of actual parameters in use of that function	Q.	$X \rightarrow XbX \mid XcX \mid dXf \mid g$
G.	Arithmetic expressions with matched pairs of parentheses	R.	$L = \{wcw \mid w \in (a \mid b)^*\}$
H.	Palindromes	S.	$X \rightarrow bXb \mid cXc \mid \varepsilon$

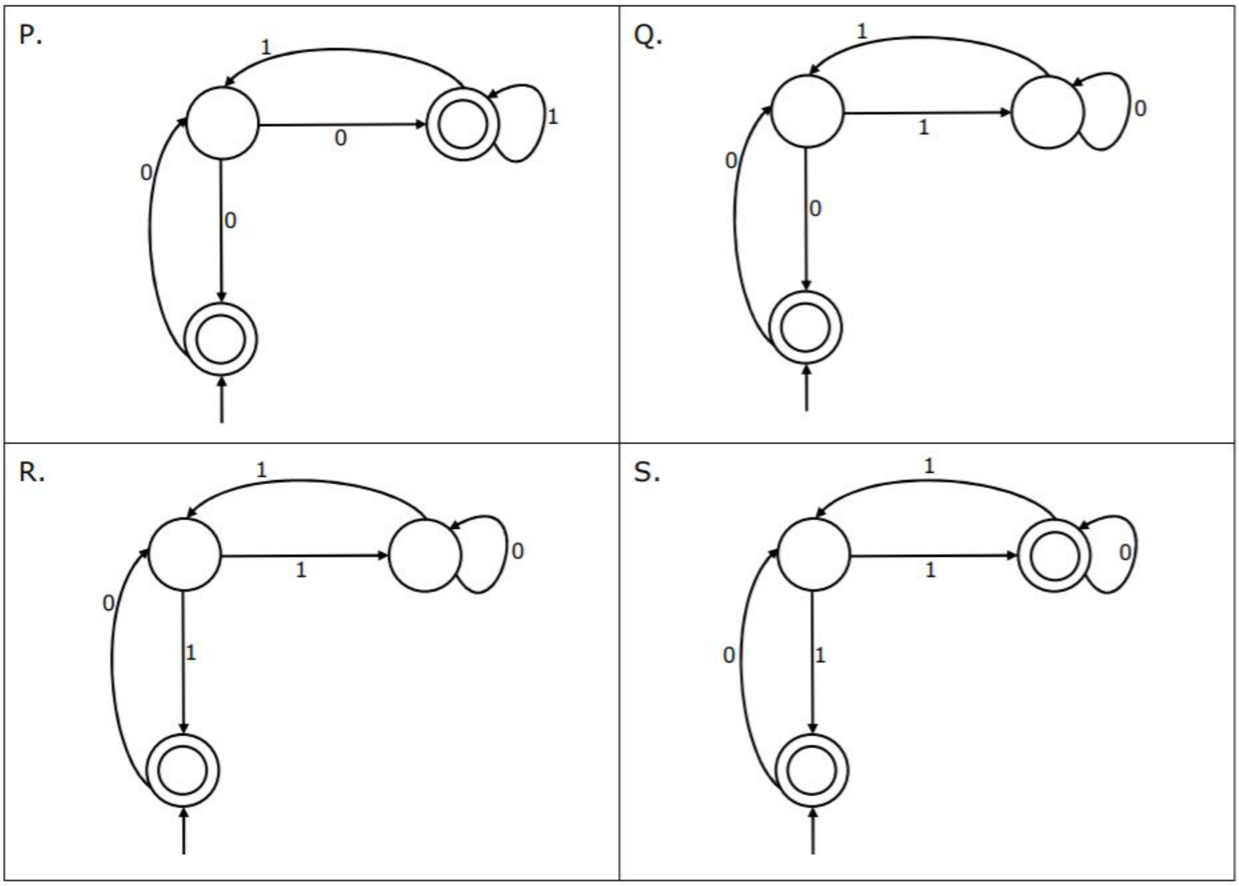
(a) E - P, F - R, G - Q, H - S

(b) E - R, F - P, G - S, H - Q

(c) E - R, F - P, G - Q, H - S

(d) E - P, F - R, G - S, H - Q

86. **[Finite-Automata | GATE 2008]** Match the following NFAs with the regular expressions they correspond to



1. $\in$ + 0(01*1 + 00) * 01*
2. $\in$ + 0(10 *1 + 00) * 0
3. $\in$ + 0(10 *1 + 10) *1
4. $\in$ + 0(10 *1 + 10) *10 *

(a) P-2, Q-1, R-3, S-4

(b) P-1, Q-3, R-2, S-4

(c) P-1, Q-2, R-3, S-4

(d) P-3, Q-2, R-1, S-4

87. **[Regular Languages | GATE 2008]** Which of the following are regular sets?

I. { a^n b^{2m} | n$\geq$ 0, m$\geq$ 0}
II. { a^n b^m | n=2m}
III. { a^n b^m | n $\neq$ 2m}
IV. { xcy | x,y$\in$ { a,b} *}

(a) I and IV only

(b) I and III only

(c) I only

(d) IV only

88. **[Decidability-and-Undecidability | GATE 2007]** Which of the following problems is undecidable?

(a) Membership problem for CFGs.

(b) Ambiguity problem for CFGs.

(c) Finiteness problem for FSAs.

(d) Equivalence problem for FSAs.

89. **[Regular-Language | GATE 2007]** Which of the following is TRUE?

(a) Every subset of a regular set is regular.

(b) Every finite subset of a non-regular set is regular.

(c) The union of two non-regular sets is not regular.

(d) Infinite union of finite sets is regular.

90. **[Finite-Automata | GATE 2007]** A minimum state deterministic finite automaton accepting the language L = { w | w ∈ { 0,1} *, number of 0s and 1s in w are divisible by 3 and 5, respectively} has

(a) 15 states

(b) 11 states

(c) 10 states

(d) 9 states

91. **[Identify-Class-Language | GATE 2007]** The language L = { $0^i\ 21^i$ | i≥ 0} over the alphabet { 0, 1, 2} is:

(a) not recursive.

(b) is recursive and is a deterministic CFL.

(c) is a regular language.

(d) is not a deterministic CFL but a CFL.

92. **[Regular-Language | GATE 2007]** Which of the following languages is regular?

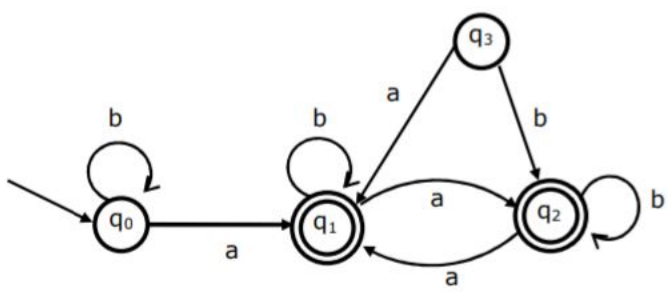
(a) { ww^R | w ∈ { 0,1} $^+$ }

(b) { ww^R x| x, w ∈ { 0,1} $^+$ }

(c) { wxw^R | x, w ∈ { 0,1} $^+$ }

(d) { xww^R | x, w ∈ { 0,1} $^+$ }

93. **[Finite-Automata | GATE 2007]** Consider the following Finite State Automaton.



The language accepted by this automaton is given by the regular expression

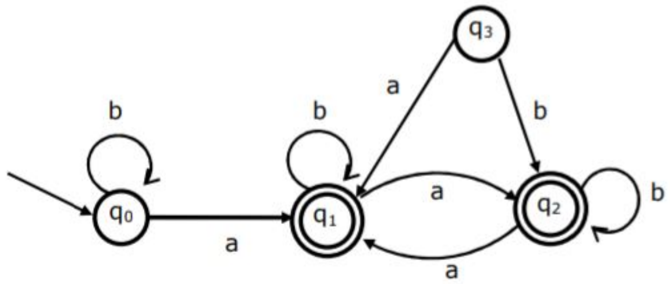
(a) b*ab*ab*ab*

(b) (a+b)*

(c) b*a(a+b)*

(d) b*ab*ab*

94. **[Finite-Automata | GATE 2007]** Consider the following Finite State Automaton.



The minimum state automaton equivalent to the above FSA has the following number of states

(a) 1

(b) 2

(c) 3

(d) 4

95. **[Context-Free-Language | GATE 2006]** Let L_1 = { $0^{n+m}\ 1^{n}\ 0^{m}$ | n,m $\geq$ 0} , L_2 = { $0^{n+m}\ 1^{n+m}\ 0^{m}$ | n,m $\geq$ 0} , and L_3 = { $0^{n+m}\ 1^{n+m}\ 0^{n+m}$ | n,m $\geq$ 0} . Which of these languages are NOT context free?

(a) L_1 only

(b) L_3 only

(c) L_1 and L_2

(d) L_2 and L_3

96. **[Regular-Language | GATE 2006]** If s is a string over (0 + 1)* then let n_0 (s) denote the number of 0's in s and n_1 (s) the number of 1's in s. Which one of the following languages is not regular?

(a) L = { s $\in$ (0+1)* | n_0 (s) is a 3-digit prime}

(b) L = { s $\in$ (0+1)* | for every prefix s' of s,| n_0 (s') - n_1 (s')| $\leq$ 2}

(c) L = { s $\in$ (0+1)* | n_0 (s) - n_1 (s)| $\leq$ 4}

(d) L = { s $\in$ (0+1)* | n_0 (s) mod 7 = n_1 (s) mod 5 = 0}

97. **[Identify-Class-Language | GATE 2006]** For S $\in$ (0+1) * let d(s) denote the decimal value of s (e.g. d(101) = 5). Let L = { s $\in$ (0+1)*| d(s)mod5 = 2 and d(s)mod7 = 4} .

Which one of the following statements is true?

(a) L is recursively enumerable, but not recursive

(b) L is recursive, but not context-free

(c) L is context-free, but not regular

(d) L is regular

98. **[Contest-Free-Grammar | GATE 2006]** Consider the following statements about the context free grammar

$G = \{ S \rightarrow SS, S \rightarrow ab, S \rightarrow ba, S \rightarrow \in \}$

I. G is ambiguous
II. G produces all strings with equal number of a's and b's
III. G can be accepted by a deterministic PDA. Which combination below expresses all the true statements about G?

(a) I only

(b) I and III only

(c) II and III only

(d) I, II and III

99. **[Identify-Class-Language | GATE 2006]** Let L_1 be a regular language, L_2 be a deterministic context-free language and L_3 a recursively enumerable, but not recursive, language. Which one of the following statements is false?

(a) $L_1 \cap L_2$ is a deterministic CFL

(b) $L_3 \cap L_1$ is recursive

(c) $L_1 \cup L_2$ is context free

(d) $L_1 \cap L_2 \cap L_3$ is recursively enumerable

100. **[Finite-Automata | GATE 2006]** Consider the regular language L = (111 + 11111)*. The minimum number of states in any DFA accepting this languages is:

(a) 3

(b) 5

(c) 8

(d) 9

101. **[Grammar | GATE 2006]** Which one of the following grammars generates the language $L = \{ a^i b^j \mid i \neq j \}$?

(a) $S \rightarrow AC \mid CB$
$C \rightarrow aCb \mid a \mid b$
$A \rightarrow aA \mid \in$
$B \rightarrow Bb \mid \in$

(b) $S \rightarrow aS \mid Sb \mid a \mid b$

(c) $S \rightarrow AC \mid CB$
$C \rightarrow aCb \mid \in$
$A \rightarrow aA \mid \in$
$B \rightarrow Bb \mid \in$

(d) $S \rightarrow AC \mid CB$
$C \rightarrow aCb \mid \in$
$A \rightarrow aA \mid a$
$B \rightarrow Bb \mid b$

102. **[Grammar | GATE 2006]** In the correct grammar of above question, what is the length of the derivation (number of steps starting from S) to generate the string a^l b^m with $l \neq m$?

(a) max(l,m)+2

(b) l+m+2

(c) l+m+3

(d) max(l, m)+3

103. **[Decidability-and-Undecidability | GATE 2005]** Consider three decision problems P_1 , P_2 and P_3 . It is known that P_1 is decidable and P_2 is undecidable. Which one of the following is TRUE?

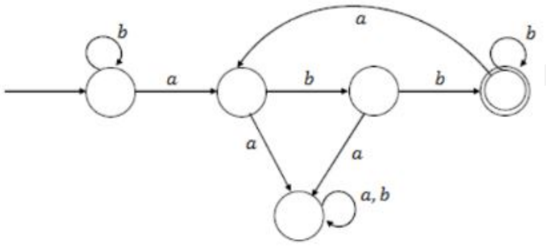
(a) P_3 is decidable if P_1 is reducible to P_3

(b) P_3 is undecidable if P_3 is reducible to P_2

(c) P_3 is undecidable if P_2 is reducible to P_3

(d) P_3 is decidable if P_3 is reducible to P_2 's complement

104. **[Finite-Automata | GATE 2005]** Consider the machine M:



The language recognized by M is:

(a) { w ∈ { a, b} * | every a in w is followed by exactly two b's}

(b) { w ∈ { a, b} *| every a in w is followed by at least two b'}

(c) { w ∈ { a, b} *| w contains the substring 'abb'}

(d) { w ∈ { a, b} *| w does not contain 'aa' as a substring}

105. **[NFA | GATE 2005]** Let N_f and N_p denote the classes of languages accepted by non-deterministic finite automata and non-deterministic push-down automata, respectively. Let D_f and D_p denote the classes of languages accepted by deterministic finite automata and deterministic push-down automata, respectively. Which one of the following is TRUE?

(a) $D_f \subset N_f$ and $D_p \subset N_p$

(b) $D_f \subset N_f$ and $D_p = N_p$

(c) $D_f = N_f$ and $D_p = N_p$

(d) $D_f = N_f$ and $D_p \subset N_p$

106. **[Context-Free-Language | GATE 2005]** Consider the languages:

$L_1 = \{ a^n \ b^n \ c^m \mid n,m > 0\}$ and $L_2 = \{ a^n \ b^m \ c^m \mid n,m > 0\}$

Which one of the following statements is FALSE?

(a) $L_1 \cap L_2$ is a context-free language

(b) $L_1 \cup L_2$ is a context-free language

(c) L_1 and L_2 are context-free languages

(d) $L_1 \cap L_2$ is a context sensitive language

107. **[Recursive-Enumerable-Languages | GATE 2005]** Let L_1 be a recursive language, and let L_2 be a recursively enumerable but not a recursive language. Which one of the following is TRUE?

$\overline{L_1}$ is recursive and $\overline{L_2}$ is recursively enumerable

(a)

$\overline{L_1}$ is recursive and $\overline{L_2}$ is not recursively enumerable

(b)

$\overline{L_1}$ and $\overline{L_2}$ are recursively enumerable

(c)

$\overline{L_1}$ is recursively enumerable and $\overline{L_2}$ is recursive

(d)

108. **[Context-Free-Language | GATE 2005]** Consider the languages:

$L_1 = \{ ww^R \mid w \in \{0,1\}^* \}$
$L_2 = \{ w\# w^R \mid w \in \{0,1\}^* \}$, where # is a special symbol
$L_3 = \{ ww \mid w \in (0, 1)^* \}$

Which one of the following is TRUE?

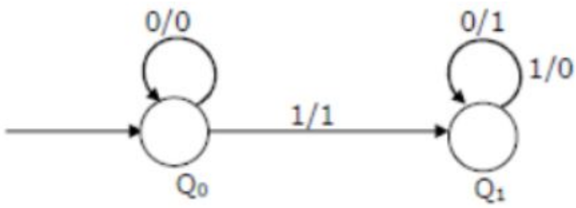
(a) L_1 is a deterministic CFL

(b) L_2 is a deterministic CFL

(c) L_3 is a CFL, but not a deterministic CFL

(d) L_3 is a deterministic CFL

109. **[Finite-Automata | GATE 2005]** The following diagram represents a finite state machine which takes as input a binary number from the least significant bit.



Which one of the following is TRUE?

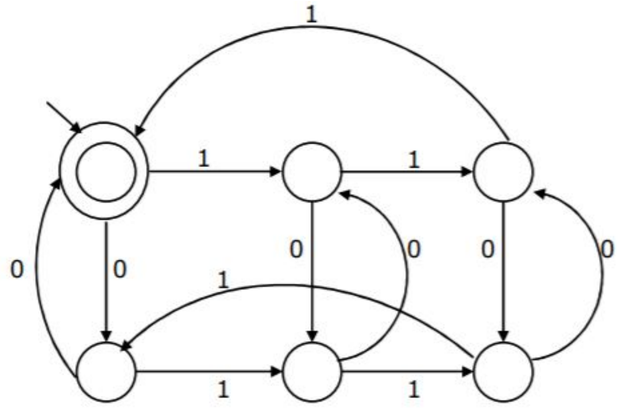
(a) It computes 1's complement of the input number

(b) It computes 2's complement of the input number

(c) It increments the input number

(d) It decrements the input number

110. **[Finite-Automata | GATE 2004]** The following finite state machine accepts all those binary strings in which the number of 1's and 0's are respectively.



(a) divisible by 3 and 2

(b) odd and even

(c) even and odd

(d) divisible by 2 and 3

111. **[Identify-Class-Language | GATE 2004]** The language { a^m b^n C^{m+n} | m, n $\geq$ 1} is

(a) regular

(b) context-free but not regular

(c) context sensitive but not context free

(d) type-0 but not context sensitive

112. **[Recursive-Enumerable-Languages | GATE 2004]** L_1 is a recursively enumerable language over Σ . An algorithm A effectively enumerates its words as w_1 , w_2 , w_3 , ... Define another language L_2 over Σ Union { # } as { w_i # w_j : w_i , $w_j \in L_1$, i < j} . Here # is a new symbol. Consider the following assertions.

S_1 : L_1 is recursive implies L_2 is recursive
S_2 : L_2 is recursive implies L_1 is recursive

Which of the following statements is true?

(a) Both S_1 and S_2 are true

(b) S_1 is true but S_2 is not necessarily true

(c) S_2 is true but S_1 is not necessarily true

(d) Neither is necessarily true

113. **[Recursive-Enumerable-Languages | GATE 2003]** Nobody knows yet if P = NP. Consider the language L defined as follows:

$$L = \begin{cases} (0+1)^* & \text{if } P = NP \\ \emptyset & \text{otherwise} \end{cases}$$

Which of the following statements is true?

(a) L is recursive

(b) L is recursively enumerable but not recursive

(c) L is not recursively enumerable

(d) Whether L is recursive or not will be known after we find out if P = NP

114. **[Regular-Expressions | GATE 2003]** The regular expression 0*(10*)* denotes the same set as

(a) (1*0)*1*

(b) 0+(0+10)*

(c) (0+1)*10(0+1)*

(d) None of the above

115. **[Identify-Class-Language | GATE 2003]** If the strings of a language L can be effectively enumerated in lexicographic (i.e., alphabetic) order, which of the following statements is true?

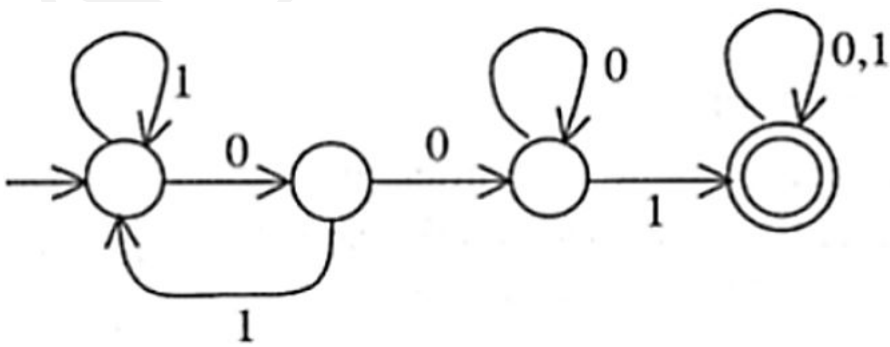
(a) L is necessarily finite

(b) L is regular but not necessarily finite

(c) L is context free but not necessarily regular

(d) L is recursive but not necessarily context free

116. **[Finite-Automata | GATE 2003]** Consider the following deterministic finite state automaton M.



Let S denote the set of seven bit binary strings in which the first, the fourth, and the last bits are 1. The number of strings in S that are accepted by M is

(a) 1

(b) 5

(c) 7

(d) 8

117. **[Contest-Free-Grammar | GATE 2003]** Let G = ({ S} ,{ a,b} ,R,S) be a context free grammar where the rule set R is S → aSb | SS | ∈ Which of the following statements is true?

(a) G is not ambiguous

(b) There exist x, y ∈ L(G) such that xy ∉ L(G)

(c) There is a deterministic pushdown automaton that accepts L(G)

(d) We can find a deterministic finite state automaton that accepts L(G)

118. **[Decidability-and-Undecidability | GATE 2003]** Consider two languages L_1 and L_2 each on the alphabet Σ . Let f: Σ → Σ be a polynomial time computable bijection such that (∀ x)[x ∈ L_1 iff f(x) ∈ L_2] . Further, let f^{-1} be also polynomial time computable.

Which of the following CANNOT be true?

(a) L_1 ∈ P and L_2 is finite

(b) L_1 ∈ NP and L_2 ∈ P

(c) L_1 is undecidable and L_2 is decidable

(d) L_1 is recursively enumerable and L_2 is recursive

119. **[Turing Machine | GATE 2003]** A single tape Turing Machine M has two states q_0 and q_1 , of which q_0 is the starting state. The tape alphabet of M is { 0, 1, B} and its input alphabet is { 0, 1} . The symbol B is the blank symbol used to indicate end of an input string. The transition function of M is described in the following table.

	0	1	B
q_0	$q_1, 1, R$	$q_1, 1, R$	Halt
q_1	$q_1, 1, R$	$q_0, 1, L$	q_0, B, L

The table is interpreted as illustrated below. The entry (q_1 , 1, R) in row q_0 and column 1 signifies that if M is in state q_0 and reads 1 on the current tape square, then it writes 1 on the same tape square, moves its tape head one position to the right and transitions to state q_1 .

Which of the following statements is true about M?

(a) M does not halt on any string in $(0+1)^+$

(b) M does not halt on any string in (00+1)*

(c) M halts on all strings ending in a 0

(d) M halts on all strings ending in a 1

120. **[Turing Machine | GATE 2003]** Define languages L_0 and L_1 as follows:

L_0 = { (M, w, 0) | M halts on w}
L_1 = { (M, w, 1) | M does not halts on w}

Here (M, w, i) is a triplet, whose first component. M, is an encoding of a Turing Machine, second component, w, is a string, and third component, i, is a bit.

Let L = $L_0 \cup L_1$. Which of the following is true?

L is recursively enumerable, but $\overline{L}$ is not

(a)

$\overline{L}$ is recursively enumerable, but L is not

(b)

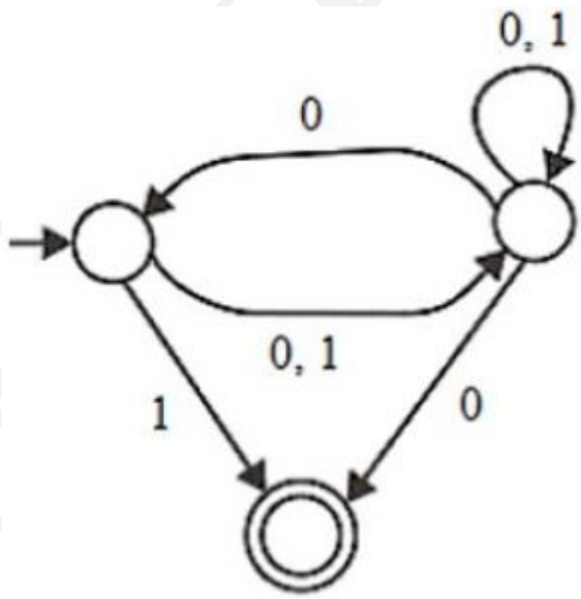
Both L and $\overline{L}$ are recursive

(c)

Neither L nor $\overline{L}$ is recursively enumerable

(d)

121. **[Finite-Automata | GATE 2003]** Consider the NFA M shown below.



Let the language accepted by M be L. Let L_1 be the language accepted by the NFA M_1 , obtained by changing the accepting state of M to a non-accepting state and by changing the non-accepting state of M to accepting states. Which of the following statements is true?

(a) $L_1 = \{0,1\}^* - L$

(b) $L_1 = \{0,1\}^*$

(c) $L_1 \subseteq L$

(d) $L_1 = L$

122. **[Identify-Class-Language | GATE 2002]** The language accepted by a Pushdown Automaton in which the stack is limited to 10 items is best described as

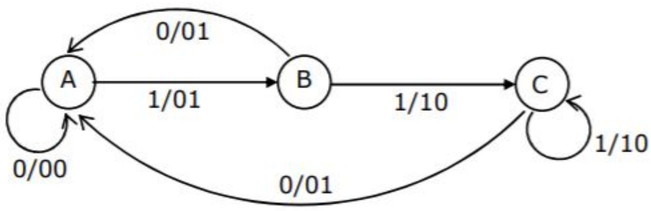
    (a) Context free

    (b) Regular

    (c) Deterministic Context free

    (d) Recursive

123. **[Finite-Automata | GATE 2002]** The Finite state machine described by the following state diagram with A as starting state, where an arc label is x/y and x stands for 1-bit input and y stands for 2- bit output



    (a) Outputs the sum of the present and the previous bits of the input.

    (b) Outputs 01 whenever the input sequence contains 11

    (c) Outputs 00 whenever the input sequence contains 10

    (d) None of the above

124. **[Finite-Automata | GATE 2002]** The smallest finite automaton which accepts the language $\{ x |$ length of x is divisible by 3$\}$ has

    (a) 2 states

    (b) 3 states

    (c) 4 states

    (d) 5 states

125. **[Properties-of-Languages | GATE 2002]** Which of the following is true?

    (a) The complement of a recursive language is recursive.

    (b) The complement of a recursively enumerable language is recursively enumerable.

    (c) The complement of a recursive language is either recursive or recursively enumerable.

    (d) The complement of a context-free language is context-free.

126. **[Identify-Class-Language | GATE 2002]** The C language is:

    (a) A context free language

    (b) A context sensitive language

    (c) A regular language

    (d) Parsable fully only by a Turing machine

127. **[Turing Machine | GATE 2002]** The aim of the following question is to prove that the language { M| M is the code of a Turing Machine which, irrespective of the input, halts and outputs a 1} , is undecidable. This is to be done by reducing form the language { M',x| M' halts on x} , which is known to be undecidable. In parts (a) and (b) describe the 2 main steps in the construction of M. in part (c) describe the key property which relates the behaviour of M on its input w to the behaviour of M' on x.

    (a) On input w, what is the first step that M must make?
    (b) On input w, based on the outcome of the first step, what is the second step that M must make?
    (c) What key property relates the behaviour of M on w to the behaviour of M' on x?

    (a) Theory Explanation is given below.

128. **[Finite-Automata | GATE 2002]** We require a four state automaton to recognize the regular expression (a| b)*abb.

    (a) Give an NFA for this purpose.
    (b) Give a DFA for this purpose.

    (a) Theory Explanation is given below.

129. **[Regular Languge | GATE 2001]** Consider the following two statements:

    S1: { 0^{2n} | n≥ 1| } is a regular language
    S2: { 0^m 1^n 0^{m+n} | m≥ 1 and n≥ 1| } is a regular language Which of the following statements is correct?

    (a) Only S1 is correct
    (b) Only S2 is correct
    (c) Both S1 and S2 are correct
    (d) None of S1 and S2 is correct

130. **[Properties-of-Languages | GATE 2001]** Which of the following statements is true?

    (a) If a language is context free it can always be accepted by a deterministic push-down automaton
    (b) The union of two context free languages is context free
    (c) The intersection of two context free languages is context free
    (d) The complement of a context free language is context free

131. **[Finite-Automata | GATE 2001]** Given an arbitrary non-deterministic finite automaton (NFA) with N states, the maximum number of states in an equivalent minimized DFA is at least

    (a) N^2
    (b) 2^N
    (c) 2N
    (d) N!

132. **[Finite-Automata | GATE 2001]** Consider a DFA over $\Sigma = \{ a,b \}$ accepting all strings which have number of a's divisible by 6 and number of b's divisible by 8. What is the minimum number of states that the DFA will have?

    (a) 8

    (b) 14

    (c) 15

    (d) 48

133. **[Turing Mchine | GATE 2001]** Consider the following problem X.

    Given a Turing machine M over the input alphabet Σ , any state q of M And a word $w \in \Sigma^*$, does the computation of M on w visit the state q?

    Which of the following statements about X is correct?

    (a) X is decidable

    (b) X is undecidable but partially decidable

    (c) X is undecidable and not even partially decidable

    (d) X is not a decision problem

134. **[Finite-Automata | GATE 2001]** Construct DFA's for the following languages:

    ```
    (a) L = { w| w ∈ { a,b} *, w has baab as a subsring }
    (b) L = { w| w ∈ { a,b} *, w has an odd number of a's and an odd number o
    ```

    (a) Theory Explanation is given below.

135. **[Push-Down-Automata | GATE 2001]** Give a deterministic PDA for the language $L = \{ a^n cb^{2n} \mid n \geq 1 \}$ over the alphabet $\Sigma = \{ a,b,c \}$. Specify the acceptance state.

    (a) Theory Explanation is given below.

136. **[Turing Machine | GATE 2001]** Let a decision problem X be defined as follows:

    ```
    X: Given a Turing machine M over Σ and nay word w ∈ Σ ,
       does M loop forever on w?
    ```

    You may assume that the halting problem of Turing machine is undecidable but partially decidable.

    (a) Show that X is undecidable.
    (b) Show that X is not even partially decidable.

    (a) Theory Explanation is given below.

137. **[Regular-Expressions | GATE 2000]** Let S and T be language over $\Sigma = \{ a,b \}$ represented by the regular expressions (a+b*)* and (a+b)*, respectively. Which of the following is true?

    (a) $S \subset T$

    (b) $T \subset S$

    (c) $S = T$

    (d) $S \cap T = \Phi$

138. **[Identify-Class-Language | GATE 2000]** Let L denotes the language generated by the grammar $S \rightarrow 0S0/00$.
Which of the following is true?

(a) $L = 0^+$

(b) L is regular but not 0^+

(c) L is context free but not regular

(d) L is not context free

139. **[Finite-Automata | GATE 2000]** What can be said about a regular language L over $\{a\}$ whose minimal finite state automation has two states?

(a) L must be $\{a^n \mid n \text{ is odd}\}$

(b) L must be $\{a^n \mid n \text{ is even}\}$

(c) L must be $\{a^n \mid \geq 0\}$

(d) Either L must be $\{a^n \mid n \text{ is odd}\}$, or L must be $\{a^n \mid n \text{ is even}\}$

140. **[Decidability-and-Undecidability | GATE 2000]** Consider the following decision problems:

(P1) Does a given finite state machine accept a given string
(P2) Does a given context free grammar generate an infinite number of stings
Which of the following statements is true?

(a) Both (P1) and (P2) are decidable

(b) Neither (P1) nor (P2) are decidable

(c) Only (P1) is decidable

(d) Only (P2) is decidable

141. **[Descriptive | GATE 2000]** (a) Construct as minimal finite state machine that accepts the language, over $\{0,1\}$, of all strings that contain neither the substring 00 nor the substring 11.

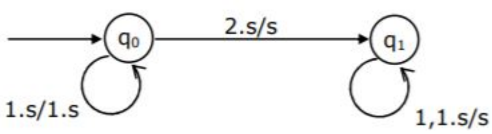
(b) Consider the grammar

$$
\begin{aligned}
S &\rightarrow aS\ Ab \\
S &\rightarrow \in \\
A &\rightarrow bA \\
A &\rightarrow \in
\end{aligned}
$$

Where S, A are non-terminal symbols with S being the start symbol; a,b are terminal symbols and $\in$ is the empty string. This grammar generates strings of the form $a^i\ b^j$ for some $i,j \geq 0$, where i and j satisfy some condition. What is the condition on the values of i and j?

(a) Theory Explanation is given below.

142. **[Descriptive | GATE 2000]** A pushdown automaton (pda) is given in the following extended notation of finite state diagrams:



The nodes denote the states while the edges denote the moves of the pda. The edge labels are of the form d, s where d is the input symbol read and s, s′ are the stack contents before and after the move. For example the edge labeled 1, s/1.s denotes the move from state to q_o to q_0 in which the input symbol 1 is read and pushed to the stack.

(a) Introduce two edges with appropriate labels in the above diagram so that the resulting pda accepts the language
$\{ x2x^R \mid x \in \{ 0,1\}^*, x^R$ denotes reverse of x$\}$, by empty stack.
(b) Describe a non-deterministic pda with three states in the above notation that accept the language $\{ 0^n 1^m \mid n \leq m \leq 2n\}$ by empty stack

(a) Theory Explanation is given below.

143. **[Finite-Automata | GATE 1999]** Consider the regular expression (0 + 1) (0 + 1).... N times. The minimum state finite automation that recognizes the language represented by this regular expression contains

(a) n states

(b) n + 1 states

(c) n + 2 states

(d) None of the above

144. **[Context-Free-Language | GATE 1999]** Context-free languages are closed under:

(a) Union, intersection

(b) Union, Kleene closure

(c) Intersection, complement

(d) Complement, Kleene closure

145. **[Push-Down-Automata | GATE 1999]** Let L_D be the set of all languages accepted by a PDA by final state and L_E the set of all languages accepted by empty stack. Which of the following is true?

(a) $L_D = L_E$

(b) $L_D \supset L_E$

(c) $L_E = L_D$

(d) None of the above

146. **[Identify-Class-Language | GATE 1999]** If L is context free language and L2 is a regular language which of the following is/are false?

(a) L1 - L2 is not context free

(b) L1 ∩ L2 is context free

(c) L1 is context free

(d) L2 is regular

(e) Both A and C

147. **[Grammar | GATE 1999]** A grammar that is both left and right recursive for a non-terminal, is

(a) Ambiguous

(b) Unambiguous

(c) Information is not sufficient to decide whether it is ambiguous or unambiguous

(d) None of the above

148. **[Regular-Expressions | GATE 1998]** If the regular set A is represented by A = (01 + 1)* and the regular set 'B' is represented by B = ((01)*1*)*, which of the following is true?

(a) $A \subset B$

(b) $B \subset A$

(c) A and B are incomparable

(d) A = B

149. **[Finite-Automata | GATE 1998]** Both A and B are equal, which generates strings over { 0,1} , while 0 is followed by 1.

(a) The numbers 1, 2, 4, 8, ..., 2^n , ... written in binary

(b) The numbers 1, 2, 4, ..., 2^n , ...written in unary

(c) The set of binary string in which the number of zeros is the same as the number of ones

(d) The set { 1, 101, 11011, 1110111, ...}

150. **[NFA | GATE 1998]** Regarding the power of recognition of languages, which of the following statements is false?

(a) The non-deterministic finite-state automata are equivalent to deterministic finite-state automata.

(b) Non-deterministic Push-down automata are equivalent to deterministic Push-down automata.

(c) Non-deterministic Turing machines are equivalent to deterministic Push-down automata.

(d) Both B and C

151. **[Regular-Expressions | GATE 1998]** The string 1101 does not belong to the set represented by

(a) 110*(0 + 1)

(b) 1 (0 + 1)* 101

(c) (10)* (01)* (00 + 11)*

(d) Both C and D

152. **[Sub-Strings | GATE 1998]** How many sub strings of different lengths (non-zero) can be found formed from a character string of length n?

(a) n

(b) n^2

(c) 2^n

$$\frac{n(n+1)}{2}$$

(d)

153. **[Finite-Automata | GATE 1998]** Let L be the set of all binary strings whose last two symbols are the same. The number of states in the minimum state deterministic finite 0 state automaton accepting L is

    (a) 2

    (b) 5

    (c) 8

    (d) 3

154. **[Regular-Language | GATE 1998]** Which of the following statements is false?

    (a) Every finite subset of a non-regular set is regular

    (b) Every subset of a regular set is regular

    (c) Every finite subset of a regular set is regular

    (d) The intersection of two regular sets is regular

155. **[Countability | GATE 1997]** Given Σ = { a,b} , which one of the following sets is not countable?

    (a) Set of all strings over Σ

    (b) Set of all languages over Σ

    (c) Set of all regular languages over Σ

    (d) Set of all languages over Σ accepted by Turing machines

156. **[Regular-Expressions | GATE 1997]** Which one of the following regular expressions over { 0,1} denotes the set of all strings not containing 100 as a substring?

    (a) 0*(1+0)*

    (b) 0*1010*

    (c) 0*1*01

    (d) 0(10+1)*

157. **[Decidability-and-Undecidability | GATE 1997]** Which one of the following is not decidable?

    (a) Given a Turing machine M, a stings s and an integer k, M accepts s within k steps

    (b) Equivalence of two given Turing machines

    (c) Language accepted by a given finite state machine is not empty

    (d) Language generated by a context free grammar is non empty

158. **[Push-Down-Automata | GATE 1997]** Which of the following languages over { a,b,c} is accepted by a deterministic pushdown automata?

    Note: w^R is the string obtained by reversing 'w'.

(a) $\{ w \subset w^R \mid w \in \{ a,b\}^* \}$

(b) $\{ ww^R \mid w \in \{ a,b,c\}^* \}$

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

(d) { w| w is a palindrome over { a,b,c} }

159. **[Regular-Expressions | GATE 1996]** Which two of the following four regular expressions are equivalent? ($\in$ is the empty string).

(i) $(00)^*(\in +0)$
(ii) $(00)^*$
(iii) 0^*
(iv) $0(00)^*$

(a) (i) and (ii)

(b) (ii) and (iii)

(c) (i) and (iii)

(d) (iii) and (iv)

160. **[Decidability-and-Undecidability | GATE 1996]** Which of the following statements is false?

(a) The Halting problem of Turing machines is undecidable.

(b) Determining whether a context-free grammar is ambiguous is undecidbale.

(c) Given two arbitrary context-free grammars G1 and G2 it is undecidable whether L(G1) = L(G2).

(d) Given two regular grammars G1 and G2 it is undecidable whether L(G1) = L(G2).

161. **[Identify-Class-Language | GATE 1996]** Let $L \subseteq \Sigma^*$ where $\Sigma = \{ a, b \}$. Which of the following is true?

(a) L = { x| x has an equal number of a's and b's } is regular

(b) $L = \{ a^n b^n \mid n \geq 1 \}$ is regular

(c) L = { x| x has more a's and b's} is regular

(d) $L = \{ a^m b^n \mid m \geq 1, n \geq 1 \}$ is regular

162. **[Identify-Class-Language | GATE 1996]** If L_1 and L_2 are context free languages and R a regular set, one of the languages below is not necessarily a context free language. Which one?

(a) L_1 , L_2

(b) $L_1 \cap L_2$

(c) $L_1 \cap R$

(d) $L_1 \cup L_2$

163. **[Context-Free-Language | GATE 1996]** Define for a context free language $L \subseteq \{ 0,1 \}^*$, init(L) = $\{ u \mid uv \in L$ for some v in $\{ 0,1\}^* \}$ (in other words, init(L) is the set of prefixes of L)
Let L = { w | w is nonempty and has an equal number of 0's and 1's}
Then init(L) is

(a) the set of all binary strings with unequal number of 0's and 1's

(b) the set of all binary strings including the null string

(c) the set of all binary strings with exactly one more 0's than the number of 1's or one more 1 than the number of 0's

(d) None of the above

164. **[Finite-Automata | GATE 1996]** Consider the given figure of state table for a sequential machine. The number of states in the minimized machine will be

Present state \ x (input)	0	1
A	D0	B1
B	A0	C1
C	A0	B1
D	A1	C1

(a) 4

(b) 3

(c) 2

(d) 1

165. **[Regular-Expressions | GATE 1995]** In some programming languages, an identifier is permitted to be a letter following by any number of letters or digits. If L and D denote the sets of letters and digits respectively, which of the following expressions defines an identifier?

(a) $(L \cup D)^+$

(b) $L(L \cup D)^*$

(c) $(L.D)^*$

(d) $L.(L.D)^*$

166. **[General | GATE 1995]** Consider a grammar with the following productions

$S \rightarrow a\alpha\ b|\ b\alpha\ c|\ aB$
$S \rightarrow \alpha\ S|\ b$
$S \rightarrow \alpha\ b\ b|\ ab$
$S\ \alpha \rightarrow bd\ b|\ b$

The above grammar is:

(a) Context free

(b) Regular

(c) Context sensitive

(d) LR(k)

167. **[Regular Languages | GATE 1995]** Which of the following definitions below generates the same language as L, where L = { x^n y^n such that n > = 1} ?

I . E $\rightarrow$ xEy| xy
II . xy| (x^+ xyy^+)
III . x^+ y^+

(a) I only

(b) I and II

(c) II and III

(d) II only

168. **[Finite-State-Machine | GATE 1995]** A finite state machine with the following state table has a single input x and a single out z.

present state	next state, z	
	x=1	x=0
A	D, 0	B, 0
B	B, 1	C, 1
C	B, 0	D, 1
D	B, 1	C, 0

If the initial state is unknown, then the shortest input sequence to reach the final state C is:

(a) 01

(b) 10

(c) 101

(d) 110

169. **[regular Languages | GATE 1995]** Let Σ = { 0,1} , L = Σ * and R = { 0^n 1^n such that n > 0} then the languages L ∪ R and R are respectively

(a) regular, regular

(b) not regular, regular

(c) regular, not regular

(d) not regular, no regular

170. **[Grammar | GATE 1994]** Which of the following conversions is not possible (algorithmically)?

(a) Regular grammar to context free grammar

(b) Non-deterministic FSA to deterministic FSA

(c) Non-deterministic PDA to deterministic PDA

(d) Non-deterministic Turing machine to deterministic Turing machine

171. **[CFG | GATE 1994]** Which of the following features cannot be captured by context-free grammars?

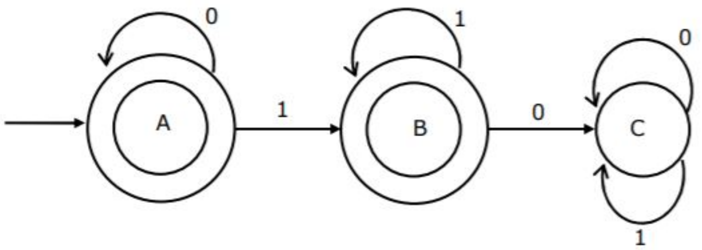
(a) Syntax of if-then-else statements

(b) Syntax of recursive procedures

(c) Whether a variable has been declared before its use

(d) Variable names of arbitrary length

172. **[Finite-Automata | GATE 1994]** The regular expression for the language recognized by the finite state automaton of figure is ________



(a) L = 0*1*

173. **[Undecidability | GATE 1994]** Every subset of a countable set is countable. State whether the above statement is true or false with reason.

(a) True

(b) False

174. **[Languages-and-Grammars | GATE 2020]** Consider the language L = $\{ a^n \mid n \geq 0\} \cup \{ a^n b^n \mid n \geq 0\}$ and the following statements.

I. L is deterministic context-free.
II. L is context-free but not deterministic context-free.
III. L is not LL(k) for any k. Which of the above statements is/are TRUE?

(a) II only

(b) III only

(c) I only

(d) I and III only

175. **[Regular-Language | GATE 2020]** Consider the following statements.

I. If $L_1 \cup L_2$ is regular, then both L_1 and L_2 must be regular.
II. The class of regular languages is closed under infinite union. Which of the above statements is/are TRUE?

(a) Both I and II

(b) II only

(c) Neither I nor II

(d) I only

176. **[Regular-Expression | GATE 2020]** Which one of the following regular expressions represents the set of all binary strings with an odd number of 1's?

(a) 10*(0*10*10*)*

(b) ((0 + 1)*1(0 + 1)*1)*10*

(c) (0*10*10*)*10*

(d) (0*10*10*)*0*1

177. **[Finite-Automata | GATE 2020]** Consider the following language.

L = { x ∈ { a,b} * | number of a's in x is divisible by 2 but not divis

The minimum number of states in a DFA that accepts L is ______.

(a) 6

178. **[Languages-and-Grammars | GATE 2020]** Consider the following languages.

$L_1 = \{ wxyx \mid w,x,y \in (0 + 1)^+ \}$
$L_2 = \{ xy \mid x,y \in (a + b)^*, \mid x \mid = \mid y \mid , x \neq y \}$ Which one of the following is TRUE?

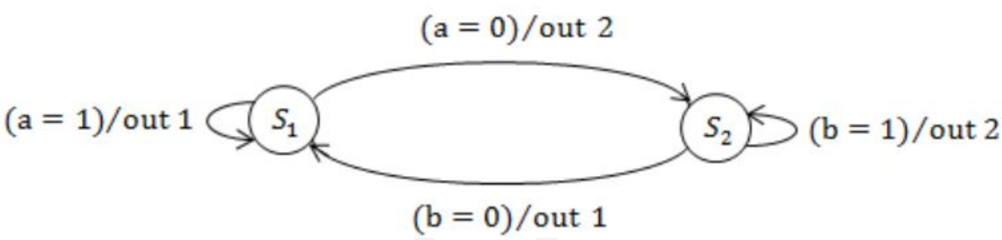
(a) L_1 is context-free but not regular and L_2 is context-free.

(b) Neither L_1 nor L_2 is context-free.

(c) L_1 is regular and L_2 is context-free.

(d) L_1 is context-free but L_2 is not context-free.

179. **[Finite-Automata | GATE 1993]** If the state machine described in figure, should have a stable state, the restriction on the inputs is given by



(a) $$a \cdot b = 1$$

(b) $$a + b = 1$$

(c) $$\bar{a} + \bar{b} = 0$$

(d) $$\overline{a \cdot b} = 1$$

180. **[NP-Complete | GATE 1992]** Which of the following problems is not NP-hard?

(a) Hamiltonian circuit problem

(b) The 0/1 Knapsack problem

(c) Finding bi-connected components of a graph

(d) The graph colouring problem

181. **[Contest-Free-Grammar | GATE 1992]** For a context-free grammar, FOLLOW(A) is the set of terminals that can appear immediately to the right of non-terminal A in some "sentential" form. We define two sets LFOLLOW(A) and RFOLLOW(A) by replacing the word "sentential" by "left sentential" and "right most sentential" respectively in the definition of FOLLOW(A).

Which of the following statements is/are true?

(a) FOLLOW(A) and FOLLOW (A) may be different.

(b) FOLLOW(A) and FOLLOW (A) are always the same.

(c) All the three sets are identical.

(d) All the three sets are different.

(e) Both A and B

182. **[Regular-Expressions | GATE 1992]** Which of the following regular expression identifies are true?

(a) r(*) = r*

(b) (r*s*) = (r+s)*

(c) (r+s)* = r* + s*

(d) r*s* = r* + s*

183. **[CFG | GATE 1992]** If G is a context-free grammar and w is a string of length l in L(G), how long is a derivation of w in G, if G is Chomsky normal form?

(a) 2l

(b) 2l + 1

(c) 2l - 1

(d) l

184. **[CFL | GATE 1992]** Context-free languages are

(a) closed under union

(b) closed under complementation

(c) closed under intersection

(d) closed under Kleene closure

(e) Both A and D

185. **[General | GATE 1992]** In which of the cases stated below is the following statement true?

"For every non−deterministic machine M_1 there exists
an equivalent deterministic machine M_2 recognizing the same language".

(a) M_1 is non-deterministic finite automaton

(b) M_1 is a non-deterministic PDA

(c) M_1 is a non-deterministic Turing machine

(d) For no machine M_1 use the above statement true

(e) Both A and C

186. **[Regular-Expressions | GATE 1991]** Choose the correct alternatives (more than one may be correct) and write the corresponding letters only: Let r = 1(1+0)*, s = 11*0 and t = 1*0 be three regular expressions. Which one of the following is true?

(a) $L(s) \subseteq L(r)$ and $L(s) \subseteq L(t)$

(b) $L(r) \subseteq L(s)$ and $L(s) \subseteq L(t)$

(c) $L(s) \subseteq L(t)$ and $L(s) \subseteq L(r)$

(d) $L(t) \subseteq L(s)$ and $L(s) \subseteq L(r)$

(e) None of the above

(f) A and C

187. **[General | GATE 1991]** Choose the correct alternatives (more than one may be correct) and write the corresponding letters only: Which one of the following is the strongest correct statement about a finite language over some finite alphabet Σ ?

(a) It could be undecidable

(b) It is Turing-machine recognizable

(c) It is a context-sensitive language

(d) It is a regular language

(e) None of the above

(f) B, C and D

188. **[Recursive-Languages | GATE 1990]** Choose the correct alternatives (More than one may be correct). Recursive languages are:

(a) A proper superset of context free languages.

(b) Always recognizable by pushdown automata.

(c) Also called type ϕ languages.

(d) Recognizable by Turing machines.

(e) Both (A) and (D)

189. **[Decidability-and-Undecidability | GATE 1990]** Choose the correct alternatives (More than one may be correct).

It is undecidable whether:

(a) An arbitrary Turing machine halts after 100 steps.

(b) A Turing machine prints a specific letter.

(c) A Turing machine computes the products of two numbers.

(d) None of the above.

(e) Both (B) and (C).

190. **[Regular-Language | GATE 1990]** Choose the correct alternatives (More than one may be correct). Let R_1 and R_2 be regular sets defined over the alphabet Σ Then:
    (a) $R_1 \cap R_2$ is not regular.
    (b) $R_1 \cup R_2$ is regular.
    (c) Σ * - R_1 is regular.
    (d) R_1 * is not regular.
    (e) Both (B) and (C).
191. **[Context-Free-and-Regular-Languages | GATE 1989]** Context-free languages and regular languages are both closed under the operation(s) of:
    (a) Union
    (b) Intersection
    (c) Concatenation
    (d) Complementation
    (e) Both A and C
192. **[Undecidability | GATE 1989]** Which of the following problems are undecidable?
    (a) Membership problem in context-free languages.
    (b) Whether a given context-free language is regular.
    (c) Whether a finite state automation halts on all inputs.
    (d) Membership problem for type 0 languages.
    (e) Both (A) and (C).
193. **[Regular-Language | GATE 1987]** Regularity is preserved under the operation of string reversal.
    (a) True
    (b) False
194. **[Regular-Language | GATE 1987]** All subsets of regular sets are regular.
    (a) True
    (b) False
195. **[Finite-Automata | GATE 1987]** A minimal DFA that is equivalent to an NDFA with n nodes has always 2^n states.
    (a) True
    (b) False
196. **[Context-Free-Language | GATE 1987]** The intersection of two CFL's is also a CFL.
    (a) True
    (b) False

197. **[Turing Machines | GATE 1987]** A is recursive if both A and its complement are accepted by Turing machines.

   (a) True

   (b) False

198. **[Contest-Free-Grammar | GATE 1987]** A context-free grammar is ambiguous if:

   (a) The grammar contains useless non-terminals.

   (b) It produces more than one parse tree for some sentence.

   (c) Some production has two non terminals side by side on the right-hand side.

   (d) None of the above.

199. **[Identify-Class-Language | GATE 1987]** FORTRAN is a:

   (a) Regular language.

   (b) Context-free language.

   (c) Context-sensitive language.

   (d) None of the above.

200. **[Finite-Automata | GATE 2008-IT]** Let N be an NFA with n states and let M be the minimized DFA with m states recognizing the same language. Which of the following in NECESSARILY true?

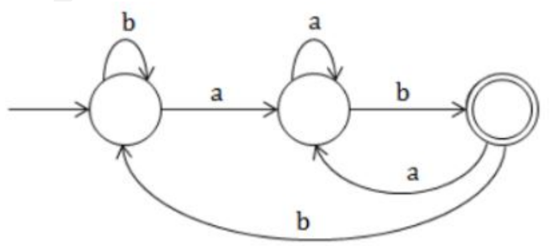
   (a) m $\leq 2^n$

   (b) n $\leq$ m

   (c) M has one accept state

   (d) m = 2^n

201. **[Finite-Automata | GATE 2008-IT]** If the final states and non-final states in the DFA below are interchanged, then which of the following languages over the alphabet { a,b} will be accepted by the new DFA?



   (a) Set of all strings that do not end with ab

   (b) Set of all strings that begin with either an a or a b

   (c) Set of all strings that do not contain the substring ab

   (d) The set described by the regular expression b*aa*(ba)*b*

202. **[Identify-Class-Language | GATE 2008-IT]** Consider the following languages.

$L_1 = \{ a^i \; b^j \; c^k \mid i = j, \; k \geq 1\}$
$L_1 = \{ a^i \; b^j \mid j = 2i, \; i \geq 0\}$

Which of the following is true?

(a) L_1 is not a CFL but L_2 is

(b) $L_1 \cap L_2 = \phi$ and L_1 is non-regular

(c) $L_1 \cup L_2$ is not a CFL but L_2 is

(d) There is a 4-state PDA that accepts L_1 , but there is no DPDA that accepts L_2

203. **[Contest-Free-Grammar | GATE 2008-IT]** Consider a CFG with the following productions.

$S \rightarrow AA \mid B$
$A \rightarrow 0A \mid A0 \mid 1$
$B \rightarrow 0B00 \mid 1$

S is the start symbol, A and B are non-terminals and 0 and 1 are the terminals. The language generated by this grammar is

(a) $\{ 0^n \, 10^{2n} \mid n \geq 1\}$

(b) $\{ 0^i \, 10^j \, 10^k \mid i, j, k \geq 0\} \cup \{ 0^n \, 10^{2n} \mid n \geq 1\}$

(c) $\{ 0^i \, 10^j \mid i, j \geq 0\} \cup \{ 0^n \, 10^{2n} \mid n \geq 1\}$

(d) The set of all strings over $\{ 0, 1\}$ containing at least two 0's

(e) None of the above

204. **[Identify-Class-Language | GATE 2008-IT]** Which of the following languages is (are) non-regular? $L_1 = \{ 0^m \, 1^n \mid 0 \leq m \leq n \leq 10000\}$ $L_2 = \{ w \mid w$ reads the same forward and backward$\}$ $L_3 = \{ w \in \{ 0, 1\}^* \mid w$ contains an even number of 0's and an even number of 1's$\}$

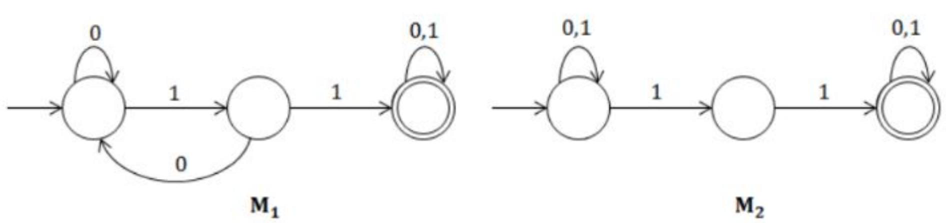
(a) L_2 and L_3 only

(b) L_1 and L_2 only

(c) L_3 only

(d) L_2 only

205. **[Finite-Automata | GATE 2008-IT]** Consider the following two finite automata. M_1 accepts L_1 and M_2 accepts L_2 .



Which one of the following is TRUE?

(a) $L_1 = L_2$

(b) $L_1 \subset L_2$

(c) $L_1 \cap L_2{}' = \phi$

(d) $L_1 \cup L_2 \neq L_1$

(e) A and C

206. **[Contest-Free-Grammar | GATE 2008-IT]** A CFG G is given with the following productions where S is the start symbol, A is a non-terminal and a and b are terminals.

$$S \rightarrow aS|\ A$$
$$A \rightarrow aAb|\ bAa|\ \in$$

Which of the following strings is generated by the grammar above?

(a) aabbaba

(b) aabaaba

(c) abababb

(d) aabbaab

207. **[Contest-Free-Grammar | GATE 2008-IT]** A CFG G is given with the following productions where S is the start symbol, A is a non-terminal and a and b are terminals.

$$S \rightarrow aS|\ A$$
$$A \rightarrow aAb|\ bAa|\ \in$$

For the correct answer in Q75, how many steps are required to derive the string and how many parse trees are there?

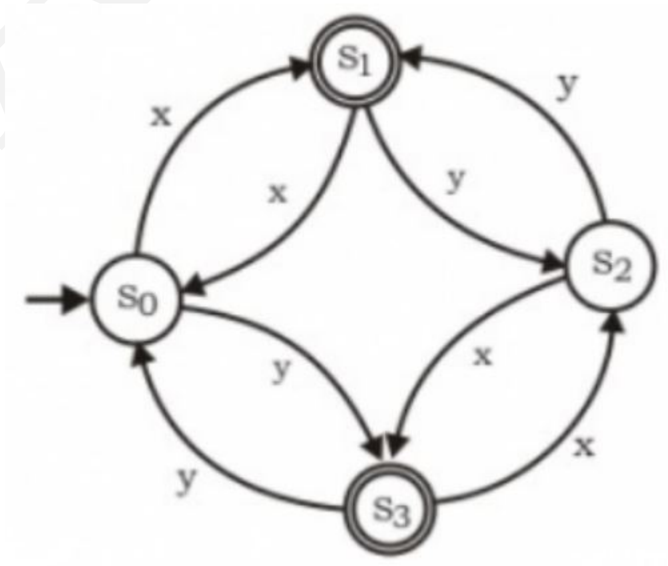
(a) 6 and 1

(b) 6 and 2

(c) 7 and 2

(d) 4 and 2

208. **[Finite-Automata | GATE 2007-IT]** Consider the following DFA in which s_0 is the start state and s_1 , s_3 are the final states.



What language does this DFA recognize ?

(a) All strings of x and y

(b) All strings of x and y which have either even number of x and even number of y or odd number or x and odd number of y

(c) All strings of x and y which have equal number of x and y

(d) All strings of x and y with either even number of x and odd number of y or odd number of x and even number of y

209. **[Grammar | GATE 2007-IT]** Consider the grammar given below

```
S → x B | y A
A → x | x S | y A A
B → y | y S | y B B
```

Consider the following strings.

```
(i) xxyyx
(ii) xxyyxy
(iii) xyxy
(iv) yxxy
(v) yxx
(vi) xyx
```

Which of the above strings are generated by the grammar ?

(a) (i), (ii), and (iii)

(b) (ii), (v), and (vi)

(c) (ii), (iii), and (iv)

(d) (i), (iii), and (iv)

210. **[Identify-Class-Language | GATE 2007-IT]** Consider the following grammars. Names representing terminals have been specified in capital letters.

```
G1 : stmnt → WHILE (expr) stmnt
     stmnt → OTHER
     expr → ID
G2 : WHILE (expr) stmnt
     stmnt → OTHER
     expr → expr + expr
     expr → expr * expr
     expr → ID
```

Which one of the following statements is true?

(a) G_1 is context-free but not regular and G_2 is regular

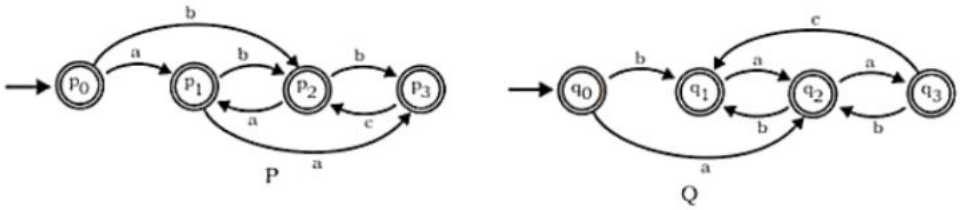
(b) G_2 is context-free but not regular and G_1 is regular

(c) Both G_1 and G_2 are regular

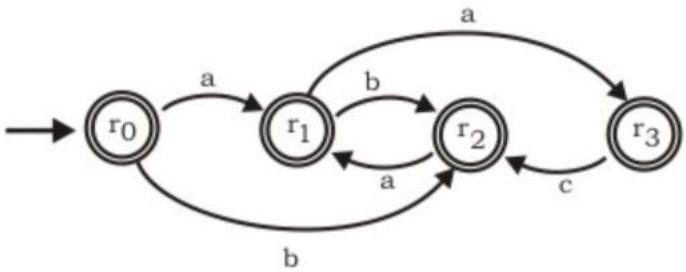
(d) Both G_1 and G_2 are context-free but neither of them is regular

211. **[Finite-Automata | GATE 2007-IT]** Consider the following finite automata P and Q over the alphabet { a, b, c} . The start states are indicated by a double arrow

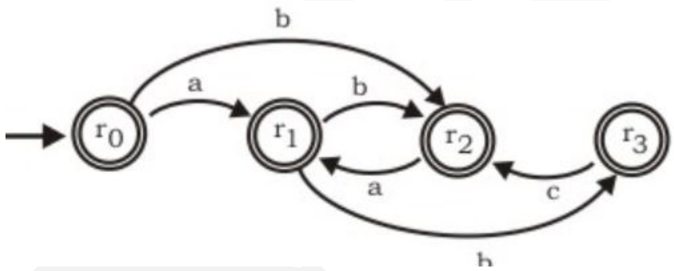
and final states are indicated by a double circle. Let the languages recognized by them be denoted by L(P) and L(Q) respectively.



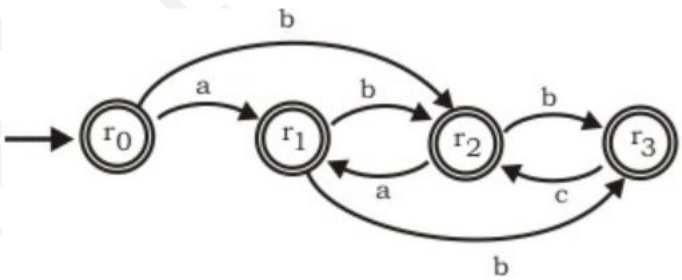
The automation which recognizes the language L(P) ∩ L(Q) is:



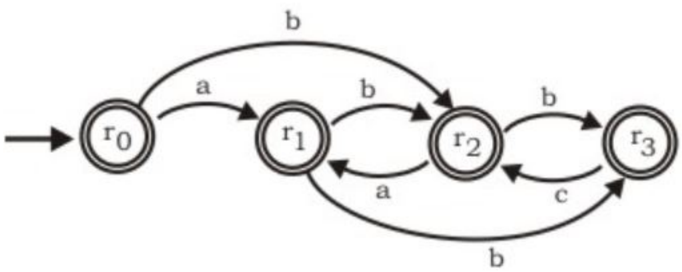
(a)



(b)



(c)

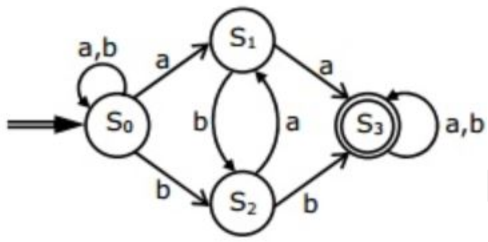


(d)

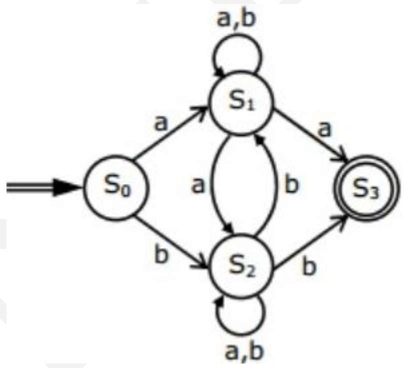
212. **[Regular-Expressions | GATE 2007-IT]** Consider the regular expression

R = (a + b)∗ (aa + bb) (a + b)∗

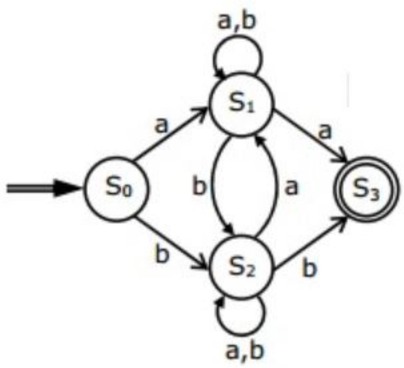
Which of the following non-deterministic finite automata recognizes the language defined by the regular expression R? Edges labeled λ denote transitions on the empty string.



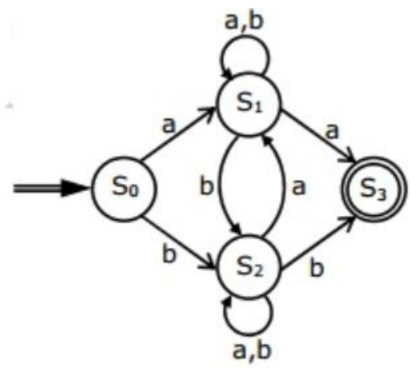
(a)



(b)



(c)

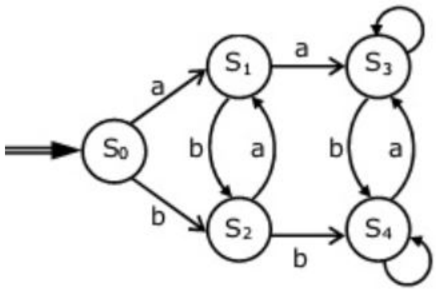


(d)

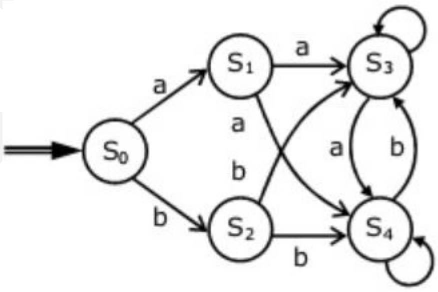
213. **[Regular-Expressions | GATE 2007-IT]** Consider the regular expression

```
R = (a + b)* (aa + bb) (a + b)*
```

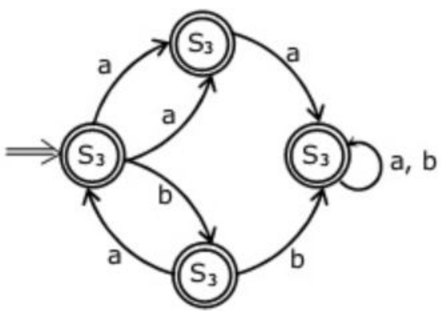
Which deterministic finite automaton accepts the language represented by the regular expression R ?



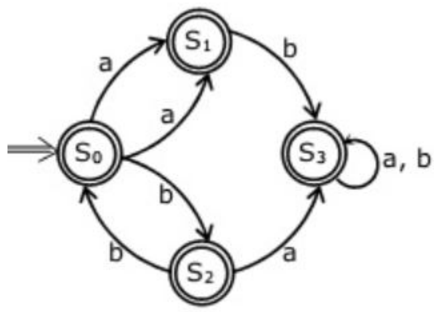
(a)



(b)



(c)



(d)

214. **[Regular-Expressions | GATE 2007-IT]** Consider the regular expression

R = (a + b)* (aa + bb) (a + b)*

Which one of the regular expressions given below defines the same language as defined by the regular expression R?

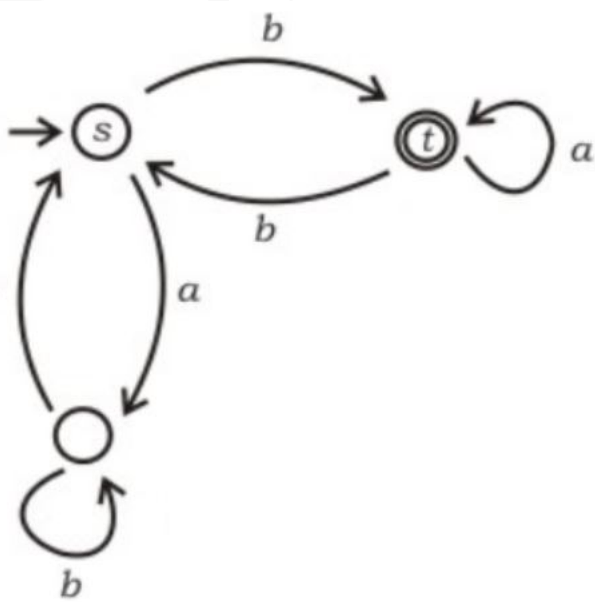
(a) $(a(ba)^* + b(ab)^*)(a + b)^+$

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

(c) $(a(ba)^* (a + bb) + b(ab)^*(b + aa))(a + b)^*$

(d) $(a(ba)^* (a + bb) + b(ab)^*(b + aa))(a + b)^+$

215. **[Finite-Automata | GATE 2006-IT]** In the automaton below, s is the start state and t is the only final state.



Consider the strings u = abbaba, v = bab, and w = aabb. Which of the following statements is true?

(a) The automaton accepts u and v but not w

(b) The automaton accepts each of u, v, and w

(c) The automaton rejects each of u, v, and w

(d) The automaton accepts u but rejects v and w

216. **[Contest-Free-Grammar | GATE 2006-IT]** In the context-free grammar below, S is the start symbol, a and b are terminals, and $\in$ denotes the empty string

$S \rightarrow aSa \mid bSb \mid a \mid b \mid \in$

Which of the following strings is NOT generated by the grammar?

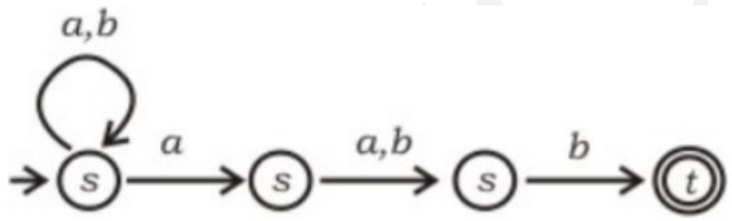
(a) aaaa

(b) baba

(c) abba

(d) babaaabab

217. **[Regular-Expressions | GATE 2006-IT]** Which regular expression best describes the language accepted by the non-deterministic automaton below?



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

(b) (abb)*

(c) (a + b)* a(a + b)* b(a + b)*

(d) (a + b)*

218. **[Regular-Grammar | GATE 2006-IT]** Consider the regular grammar below

$S \rightarrow bS \mid aA \mid \in$
$A \rightarrow aS \mid bA$

The Myhill-Nerode equivalence classes for the language generated by the grammar are

(a) { w $\in$ (a + b)* | # a(w) is even) and { w $\in$ (a + b)* | # a(w) is odd}

(b) { w $\in$ (a + b)* | # a(w) is even) and { w $\in$ (a + b)* | # b(w) is odd}

(c) { w $\in$ (a + b)* | # a(w) = # b(w) and { w $\in$ (a + b)* | # a(w) $\neq$ # b(w)}

(d) { $\in$ } , { wa | w $\in$ (a + b)* and { wb | w $\in$ (a + b)*}

219. **[Regular Languages | GATE 2006-IT]** Which of the following statements about regular languages is NOT true?

(a) Every language has a regular superset

(b) Every language has a regular subset

(c) Every subset of a regular language is regular

(d) Every subset of a finite language is regular

220. **[Push-Down-Automata | GATE 2006-IT]** Which of the following languages is accepted by a non-deterministic pushdown automaton (PDA) but NOT by a deterministic PDA?

(a) { a^n b^n c^n | n≥ 0}

(b) { a^l b^m c^n | l ≠ m or m ≠ n}

(c) { a^n b^n | n≥ 0}

(d) { a^m b^n | m,n≥ 0}

221. **[Identify-Class-Language | GATE 2006-IT]** Let L be a context-free language and M a regular language. Then the language L ∩ M is

(a) always regular

(b) never regular

(c) always a deterministic context-free language

(d) always a context-free language

222. **[Push-Down-Automata | GATE 2006-IT]** Consider the pushdown automaton (PDA) below which runs over the input alphabet (a, b, c). It has the stack alphabet { Z_0 , X} where Z_0 is the bottom-of-stack marker. The set of states of the PDA is (s, t, u, f} where s is the start state and f is the final state. The PDA accepts by final state. The transitions of the PDA given below are depicted in a standard manner. For example, the transition (s, b, X) → (t, XZ_0) means that if the PDA is in state s and the symbol on the top of the stack is X, then it can read b from the input and move to state t after popping the top of stack and pushing the symbols Z_0 and X (in that order) on the stack.

(s , a , Z_0) → (s , XXZ_0)
(s , ∈ , Z_0) → (f , ∈)
(s , a , X) → (s , XXX)
(s , b , X) → (t , ∈)
(t , b , X) → (t , . ∈)
(t , c , X) → (u , ∈)
(u , c , X) → (u , ∈)
(u , ∈ , Z_0) → (f , ∈)

The language accepted by the PDA is

(a) { a^l b^m c^n | l = m = n}

(b) { a^l b^m c^n | l = m}

(c) { a^l b^m c^n | 2l = m+n}

(d) { a^l b^m c^n | m=n}

223. **[Contest-Free-Grammar | GATE 2006-IT]** In the context-free grammar below, S is the start symbol, a and b are terminals, and ∈ denotes the empty string.

S → aSAb | ∈
A → bA | ∈

The grammar generates the language

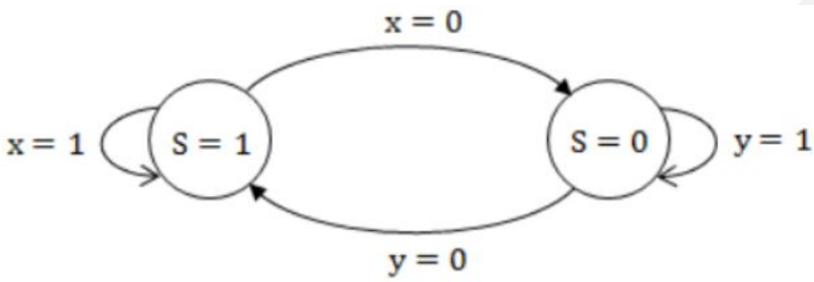
(a) ((a + b)* b)*

(b) { a^m b^n | m $\leq$ n}

(c) { a^m b^n | m = n}

(d) a* b*

224. **[Finite-Automata | GATE 2006-IT]** For a state machine with the following state diagram the expression for the next state S^+ in terms of the current state S and the input variables x and y is



(a) S^+ = S′ . y′ + S . x

(b) S^+ = S. x . y′ + S′ . y . x′

(c) S^+ = x . y′

(d) S^+ = S′ . y + S . x′col

225. **[Regular-Language | GATE 2006-IT]** Let L be a regular language. Consider the constructions on L below:
I. repeat (L) = { ww | w $\in$ L}
II. prefix (L) = { u | $\exists$ v : uv $\in$ L}
III. suffix (L) = { v | $\exists$ u : uv $\in$ L}
IV. half (L) = { u | $\exists$ v : | v | = | u | and uv $\in$ L}
Which of the constructions could lead to a non-regular language?

(a) Both I and IV

(b) Only I

(c) Only IV

(d) Both II and III

226. **[Regular-Language | GATE 2006-IT]** Let L be a regular language. Consider the constructions on L below:
(I) repeat (L) = { ww | w $\in$ L}
(II) prefix (L) = { u | $\exists$ v : uv $\in$ L}
(III) suffix (L) = { v | $\exists$ u uv $\in$ L}
(IV) half (L) = { u | $\exists$ v : | v | = | u | and uv $\in$ L}
Which choice of L is best suited to support your answer above?

(a) (a + b)*

(b) { $\in$, a, ab, bab}

(c) (ab)*

(d) { a^n b^n | n $\geq$ 0}

227. **[Regular Languages and finite automata | GATE 2005-IT]** Let L be a regular language and M be a context-free language, both over the alphabet Σ . Let L^c and M^c denote the complements of L and M respectively. Which of the following statements about the language if $L^c \cup M^c$ is TRUE?

    (a) It is necessarily regular but not necessarily context-free.

    (b) It is necessarily context-free.

    (c) It is necessarily non-regular.

    (d) None of the above.

228. **[Regular languages and finite automata | GATE 2005-IT]** Which of the following statements is TRUE about the regular expression 01*0?

    (a) It represents a finite set of finite strings.

    (b) It represents an infinite set of finite strings.

    (c) It represents a finite set of infinite strings.

    (d) It represents an infinite set of infinite strings.

229. **[Regular languages and finite automata | GATE 2005-IT]** The language $\{ 0^n \ 1^n \ 2^n \ | 1 \leq n \leq 10^6 \}$ is

    (a) regular

    (b) context-free but not regular

    (c) context-free but its complement is not context-free

    (d) not context-free

230. **[Logical-Functions-and-Minimization | GATE 2005-IT]** Which of the following expressions is equivalent to $(A \oplus B) \oplus C$

    $$(A + B + C)(\overline{A} + \overline{B} + \overline{C})$$

    (a)

    $$(A + B + C)(\overline{A} + \overline{B} + C)$$

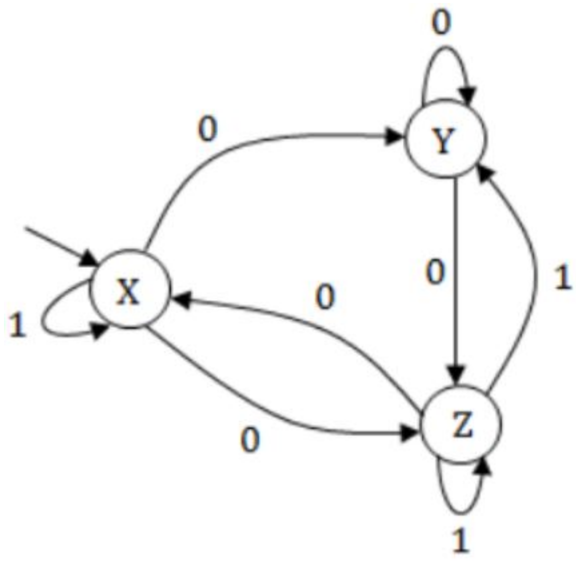
    (b)

    $$ABC + \overline{A}(B \oplus C) + \overline{B}(A \oplus C)$$

    (c)

    (d) None of these

231. **[Regular Languages and Finite Automata | GATE 2005-IT]** Consider the non-deterministic finite automaton (NFA) shown in the figure.



State X is the starting state of the automaton. Let the language accepted by the NFA with Y as the only accepting state be L1. Similarly, let the language accepted by the NFA with Z as the only accepting state be L2. Which of the following statements about L1 and L2 is TRUE? **Correction in Question:** There is an edge from Z-> Y labeled 0 and another edge from Y-> Z labeled 1 - in place of double arrowed and no arrowed edges.

(a) L1 = L2

(b) L1 $\subset$ L2

(c) L2 $\subset$ L1

(d) None of the above

232. **[Push-Down-Automata | GATE 2005-IT]** Let P be a non-deterministic push-down automaton (NPDA) with exactly one state, q, and exactly one symbol, Z, in its stack alphabet. State q is both the starting as well as the accepting state of the PDA. The stack is initialized with one Z before the start of the operation of the PDA. Let the input alphabet of the PDA be Σ . Let L(P) be the language accepted by the PDA by reading a string and reaching its accepting state. Let N(P) be the language accepted by the PDA by reading a string and emptying its stack.
Which of the following statements is TRUE?

(a) L(P) is necessarily Σ * but N(P) is not necessarily Σ *

(b) N(P) is necessarily Σ * but L(P) is not necessarily Σ *

(c) Both L(P) and N(P) are necessarily Σ *

(d) Neither L(P) nor N(P) are necessarily Σ *

233. **[DFA | GATE 2005-IT]** Consider the regular grammar:
S $\rightarrow$ Xa | Ya
X $\rightarrow$ Za Z $\rightarrow$ Sa | $\in$
Y $\rightarrow$ Wa W $\rightarrow$ Sa
where S is the starting symbol, the set of terminals is { a} and the set of non-terminals is { S, W, X, Y, Z} . We wish to construct a deterministic finite automaton (DFA) to recognize the same language. What is the minimum number of states required for the DFA?

(a) 2

(b) 3

(c) 4

(d) 5

234. **[Pumping-lemma | GATE 2005-IT]** A language L satisfies the Pumping Lemma for regular languages, and also the Pumping Lemma for context-free languages. Which of the following statements about L is TRUE?

(a) L is necessarily a regular language

(b) L is necessarily a context-free language, but not necessarily a regular language

(c) L is necessarily a non-regular language

(d) None of the above

235. **[Regular languages and finite automata | GATE 2005-IT]** Consider the context-free grammar

```
E → E + E
E → (E * E)
E → id
```

where E is the starting symbol, the set of terminals is { id, (,+,),*} , and the set of nonterminals is { E} .
Which of the following terminal strings has more than one parse tree when parsed according to the above grammar?

(a) id + id + id + id

(b) id + (id* (id * id))

(c) (id* (id * id)) + id

(d) ((id * id + id) * id)

236. **[CFG | GATE 2005-IT]** Consider the context-free grammar
E → E + E
E → (E * E)
E → id
where E is the starting symbol, the set of terminals is { id, (,+,),*} , and the set of non-terminals is { E} .
For the terminal string id + id + id + id, how many parse trees are possible?

(a) 5

(b) 4

(c) 3

(d) 2

237. **[Graphs | GATE 2005-IT]** A sink in a directed graph is a vertex i such that there is an edge from every vertex $j \neq i$ to i and there is no edge from i to any other vertex. A directed graph G with n vertices is represented by its adjacency matrix A, where A[i] [j] = 1 if there is an edge directed from vertex i to j and 0 otherwise. The following algorithm determines whether there is a sink in the graph G.

```
i = 0
do {
    j = i + 1;
    while ((j < n) && E1 ) j++;
    if (j < n) E2 ;
} while (j < n);

flag = 1;
for (j = 0; j < n; j++)
    if ((j! = i) && E3 )
        flag = 0;

if (flag)
    printf("Sink exists");
else
    printf("Sink does not exist");
```

Choose the correct expressions for E_3

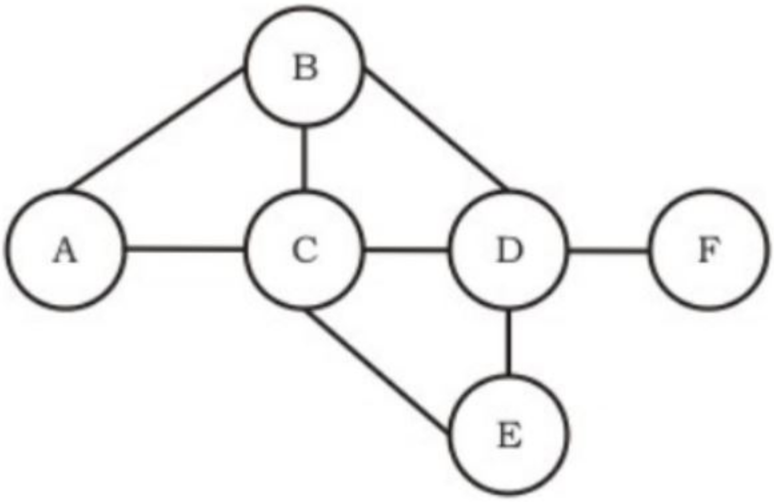
(a) (A[i] [j] && !A[j] [i])

(b) (!A[i] [j] && A[j] [i])

(c) (!A[i] [j] | | A[j] [i])

(d) (A[i] [j] | | !A[j] [i])

238. **[Graphs | GATE 2005-IT]** Consider a simple graph with unit edge costs. Each node in the graph represents a router. Each node maintains a routing table indicating the next hop router to be used to relay a packet to its destination and the cost of the path to the destination through that router. Initially, the routing table is empty. The routing table is synchronously updated as follows. In each updation interval, three tasks are performed.
1. A node determines whether its neighbours in the graph are accessible. If so, it sets the tentative cost to each accessible neighbour as 1. Otherwise, the cost is set to ∞.
2. From each accessible neighbour, it gets the costs to relay to other nodes via that neighbour (as the next hop).
3. Each node updates its routing table based on the information received in the previous two steps by choosing the minimum cost.



For the graph given above, possible routing tables for various nodes after they have stabilized, are shown in the following options. Identify the correct table.

Table for node A

A	-	-
B	B	1
C	C	1
D	B	3
E	C	3
F	C	4

(a)

Table for node B

A	A	1
B	B	1
C	-	-
D	D	1
E	E	1
F	E	3

(b)

Table for node C

A	A	1
B	-	-
C	C	1
D	D	1
E	C	2
F	D	2

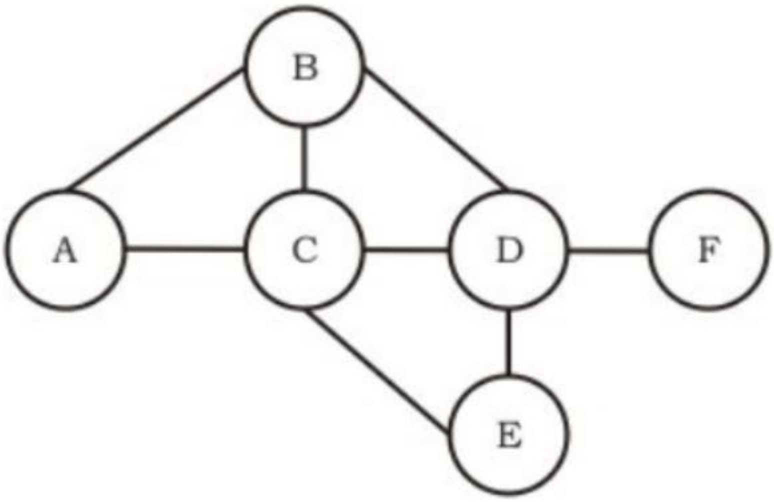
(c)

Table for node D

A	B	3
B	B	1
C	C	1
D	-	-
E	E	1
F	F	1

(d)

239. **[Graphs | GATE 2005-IT]** Consider a simple graph with unit edge costs. Each node in the graph represents a router. Each node maintains a routing table indicating the next hop router to be used to relay a packet to its destination and the cost of the path to the destination through that router. Initially, the routing table is empty. The routing table is synchronously updated as follows. In each updation interval, three tasks are performed.
1. A node determines whether its neighbours in the graph are accessible. If so, it sets the tentative cost to each accessible neighbour as 1. Otherwise, the cost is set to ∞.
2. From each accessible neighbour, it gets the costs to relay to other nodes via that neighbour (as the next hop).
3. Each node updates its routing table based on the information received in the previous two steps by choosing the minimum cost.



Continuing from the earlier problem, suppose at some time t, when the costs have stabilized, node A goes down. The cost from node F to node A at time (t + 100) is

(a) $>$ 100 but finite

(b) ∞

(c) 3

(d) $>$ 3 and $\leq$ 100

240. **[Regular-Expressions | GATE 2004-IT]** Which one of the following regular expressions is NOT equivalent to the regular expression (a + b + c)*?

(a) (a* + b* + c*)*

(b) (a*b*c*)*

(c) ((ab)* + c*)*

(d) (a*b* + c*)*

241. **[General | GATE 2004-IT]** 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 regular language

242. **[Push-Down-Automata | GATE 2004-IT]** Which one of the following strings is not a member of L(M)?
Let M = (K,Σ ,Γ ,Δ ,s,F) be a pushdown automaton, where
K = { s,f} , F = { f} , Σ = { a,b} , Γ = { a} and
Δ = { ((s,a,$\in$), (s,a)), ((s,b,$\in$), (s,a)), ((s,a,$\in$), (f,$\in$)), ((f,a,a), (f,$\in$)), ((f,b,a), (f,$\in$))}

(a) aaa

(b) aabab

(c) baaba

(d) bab

243. **[Finite-Automata | GATE 2004-IT]** Let M = { K,Σ ,δ ,s,F} be a finite state automaton, where
K = { A,B} , Σ = { a,b} , s = A, F = { B} , δ (A,a) = A, δ (A,b) = B, δ (B,a) = B and δ (B,a) = A
A grammar to generate the language accepts by M can be specified as G = (V,Σ ,R,S), where V = K∪ Σ , and S = A.
Which one of the following set to rules will make L(G) = L(M)?

(a) { A→ aB, A→ bA, B→ bA, B→ aA, B→ ∈ }

(b) { A→ aA, A→ bB, B→ bB, B→ aA, B→ ∈ }

(c) { A→ bB, A→ aB, B→ aA, B→ bA, A→ ∈ }

(d) { A→ aA, A→ bA, B→ bB, B→ aA, A→ ∈ }

244. **[Languages-and-Grammars | ISRO-2018]** A language with string manipulation facilities uses the following operations.

head(s)- returns the first character of the string s
tail(s)- returns all but the first character of the string s

concat(sl, s2)- concatenates string s1 with s2.

The output of concat(head(s), head(tail(tail(s)))), where s is acbc is

(a) ab

(b) ba

(c) ac

(d) as

245. **[Regular-Language | ISRO-2018]** Choose the correct statement:

(a) A = { a^n b^n | n = 1, 2, 3, ... } is a regular language

(b) The set B, consisting of all strings made up of only a's and b's having an equal number of a's and b's defines a regular language

(c) L(A * B) ∩ B gives the set A

(d) None of the above

246. **[Context-Free-Language | ISRO-2018]** CFG (Context Free Grammar) is not closed under

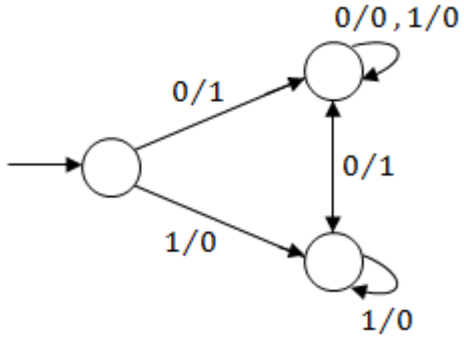
(a) Union

(b) Complementation

(c) Kleene star

(d) Product

247. **[Finite-Automata | ISRO-2018]** The FSM (Finite State Machine) machine pictured in the figure below



(a) Complements a given bit pattern

(b) Finds 2's complement of a given bit pattern

(c) Increments a given bit pattern by 1

(d) Changes the sign bit

248. **[Context-Free-Language | ISRO-2018]** A CFG(Context Free Grammar) is said to be in Chomsky Normal Form (CNF), if all the productions are of the form A→ BC or A→ a. Let G be a CFG in CNF. To derive a string of terminals of length x, the number of products to be used is

(a) 2x - 1

(b) 2x

(c) 2x + 1

(d) 2^x

249. **[Context-Free-Language | ISRO CS 2008]** Consider the grammar
S → ABCc | bc
BA → AB
Bb → bb
Ab → ab
Aa → aa
Which of the following sentences can be derived by this grammar?

(a) abc

(b) aab

(c) abcc

(d) abbc

250. **[Languages-and-Grammars | ISRO-2017 May]** Given the following statements:
S1 : Every context-sensitive language L is recursive
S2 : There exists a recursive language that is not context-sensitive
Which statements are true?

(a) Only S1 is correct

(b) Only S2 is correct

(c) Both S1 and S2 are not correct

(d) Both S1 and S2 are correct

251. **[Equivalence-of-Languages | ISRO-2017 May]** Which one of the following is FALSE?

(a) There is a unique minimal DFA for every regular language

(b) Every NFA can be converted to an equivalent PDA

(c) The complement of every context-free language is recursive

(d) Every non-deterministic PDA can be converted to an equivalent deterministic PDA

252. **[Recursive-and-Recursively-Enumerable-Language | ISRO-2017 May]** If L and P are two recursively enumerable languages, then they are not closed under

(a) Kleene Star L * of L

(b) Intersection $L \cap P$

(c) Union $L \cup P$

(d) Set Difference

253. **[Regular-Expression | ISRO-2017 December]** For $\Sigma = \{a,b\}$ the regular expression r = (aa)*(bb)*b denotes

(a) Set of strings with 2 a's and 2 b's

(b) Set of strings with 2 a's 2 b's followed by b

(c) Set of strings with 2 a's followed by b's which is a multiple of 3

(d) Set of strings with even number of a's followed by odd number of b's

254. **[Context-Free-Language | ISRO-2017 December]** Consider the grammar with productions

$S \rightarrow aSb \mid SS \mid \in$

This grammar is

(a) not context-free, not linear

(b) not context-free, linear

(c) context-free, not linear

(d) context-free, linear

255. **[Languages-and-Grammars | ISRO-2017 December]** Identify the language generated by the following grammar
S -> AB
A -> aAb| ∈
B -> bB| b

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

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

(c) { a^m b^n | n> m, m> 0}

(d) { a^m b^n | n> m, m> =0}

256. **[Recursive-and-Recursively-Enumerable-Language | ISRO-2017 December]** Let L_1 be regular language, L_2 be a deterministic context free language and L_3 a recursively enumerable language, but not recursive. Which one of the following statements is false?

(a) $L_1 \cap L_2$ is context-free

(b) $L_3 \cap L_1$ is recursive

(c) $L_1 \cup L_2$ is context-free

(d) $L_1 \cap L_2 \cap L_3$ is recursively enumerable

257. **[Context-Free-Language | ISRO-2017 December]** Let L = { a^p | p is a prime} . Then which of the following is true?

(a) It is not accepted by a Turing Machine

(b) It is regular but not context-free

(c) It is context-free but not regular

(d) It is neither regular nor context-free but accepted by a Turing Machine

258. **[Finite-Automata | ISRO-2016]** A FSM(finite state machine) can be considered to be a turing machine of finite tape length

(a) without rewinding capability and unidirectional tape movement

(b) rewinding capability and unidirectional tape movement

(c) without rewinding capability and bidirectional tape movement

(d) rewinding capability and bidirectional tape movement

259. **[Regular-Expression | ISRO-2016]** Let L = { w = (0+1)* | w has even number of 1's} , i.e. L is the set of all bit strings with even number of 1's. Which one of the regular expression below represents L ?

(a) (0*10*1)*

(b) 0*(10*10*)*

(c) 0*(10*1*)*0*

(d) 0*1(10*1)10*

260. **[Context-Free-Language | ISRO-2016]** Consider the following statements about the context-free grammar
G = { $S \rightarrow SS$, $S \rightarrow ab$, $S \rightarrow ba$, $S \rightarrow \wedge$ }
I. G is ambiguous
II. G produces all strings with an equal number of a's and b's
III. G can be accepted by a deterministic PDA.
Which combination below expresses all the true statements about?

(a) I only

(b) I and III only

(c) II and III only

(d) I, II and III

261. **[Recursive-and-Recursively-Enumerable-Language | ISRO-2016]** If L and L′ are recursively enumerable then L is

(a) Regular

(b) Context-free

(c) Context Sensitive

(d) Recursive

262. **[Languages-and-Grammars | ISRO-2016]** S → aSa | bSb | a | b

The language generated by the above grammar over the alphabet is the set of

(a) all palindromes

(b) all odd length palindromes

(c) strings that begin and end with the same symbol

(d) all even length palindromes

263. **[Languages-and-Grammars | ISRO-2016]** What is the highest type number that can be assigned to the following grammar?
S → Aa
A → Ba
B → abc

(a) Type 0

(b) Type 1

(c) Type 2

(d) Type 3

264. **[Resursive | ISRO CS 2011]** A problem whose language is recursive is called?

(a) Unified problem

(b) Boolean function

(c) Recursive problem

(d) Decidable

265. **[Context-free-language | ISRO CS 2011]** Which of the following sentences can be generated by

S -> aS | bA

A -> d | cA

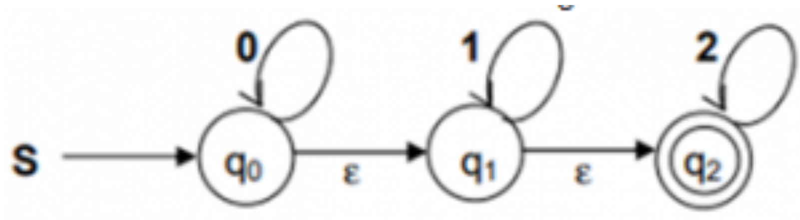
(a) bccdd

(b) abbcca

(c) abcabc

(d) abcd

266. **[DFA | ISRO CS 2013]** What are the final states of the DFA generated from the following NFA?



(a) q_0 , q_1 , q_2

(b) [q_0 , q_1] , [q_0 , q_2] , [ ]

(c) q_0 , [q_1 , q_2]

(d) [q_0 , q_1] , q_2

267. **[Finite-Automata | ISRO CS 2014]** The number of states required by a Finite State Machine, to simulate the behavior of a computer with a memory capable of storing 'm' words, each of length 'n' bits is?

(a) m x 2^n

(b) 2^{m+n}

(c) 2^{mn}

(d) m+n

268. **[Languages-and-Grammars | ISRO CS 2014]** What is the number of steps required to derive the string ((() ()) ()) for the following grammar?
$S \rightarrow SS$
$S \rightarrow (S)$
$S \rightarrow \in$

(a) 10

(b) 15

(c) 12

(d) 16

269. **[Finite-Automata | ISRO CS 2014]** How many states are there in a minimum state deterministic finite automaton accepting the language L = { w | w { 0,1} number of 0's is divisible by 2 and number of 1's is divisible by 5, respectively} ?

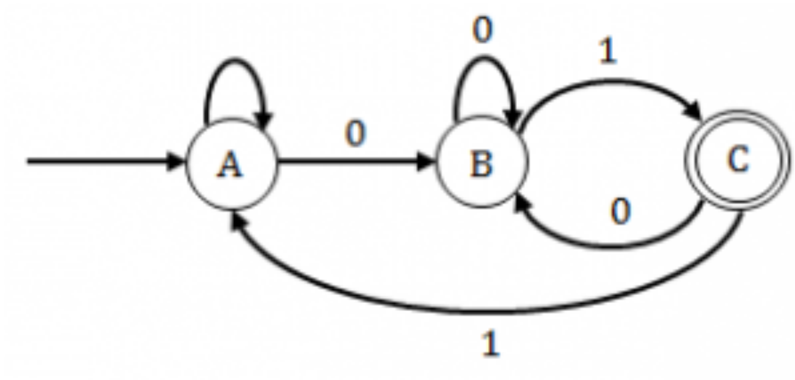
(a) 7

(b) 9

(c) 10

(d) 11

270. **[Finite-Automata | ISRO CS 2014]** The following Finite Automaton recognizes which of the given languages?



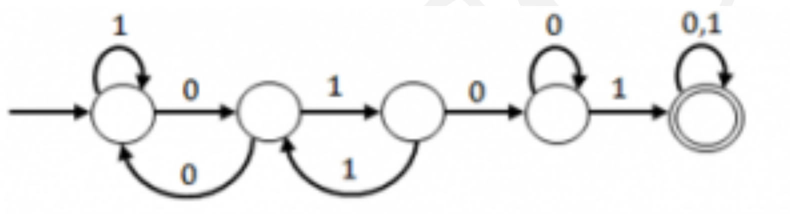
(a) { 1, 0} * { 01}

(b) { 1, 0} * { 1}

(c) { 1} { 1, 0} * { 1}

(d) 1*0* { 0, 1}

271. **[Finite-Automata | ISRO CS 2014]** Consider the following Deterministic Finite Automaton.



Let denote the set of eight bit strings whose second, third, sixth and seventh bits are 1. The number of strings in that are accepted by M is

(a) 0

(b) 1

(c) 2

(d) 3

272. **[Languages-and-Grammars | ISRO CS 2014]** Consider the following grammar.
S → AB
A → a
A → BaB
B → bbA
Which of the following statements is FALSE?

(a) The length of every string produced by this grammar is even

(b) No string produced by this grammar has three consecutive a's

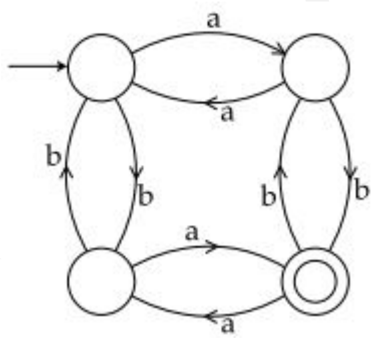
(c) The length of substring produced by B is always odd

(d) No string produced by this grammar has four consecutive b's

273. **[Turing-machines | ISRO CS 2014]** Which of the following is FALSE with respect to possible outcomes of executing a Turing Machine over a given input?
   (a) it may halt and accept the input
   (b) it may halt by changing the input
   (c) it may halt and reject the input
   (d) it may never halt

274. **[Regular-Language | UGC-NET CS 2018 JUNE Paper-2]** Two finite state machines are said to be equivalent if they :
   (a) Have the same number of edges
   (b) Have the same number of states
   (c) Recognize the same set of tokens
   (d) Have the same number of states and edges

275. **[Regular-Language | UGC-NET CS 2018 JUNE Paper-2]** The finite state machine given in figure below recognizes :



   (a) any string of odd number of a's
   (b) any string of odd number of b's
   (c) any string of even number of a's and odd number of b's
   (d) any string of odd number of a's and odd number of b's

276. **[Context-Free-Language | UGC-NET CS 2018 JUNE Paper-2]** A pushdown automata behaves like a Turing machine when the number of auxiliary memory is :
   (a) 0
   (b) 1
   (c) 1 or more
   (d) 2 or more

277. **[Context-Free-Language | UGC-NET CS 2018 JUNE Paper-2]** Pushdown automata can recognize language generated by
   (a) Only context free grammar

(b) Only regular grammar

(c) Context free grammar or regular grammar

(d) Only context sensitive grammar

278. **[Context-Free-Grammar | UGC-NET CS 2018 JUNE Paper-2]** To obtain a string of n Terminals from a given Chomsky normal form grammar, the number of productions to be used is :

(a) 2n-1

(b) 2n

(c) n+1

(d) n^2

279. **[Context-Free-Language | UGC-NET CS 2018 JUNE Paper-2]** Consider the following two Grammars :

G1 : S $\rightarrow$ SbS| a
G2 : S $\rightarrow$ aB| ab, A $\rightarrow$ GAB| a, B $\rightarrow$ ABb| b Which of the following option is correct ?

(a) Only G1 is ambiguous

(b) Only G2 is ambiguous

(c) Both G1 and G2 are ambiguous

(d) Both G1 and G2 are not ambiguous

280. **[Turing-machines | UGC-NET CS 2018 JUNE Paper-2]** Context sensitive language can be recognized by a :

(a) Finite state machine

(b) Deterministic finite automata

(c) Non-deterministic finite automata

(d) Linear bounded automata

281. **[Context-sensitive-language | UGC-NET CS 2018 JUNE Paper-2]** The set A = { 0^n 1^n 2^n | n=1, 2, 3, ... } is an example of a grammar that is :

(a) Context sensitive

(b) Context free

(c) Regular

(d) None of the above

282. **[Turing-machines | UGC-NET CS 2018 JUNE Paper-2]** Consider the following statements( ) :

S1 : There exists no algorithm for deciding if any two Turing machines M1 and M2 accept the same language.
S2 : The problem of determining whether a Turing machine halts on any input is undecidable. Which of the following options is correct ?

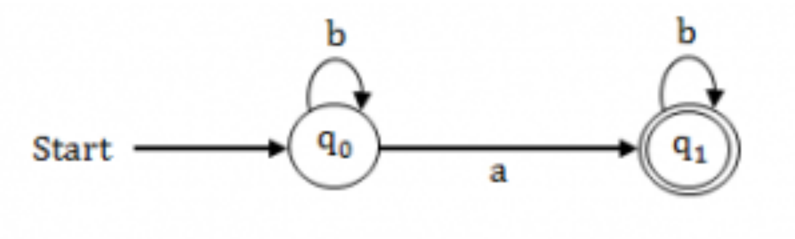
(a) Both S1 and S2 are correct

(b) Both S1 and S2 are not correct

(c) Only S1 is correct

(d) Only S2 is correct

283. **[Nielit Scentist-B** [**02-12-2018**] **]** Consider the following finite state automaton. The language accepted by this automaton is given by the regular.



(a) ab*b*

(b) a*b*

(c) b*b

(d) b*ab*

284. **[Nielit Scentist-B** [**02-12-2018**] **]** Which of the following languages over the alphabet { 0,1} is described by the given regular expression: (0+1)*1(0+1)*1?

(a) The set of all strings containing the substrings 11

(b) The set of all string containing at most two 1's

(c) The set of all strings containing at least two 1's

(d) The set of all strings that begins and ends with only 0.

285. **[Nielit Scentist-B** [**02-12-2018**] **]** The language { W^a X^b Y^{a+b} | a,b > =1} is:

(a) Regular

(b) Context free but non regular

(c) Context sensitive but non context free

(d) Type 0 but non context sensitive

286. **[Nielit Scentist-B** [**02-12-2018**] **]** Identify the true statement from the given statements:
(1) A recursive formal language is a recursive subset in the set of all possible words over the alphabet of the language
(2) The complement of a recursive language is recursive
(3) The complement of a context free language is context free

(a) Only (1)

(b) (1) and (2)

(c) (1),(2) and (3)

(d) (2) and (3)

287. **[Nielit Scentist-B** [**02-12-2018**] **]** In the given language L={ ab,aa,baa} , __ number of strings are in L*
(1) baaaba

(2) aabaaaa
(3) baaabaaaabaa
(4) baaabaaa

(a) (1)

(b) (2)

(c) (3)

(d) (4)

288. **[Context-Free-Language | Nielit Scientist-C 2016 march]** Context free grammar can be recognized by

(a) finite state automaton

(b) 2-way linear bounded automata

(c) pushdown automata

(d) Both (B) and (C)

289. **[Decidability-and-Undecidability | Nielit Scientist-C 2016 march]** If every string of a language can be determined, whether it is legal or illegal in finite time, the language is called

(a) Decidable

(b) Undecidable

(c) interpretive

(d) non-deterministic

290. **[Regular-Expression | Nielit Scientist-C 2016 march]** Regular expression (a| b)(a| b) denotes the set

(a) { a,b,ab,aa}

(b) { a,b,ba,bb}

(c) { a,b}

(d) { aa,ab,ba,bb}

291. **[Finite-Automata | Nielit Scientist-C 2016 march]** Two finite state machines are said to be equivalent if they

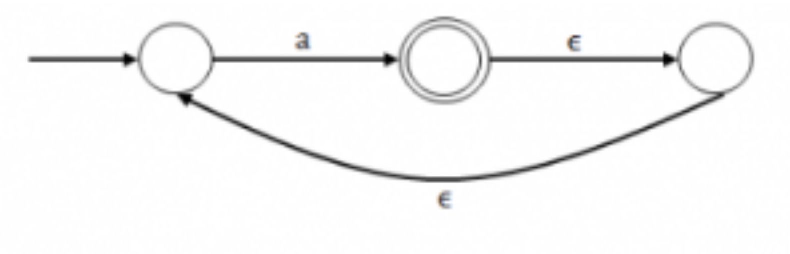
(a) have same number of states

(b) have same number of edges

(c) have same number of states and edges

(d) recognized same set of tokens

292. **[Finite-Automata | Nielit Scientist-B CS 22-07-2017]** What is the complement of the language accepted by the NFA shown below?



1.ϕ
2.{ $\in$ }
3.a*
4.{ a, $\in$ }

(a) 1

(b) 2

(c) 3

(d) 4

293. **[Recursive-and-Recursively-Enumerable-Language | Nielit Scientist-B CS 22-07-2017]** Let L be a language and L′ be its complement. Which one of the following is NOT a viable possibility?

(a) Neither L nor L′ is RE

(b) One of L and L′ is RE but not recursive;The other is not RE

(c) Both L and L′ are RE but not recursive

(d) Both L and L′ are recursive

294. **[Recursive-and-Recursively-Enumerable-Language | Nielit Scientist-B CS 22-07-2017]** Let L1 be a recursive language, and let L2 be a recursively enumerable but not a recursive language. Which one of the following is TRUE?

(a) L1′ is recursive and L2′ is recursively enumerable

(b) L1′ is recursive and L2′ is not recursively enumerable

(c) L1′ and L2′ are recursively enumerable

(d) L1′ is recursively enumerable and L2′ is recursive

295. **[Decidability-and-Undecidability | UGC-NET CS 2018 DEC Paper-2]** Consider the following problems:

(i) Whether a finite automaton halts on all inputs?
(ii) Whether a given Context Free Language is Regular?
(iii) Whether a Turing Machine computes the product of two numbers?

Which one of the following is correct?

Code:

(a) Only (ii) and (iii) are undecidable problems

(b) (i), (ii) and (iii) are undecidable problems

(c) Only (i) and (ii) are undecidable problems

(d) Only (i) and (iii) are undecidable problems

296. **[Nielit STA [02-12-2018]]** Which of the following problems are decidable?

1. Does a given ever produce an output?
2. If L is a context free language, then is L′ (complement of L) also context free?
3. If L is a regular language, then is L′ also regular?
4. If L is a recursive language, then is L′ also recursive?

(a) (a), (b), (c), (d)

(b) (a), (b)

(c) (b), (c), (d)

(d) (c), (d)

297. **[Nielit STA [02-12-2018]]** Which of the following statements is true?

(a) If a language is context free it can always be accepted by a deterministic push-down automaton

(b) The union of two context free language is context free

(c) The intersection of two context free language is context free

(d) The complement of a context free language is context free

298. **[Nielit STA [02-12-2018]]** The best example of language for defining the non regular languages is:

(a) Languages for palindrome and prime

(b) Languages for palindrome and Even-Even

(c) Language for prime and Even-Even

(d) Language for palindrome and factorial

299. **[Regular-Expression | Nielit Scientist-B CS 2016 march]** Which of the following regular expressions denotes a language comprising all possible strings over the alphabet { a,b} ?

(a) a*b*

(b) (a | b)*

(c) (ab) *

(d) (a | b*)

300. **[Equivalence-of-Languages | Nielit Scientist-B CS 2016 march]** Regarding power of recognition of language, which of the following is false?

(a) Non deterministic finite-state automata are equivalent to deterministic finite-state automata

(b) Non deterministic PDA are equivalent to Deterministic PDA

(c) Nondeterministic turing machines are equivalent to deterministic PDA

(d) Multi tape Turing machines are equivalent to single tape Turing machines

301. **[Context-Free-Language | Nielit Scientist-B CS 2016 march]** If L1 and L2 are context free language and R a regular set, then which one of the languages below is not necessarily a context free language?

    (a) L1.L2

    (b) L1 ∩ L2

    (c) L1 ∩ R

    (d) L1 U L2

302. **[Nielit STA [02-12-2018]]** Given language L={ $a^{(2*m)}$ $c^{(4*n)}$ d^n b^m | m,n> =0} . Find the best appropriate match to recognize L.

    (a) Finite automata

    (b) Pushdown automata

    (c) Non deterministic turing machine

    (d) Non deterministic PDA

303. **[Nielit STA [02-12-2018]]** Consider the problem of determining string 'w' is given some turing machine 'M' will it enter into some state 'q', where q belongs to set of all states in Turing machine M and sting w is not equal to empty string. Which among the following is correct for above statement?

    (a) Given problems is computable

    (b) Given problem is non computable

    (c) Given problem has finite state solution

    (d) Given problem is solved in polynomial time.

304. **[Regular-Expression | Nielit Scientist-B CS 2016 march]** The CFG S → aS| bS| a| b is equivalent to regular expression

    (a) (a+b)

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

    (c) (a+b)(a+b)

    (d) all of these

305. **[Finite-Automata | Nielit Scientist-B CS 2016 march]** If L be a language recognizable by a finite automation, then language from { L} ={ w such that w is prefix of v where v ∈ L} , is a

    (a) regular language

    (b) context free language

    (c) context sensitive language

    (d) recursive enumeration language

306. **[Regular-Language | Nielit Scientist-B CS 2016 march]** Which of the following statements is correct?

    (a) A={ a ^{n} b ^{n} | n= 0,1,2,3..} is regular language

    (b) Set B of all strings of equal number of a's and b's defines a regular language

(c) L(A*B*) ∩ B gives the set A

(d) None of these

307. **[Regular-Expression | UGC-NET CS 2018 DEC Paper-2]** Let r = a(a + b)*, s = aa*b and t = a*b be three regular expressions.

Consider the following:
(i) L(s) ⊆ L(r) and L(s) ⊆ L(t)
(ii). L(r) ⊆ L(s) and L(s) ⊆ L(t)

Choose the correct answer from the code given below :

Code :

(a) Only (i) is correct

(b) Both (i) and (ii) are correct

(c) Only (ii) is correct

(d) Neither (i) nor (ii) is correct

308. **[Regular-Language | NieLit STA 2016 March 2016]** Regular sets are closed under

(a) Union

(b) Concatenation

(c) Kleene's closure

(d) All of these

309. **[Finite-Automata | UGC-NET CS 2018 DEC Paper-2]** Consider the language L given by

L = { 2^{nk} | k> 0, and n is non-negative integer number}

The minimum number of states of finite automaton which accept the language L is

(a) n

(b) n+1

(c) 2^n

(d) n(n+1)/2

310. **[Decidability-and-Undecidability | UGC-NET CS 2018 DEC Paper-2]** Which of the following problem is decidable for recursive language (L) ?

(a) Is L = Φ ?

(b) Is w∈ L, where w is a string ?

(c) Is L = R, where R is given regular set ?

(d) Is L = Σ * ?

311. **[Regular-Language | UGC-NET CS 2018 DEC Paper-2]** Consider R to be any regular language and L_1 .L_2 be any two context-free languages

Which one of the following is correct ?

$$\overline{(L_1 \cup L_2)} - R \text{ is context free}$$

(a)

$$L_1 - R \text{ is context free}$$

(b)

$$\overline{L_1} \text{ is context free}$$

(c)

$$L_1 \cap L_2 \text{ is context free}$$

(d)

312. **[DFA | NieLit STA 2016 March 2016]** Can a DFA simulate NFA?
    (a) No
    (b) Yes
    (c) Sometimes
    (d) Depends on NFA
313. **[Finite-Automata | Nielit Scientist-B CS 4-12-2016]** Palindromes can't be recognized by any Finite State Automata because
    (a) FSA cannot remember arbitrarily large amount of information
    (b) FSA cannot deterministically fix the midpoint
    (c) Even if the mid-Point is known an FSA cannot find whether the second half of the matches the first half
    (d) All of the above
314. **[Closure-Property | Nielit Scientist-B CS 4-12-2016]** If L1 is CSL and L2 is regular language which of the following is false?
    (a) L1-L2 is not context free
    (b) L1 intersection L2 is context free
    (c) L1 is context free
    (d) Both (A) and (C)
315. **[Turing-machines | Nielit Scientist-B CS 4-12-2016]** Which of the following is TRUE?
    (a) Turing machine is a simple mathematical model of general purpose computer
    (b) Turing machine is more powerful than finite automata
    (c) Turing Machine can be simulated by a general purpose computer
    (d) All of these

316. **[DFA | Nielit Scientist-B CS 4-12-2016]** Given two DFA's M1 and M2. They are equivalent if:

(a) M1 and M2 has the same number of states

(b) M1 and M2 accepts the same language i.e L(M1)=L(M2)

(c) M1 and M2 has the same number of final states

(d) None of the above

317. **[Regular-Expression | Nielit Scientist-B CS 4-12-2016]** (00+01+10)(0+1)* represents:

(a) Strings not starting with 11

(b) Strings of odd length

(c) Strings starting with 00

(d) Strings of even length

318. **[Regular-Language | ISRO CS 2015]** Let R1 and R2 be regular sets defined over the alphabet, then

(a) R1 $\cap$ R2 is not regular

(b) R1 $\cup$ R2 is not regular

(c) Σ * - R1 is regular

(d) R1 * is not regular

319. **[DFA | JT(IT) 2018 PART-B Computer Science]** State whether TRUE or FALSE

(i) In NDFA, the transition function δ : Q * $\Sigma \rightarrow 2^Q$
(ii) NDFA does not permit empty string transitions

(a) (i) False (ii) False

(b) (i) True (ii) False

(c) (i) False (ii) True

(d) (i) True (ii) True

320. **[Nielit Scientist-B 17-12-2017]** According to the given language, which among the following expression does it corresponds to? Language L={ x $\in$ { 0,1} | x is of length 4 or less}

(a) $(0+1+0+1+0+1+0+1)^4$

(b) $(0+1)^4$

(c) $(01)^4$

(d) $(0+1+\in)^4$

321. **[Nielit Scientist-B 17-12-2017]** Let G be a grammar in CFG and Let W_1 ,$W_2 \in$ L(G) such that | W_1 | =| W_2 | then which of the following statement is TRUE?

(a) Any derivation of W_1 has exactly the same number of steps as any derivation of W_2

(b) Different derivation have different length

(c) Some derivation of W_1 may be shorter the derivation of W_2

(d) None of the options

322. **[Nielit Scientist-B 17-12-2017]** A regular expression is (a+b*c) is equivalent to :
    (a) Set of strings with either a or one or more occurences of b followed by c.
    (b) (b*c+a)
    (c) Set of strings with either a or zero or more occurence of b followed by c
    (d) Both (B) and (C)

323. **[Nielit Scientist-B 17-12-2017]** Which of the following are undecidable?
P1: The language generated by some CFG contains any words of length less than some given number n.
P2: Let L1 be CFL and L2 be regular, to determine whether L1 and L2 have common elements
P3: Any given CFG is ambiguous or not
P4: For any given CFG G, to determine whether $\in$ belongs to L(G)
    (a) P2 only
    (b) P1 and P2 only
    (c) P2 and P3 only
    (d) P3 only

324. **[Nielit Scientist-B 17-12-2017]** Recursive enumerable language are not closed under___
    (a) Set difference
    (b) Complement
    (c) Both (A) and (B)
    (d) None of the options

325. **[Nielit Scientist-B 17-12-2017]** What is the meaning of regular expression Σ * 001 Σ *?
    (a) Any string containing '1' as substring
    (b) Any string containing '01' as substring
    (c) Any string containing '011' as substring
    (d) All string containing '001' as substring

326. **[Nielit Scientist-B 17-12-2017]** The grammar $S \rightarrow aSb \mid bSa \mid SS \mid \in$ is :
    (a) Unambiguous CFG
    (b) Ambiguous CFG
    (c) Not a CFG
    (d) Deterministic CFG

327. **[Nielit Scientist-B 17-12-2017]** If any string of a language L can be effectively enumerator in a lexicographic by an enumerator in a lexicographic order then language L is___
    (a) Regular

(b) Context free but not regular

(c) Recursive but not necessarily context free

(d) Recursively enumerable but not necessarily recursive

328. **[Nielit Scientist-B 17-12-2017]** The collection of turing recognizable languages are closed under:
i.Union
ii.Intersection
iii.complement
iv.Concatenation
v.star closure

(a) i only

(b) Both i,iv

(c) i,ii,iv and v

(d) All of the options

329. **[Nielit Scientist-B 17-12-2017]** Which of the following regular expression is equal to (r1+r2)*?

(a) r1*r2*

(b) (r1r2)*

(c) r1*r2*+r1r2

(d) (r1*r2*)*

330. **[Nielit Scientist-B 17-12-2017]** Which of the following is true?
S1: The power of a multi tape Turing machine is greater than the power of a single tape turing machine
S2: Every non deterministic Turing machine has an equivalent deterministic Turing machine

(a) S1

(b) S2

(c) Both S1 and S2

(d) None of the options

331. **[Languages-and-Grammars | JT(IT) 2018 PART-B Computer Science]** Which of the following correctly defines kleene closure?

(a) It is the infinite set of all possible strings of all possible lengths over Σ (input set) excluding λ (empty string)

(b) It is the finite set of all possible strings of all possible lengths over Σ (input set) excluding λ (empty string)

(c) It is the finite set of all possible strings of all possible lengths over Σ (input set)

(d) It is the infinite set of all possible strings of all possible lengths over Σ (input set)

332. **[Nielit Scientist-B 17-12-2017]** Which of the following is TRUE?

(a) mealy and moore machine are language acceptors

(b) Finite state automata is language translator

(c) NPDA is more powerful than DPDA

(d) mealy machine is more powerful than moore machine

333. **[Nielit Scientist-B 17-12-2017]** The string 1101 does not belong to the set represented by:

(a) (00+(11)*0)

(b) 1(0+1)*101

(c) (10)*(01)*(00+11)*

(d) 110*(0+1)

(e) Option-1 and 3

334. **[Nielit Scientist-B 17-12-2017]** Let n is the length of string to test for membership, then the number of table entry in CYK algorithm is:

(a) n(n+1)

(b) n^2 +1

(c) n^2 -1

(d) n(n+1)/2

335. **[Nielit Scientist-B 17-12-2017]** Which of the following statement is true?

(a) Deterministic Context free language are closed under complement

(b) Deterministic Context free language are not closed under union

(c) Deterministic Context free language are closed under intersection with regular set

(d) All of the options

336. **[Nielit Scientist-B 17-12-2017]** Which machine is equally powerful in both deterministic and non deterministic form?

(a) PDA

(b) TM

(c) LBA

(d) None of the options

337. **[Nielit Scientist-B 17-12-2017]** Which of the following is a correct hierarchical relationships of the following where
L1: Set of languages accepted by NFA
L2: Set of languages accepted by DFA
L3: Set of languages accepted by DPDA
L4: Set of languages accepted by NPDA
L5: Set of recursive languages
L6. Set of recursively enumerable languages?

(a) L1,L2$\subset$ L3$\subset$ L4$\subset$ L5$\subset$ L6

(b) L1⊂ L2⊂ L3 ⊂ L4⊂ L5 ⊂ L6

(c) L2⊂ L1⊂ L3 ⊂ L4⊂ L5⊂ L6

(d) L1⊂ L2⊂ L3⊂ L4⊂ L6⊂ L5

338. **[Nielit Scientist-B 17-12-2017]** Which machine is equally powerful in both deterministic and nondeterministic form?

(a) Pushdown automata

(b) Turing machine

(c) Linear Bounded Automata

(d) None of the options

339. **[Nielit Scientist-B 17-12-2017]** Which of the following is equivalent regular expressions?
i.((01)*(10)*)*
ii.(10+01)*
iii.(01)*+(11)*
iv.(0*+(11)*+0*)*

(a) i and ii

(b) ii and iii

(c) iii and iv

(d) iv and i

340. **[Languages-and-Grammars | Nielit Scientific Assistance IT 15-10-2017]** Which of the definitions generates the same languages as L, where
L={ $x^n y^n$, n> =1 }
i. E→ xEy | xy
ii.xy| x^+ x yy^+
iii. x^+ y^+

(a) i only

(b) i and ii only

(c) ii and iii only

(d) ii only

341. **[Languages-and-Grammars | JT(IT) 2018 PART-B Computer Science]** A language is a subset of Σ * for some alphabet Σ . If a language takes all possible strings of length 2 over Σ = { a,b} , then, which of the below is correct?

(a) L = { ab,bb,ba}

(b) L = { aa,ab,ba,bb}

(c) L = { ab,bb,aa}

(d) L = { ab,ba,aa}

342. **[Nielit STA 17-12-2017]** The automaton which allows transformation to a new state without consuming any input symbols:

(a) NFA

(b) DFA

(c) NFA-∈ / NFA-l

(d) All of the above

343. **[Nielit STA 17-12-2017]** Complement of a DFA can be obtained by:

(a) making starting state as final state

(b) make final as a starting state

(c) make final states non-final and non final as final

(d) None of the options

344. **[Nielit STA 17-12-2017]** Concatenation operation refers to which of the following set operations:

(a) Union

(b) Dot

(c) Kleene

(d) none of the options

345. **[Nielit STA 17-12-2017]** Which of the following statement is true?

(a) mealy and moore machine are language acceptors

(b) Finite state automata is language translator

(c) NPDA is more powerful than DPDA

(d) mealy machine is more powerful than moore machine

346. **[Nielit STA 17-12-2017]** If L1 and L2 are regular sets then intersection of these two will be:

(a) Regular

(b) Non regular

(c) Recursive

(d) Non Recursive

347. **[Nielit STA 17-12-2017]** let P,Q,R be a regular expression over Z. If P does not contain null string, then R=Q+RP has a unique solution____

(a) Q*P

(b) QP*

(c) Q*P*

(d) (P*Q*)*

348. **[Nielit STA 17-12-2017]** A finite automaton accepts which type of language:

(a) Type 0

(b) Type 1

(c) Type 2

(d) Type 3

349. **[Nielit STA 17-12-2017]** (0+∈)(1+∈) represents:

(a) { 0,1,01,∈ }

(b) { 0,1,∈ }

(c) { 0,1,01,11,00,10,∈ }

(d) { 0,1}

350. **[Nielit STA 17-12-2017]** What is the relation between DFA and NFA on the basis of computational power?

(a) DFA> NFA

(b) NFA> DFA

(c) Equals

(d) Can't be said

351. **[Nielit STA 17-12-2017]** How many DFA's exits with two states over input alphabet { 0,1} ?

(a) 16

(b) 26

(c) 32

(d) 64

352. **[Nielit STA 17-12-2017]** Complement of (a+b)* will be:

(a) π

(b) ϕ

(c) a

(d) b

353. **[Nielit STA 17-12-2017]** Finite automata requires minimum__ number of stacks

(a) 1

(b) 0

(c) 2

(d) none of the options

354. **[Regular-Expression | KVS 22-12-2018 Part-B]** Which of the following expression results in zero?

(a) (0+0+1)(0+0+1)

(b) (0+0+0)(0+1+1)

(c) (1+0+0)(1+1+1)

(d) (0+1+0)(1+0+1)

355. **[Recursive-and-Recursively-Enumerable-Language | Nielit Scientific Assistance CS 15-10-2017]** A language L for which there exists a TM,, 'T', that accepts every word in L and either rejects or loops for every word that is not in L, is said to be

(a) recursive

(b) recursively enumerable

(c) NP-Hard

(d) None of the above

356. **[Pumping Lemma | Nielit Scientific Assistance CS 15-10-2017]** The logic of pumping lemma us a good example of

(a) The pigeonhole principle

(b) The divide and conquer technique

(c) recursion

(d) Iteration

357. **[Finite-Automata | JT(IT) 2018 PART-B Computer Science]** A DFA can be expressed as a 5 tuple(Q, Σ , δ , q_0 , F), where δ is the transition function defined as ___?

(a) $\delta : \Sigma \rightarrow Q$

(b) $\delta : Q \text{ x } Q \rightarrow \Sigma$

(c) $\delta : Q \rightarrow Q$

(d) $\delta : Q \text{ x } \Sigma \rightarrow Q$

358. **[Regular-Expression | JT(IT) 2018 PART-B Computer Science]** If r and s are regular expression representing the languages L(r) and L(s), respectively, then which of the following is FALSE?

(a) (r)| (s) is a regular expression representing L(r)UL(s)

(b) (r)| (s) is a regular expression representing (L(r))* or (L(s))*

(c) (r)* is a regular expression representing (L(r))*

(d) (r)(s) is regular expression representing L(r)L(s)

359. **[Languages-and-Grammars | Nielit Scientific Assistance CS 15-10-2017]** Which of the definitions generates the same languages as L, where
L={ x ^{n} y^n , n> =1 }
i. E$\rightarrow$ xEy | xy
ii.xy| x $^+$ x yy$^+$
iii. x $^+$ y $^+$

(a) i only

(b) i and ii only

(c) ii and iii only

(d) ii only

360. **[Languages-and-Grammars | JT(IT) 2016 PART-B Computer Science]** For the context free grammar G:

R $\rightarrow$ XRX| S ,
S $\rightarrow$ aTbTa ,
T $\rightarrow$ XTX| X$\in$
X $\rightarrow$ a| b

The strings which are not in L(G) are:

(a) ab,ba,aab

(b) abb,aabab

(c) a,b,aa

(d) a,b,$\in$

361. **[Regular-Expression | UGC NET CS 2017 Nov- paper-2]** Which of the following regular expressions, each describing a language of binary numbers (MSB to LSB) that represents non negative decimal values, does not include even values ?

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

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

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

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

362. **[Context-Free-Language | UGC NET CS 2017 Nov- paper-2]** Which of the following statements is/are TRUE ?
(i) The grammar S $\rightarrow$ SS | a is ambiguous (where S is the start symbol).
(ii) The grammar S $\rightarrow$ 0S1 | 01S | e is ambiguous (the special symbol e represents the empty string and S is the start symbol).
(iii) The grammar (where S is the start symbol).
S $\rightarrow$ T/U
T $\rightarrow$ x S y ? xy ? e
U $\rightarrow$ yT
generates a language consisting of the string yxxyy.

(a) Only (i) and (ii) are TRUE

(b) Only (i) and (iii) are TRUE

(c) Only (ii) and (iii) are TRUE

(d) All of (i), (ii) and (iii) are TRUE

363. **[Regular-Expression | UGC NET CS 2017 Jan -paper-2]** Which of the following strings would match the regular expression : p+ [3 - 5] * [xyz] ?
I. p443y
II. p6y
III. 3xyz
IV. p35z
V. p353535x
VI. ppp5

(a) I, III and VI only

(b) IV, V and VI only

(c) II, IV and V only

(d) I, IV and V only

364. **[Regular-Expression | UGC NET CS 2016 Aug- paper-2]** The number of strings of length 4 that are generated by the regular expression $(0^+1^+ | 2^+3^+)^*$, where | is an alternation character and { +, *} are quantification characters, is:

(a) 08

(b) 09

(c) 10

(d) 12

365. **[Languages-and-Grammars | UGC NET CS 2016 Aug- paper-2]** Which of the following is FALSE?

(a) The grammar S→ aS| aSbS| ∈ , where S is the only non-terminal symbol, and ∈ is the null string, is ambiguous.

(b) An unambiguous grammar has same leftmost and rightmost derivation.

(c) An ambiguous grammar can never be LR(k) for any k.

(d) Recursive descent parser is a top-down parser.

366. **[Regular-Expression | UGC NET CS 2016 July- paper-2]** The number of strings of length 4 that are generated by the regular expression (0| ∈)1 + 2* (3| ∈), where | is an alternation character, { +, *} are quantification characters, and ∈ is the null string, is :

(a) 08

(b) 10

(c) 11

(d) 12

367. **[Context-Free-Grammar | UGC NET CS 2015 Jun- paper-2]** If all the production rules have single non-terminal symbol on the left side, the grammar defined is:

(a) context free grammar

(b) context sensitive grammar

(c) unrestricted grammar

(d) phrase grammar

368. **[Context-Free-Language | UGC NET CS 2004 Dec-Paper-2]** The context-free languages are closed for :
(i) Intersection
(ii) Union
(iii) Complementation
(iv) Kleene Star
then

(a) (i) and (iv)

(b) (i) and (iii)

(c) (ii) and (iv)

(d) (ii) and (iii)

369. **[Languages-and-Grammars | UGC NET CS 2005 Dec-Paper-2]** Which sentence can be generated by
S→ d/bA

A→ d/ccA

(a) bccddd

(b) aabccd

(c) ababccd

(d) abbbd

(e) None of the above

370. **[Regular-Expression | UGC NET CS 2005 Dec-Paper-2]** Regular expression a+b denotes the set :

(a) { a}

(b) { ∈ , a, b}

(c) { a, b}

(d) None of these

371. **[Finite-Automata | UGC NET CS 2005 june-paper-2]** Which of the following is not true ?

(a) Power of deterministic automata is equivalent to power of non-deterministic automata.

(b) Power of deterministic pushdown automata is equivalent to power of non-deterministic pushdown automata.

(c) Power of deterministic turing machine is equivalent to power of non-deterministic turing machine.

(d) All the above

372. **[Context-Free-Language | UGC NET CS 2005 june-paper-2]** Identify the language which is not context-free.

(a) L = { wwR | w∈ { 0,1} * }

(b) L = { a^n b^n | n≥ 0 }

(c) L = { ww | w∈ { 0,1} * }

(d) L = { a^n b^m c^m d^n | n,m ≥ 0 }

373. **[Context-Sensitive-Grammar | UGC NET CS 2005 june-paper-2]** Which of the following is the most general phase-structured grammar ?

(a) Regular

(b) Context - Sensitive

(c) Context free

(d) None of these

374. **[Context-Sensitive-Grammar | UGC NET CS 2005 june-paper-2]** Which activity is not included in the first pass of two pass assemblers ?

(a) Build the symbol table

(b) Construct the machine code

(c) Separate mnemonic opcode and operand fields.

(d) None of these

375. **[Regular-Expression | UGC NET CS 2006 Dec-paper-2]** Which of the regular expressions corresponds to this grammar ?
S → AB/AS, A→ a/aA, B→ b

(a) aa*b +

(b) aa*b

(c) (ab)*

(d) a(ab)*

376. **[Languages-and-Grammars | UGC NET CS 2006 Dec-paper-2]** Which of the following is the most general phase-structured grammar ?

(a) Regular

(b) Context-sensitive

(c) Context free

(d) Syntax tree

377. **[Languages-and-Grammars | UGC NET CS 2006 June-Paper-2]** Which of the following strings is in the language defined by grammar
S → 0A
A → 1A/0A/1

(a) 01100

(b) 00101

(c) 10011

(d) 11111

378. **[Context-Free-Language | UGC NET CS 2014 Dec-Paper-2]** The following Context-Free Grammar (CFG) :
S → aB | bA
A → a | as | bAA
B → b | bs | aBB
will generate

(a) odd numbers of a's and odd numbers of b's

(b) even numbers of a's and even numbers of b's

(c) equal numbers of a's and b's

(d) different numbers of a's and b's

379. **[Languages-and-Grammars | UGC NET CS 2018-DEC Paper-2]** The number of substrings that can be formed from string given by "a d e f b g h n m p" is

(a) 10

(b) 45

(c) 56

(d) 55

380. **[Context-Free-Language | UGC NET CS 2018-DEC Paper-2]** Consider the following language:
$L_1 = \{ a^{n+m}\ b^n\ a^m \mid n, m \geq 0 \}$
$L_2 = \{ a^{n+m}\ b^{n+m}\ a^{n+m} \mid n, m \geq 0 \}$
Which one of the following is correct?

(a) Only L_1 is Context Free Language

(b) Both L_1 and L_2 are not Context Free Language

(c) Only L_1 is Context Free Language

(d) Both L_1 and L_2 are Context Free Language

381. **[Finite-Automata | UGC NET CS 2018-DEC Paper-2]** Consider the following problems:
(i) Whether a finite automaton halts on all inputs?
(ii) Whether a given Context Free Language is Regular?
(iii) Whether a Turing Machine computes the product of two numbers?
Which one of the following is correct?

(a) Only (ii) and (iii) are undecidable problems

(b) (i), (ii) and (iii) are undecidable problems

(c) Only (i) and (ii) are undecidable problems

(d) Only (i) and (iii) are undecidable problems

382. **[Context-Free-Grammar | UGC NET CS 2014 June-paper-2]** The context free grammar for the language $L = \{ a^n\ b^m\ c^k \mid k = | n - m| , n \geq 0, m \geq 0, k \geq 0\}$ is

(a) $S \to S_1\ S_3$, $S_1 \to aS_1\ c \mid S_2 \mid \lambda$, $S_2 \to aS_2\ b \mid \lambda$, $S_3 \to aS_3\ b \mid S_4 \mid \lambda$, $S_4 \to bS_4\ c \mid \lambda$

(b) $S \to S_1\ S_3$, $S_1 \to aS_1\ S_2\ c \mid \lambda$, $S_2 \to aS_2\ b \mid \lambda$, $S_3 \to aS_3\ b \mid S_4 \mid \lambda$, $S_4 \to bS_4\ c \mid \lambda$

(c) $S \to S_1 \mid S_2$, $S_1 \to aS_1\ S_2\ c \mid \lambda$, $S_2 \to aS_2\ b \mid \lambda$, $S_3 \to aS_3\ b \mid S_4 \mid \lambda$, $S_4 \to bS_4\ c \mid \lambda$

(d) $S \to S_1 \mid S_3$, $S_1 \to aS_1\ c \mid S_2 \mid \lambda$, $S_2 \to aS_2\ b \mid \lambda$, $S_3 \to a\ S_3\ b \mid S_4 \mid \lambda$, $S_4 \to bS_4\ c \mid \lambda$

383. **[Regular-Language | UGC NET CS 2014 June-paper-2]** The regular grammar for the language
L = { w| na(w) and nb(w) are both even,
$w \in \{ a, b\}^*\}$ is given by :
(Assume, p, q, r and s are states)

(a) $p \to aq \mid br \mid \lambda$, $q \to bs \mid ap$
$r \to as \mid bp$, $s \to ar \mid bq$, p and s are initial and final states.

(b) $p \to aq \mid br$, $q \to bs \mid ap$
$r \to as \mid bp$, $s \to ar \mid bq$, p and s are initial and final states.

(c) $p \to aq \mid br \mid \lambda$, $q \to bs \mid ap$
$r \to as \mid bp$, $s \to ar \mid bq$ p is both initial and final states.

(d) $p \to aq \mid br$, $q \to bs \mid ap$
$r \to as \mid bp$, $s \to ar \mid bq$ p is both initial and final states

384. **[Regular-Expression | UGC NET CS 2018-DEC Paper-2]** let r= a(a + b)*, s=aa*b and t=a*b be three regular expressions. Consider the following:
(i) $L(s) \subseteq L(r)$ and $L(s) \subseteq L(t)$
(ii). $L(r) \subseteq L(s)$ and $L(s) \subseteq L(t)$

(a) Only (i) is correct

(b) Both (i) and (ii) are correct

(c) Only (ii) is correct

(d) Neither (i) nor (ii) is correct

385. **[Finite-Automata | UGC NET CS 2018-DEC Paper-2]** Consider the language L given by
L = { 2_{nk} | $k > 0$, and n is non - n egative integer number }
The minimum number of states of finite automaton which accept the language L is

(a) n

(b) n+1

(c) 2^n

(d) n (n + 1)/2

386. **[Decidability-and-Undecidability | UGC NET CS 2018-DEC Paper-2]** Which of the following problem is decidable for recursive language (L) ?

(a) Is L = Φ ?

(b) Is w∈ L, where w is a string ?

(c) Is L=R, where R is given regular set ?

(d) Is L = Σ * ?

387. **[Regular-Language | UGC NET CS 2018-DEC Paper-2]** Consider R to be any regular language and L_1 .L_2 be any two context-free languages Which one of the following is correct ?

(a) ($L_1 \cup L_2$) - R is context free

(b) L_1 - R is context free

(c) L_1 is context free

(d) $L_1 \cap L_2$ is context free

388. **[DFA | UGC NET CS 2013 Sep-paper-2]** The number of states in a minimal deterministic finite automaton corresponding to the language L = { a^n | $n \geq 4$ } is

(a) 3

(b) 4

(c) 5

(d) 6

389. **[Regular-Expression | UGC NET CS 2013 Sep-paper-2]** Regular expression for the language L = { w ∈ { 0, 1} * | w has no pair of consecutive zeros} is

(a) (1 + 010)*

(b) (01 + 10)*

(c) (1 + 010)* (0 + λ)

(d) (1 + 01)* (0 + λ)

390. **[Regular-Language | UGC NET CS 2013 Sep-paper-2]** Consider the following two languages :
L1 = { a^n b^l a^k | n + l + k> 5 }
L2 = { a^n b^l a^k | n> 5, l > 3, k≤ l }
Which of the following is true ?

(a) L_1 is regular language and L_2 is not regular language.

(b) Both L_1 and L_2 are regular languages.

(c) Both L_1 and L_2 are not regular languages.

(d) L_1 is not regular language and L_2 is regular language

391. **[Languages-and-Grammars | UGC NET CS 2013 Sep-paper-2]** LL grammar for the language

L = { a^n b^m c^{n+m} | m≥ 0, n≥ 0} is

(a) S → aSc | S_1 ; S_1 → bS_1 c | λ

(b) S → aSc | S_1 | λ ; S_1 → bS_1 c

(c) S → aSc | S_1 | λ ; S_1 → bS_1 c| λ

(d) S → aSc | λ ; S_1 → bS_1 c| λ |

392. **[Context-Free-Grammar | UGC NET CS 2013 Sep-paper-2]** Assume the statements S_1 and S_2 given as :

S_1 : Given a context free grammar G, there exists an algorithm for determining whether L(G) is infinite.

S_2 : There exists an algorithm to determine whether two context free grammars generate the same language.

Which of the following is true ?

(a) S_1 is correct and S_2 is not correct.

(b) Both S_1 and S_2 are correct.

(c) Both S_1 and S_2 are not correct.

(d) S_1 is not correct and S_2 is correct.

393. **[Finite-Automata | UGC NET CS 2018 JUNE Paper-2]** Two finite state machines are said to be equivalent if they :

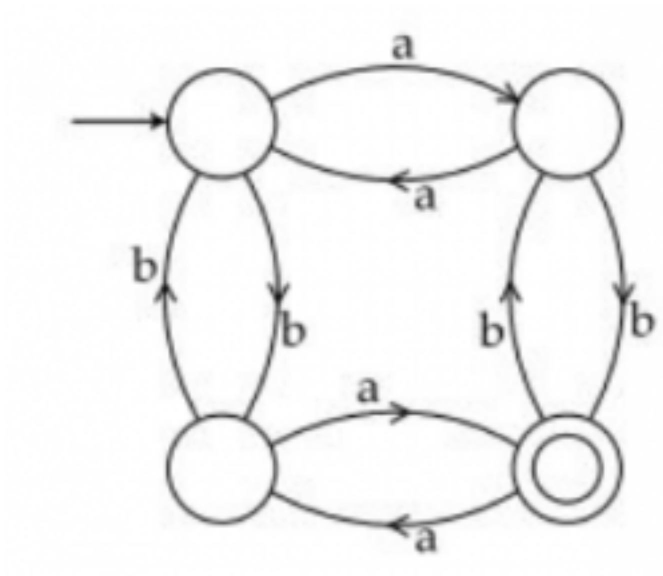
(a) Have the same number of edges

(b) Have the same number of states

(c) Recognize the same set of tokens

(d) Have the same number of states and edges

394. **[Finite-Automata | UGC NET CS 2018 JUNE Paper-2]** The finite state machine given in figure below recognizes :



(a) any string of odd number of a's

(b) any string of odd number of b's

(c) any string of even number of a's and odd number of b's

(d) any string of odd number of a's and odd number of b's

395. **[Turing-machines | UGC NET CS 2018 JUNE Paper-2]** A pushdown automata behaves like a Turing machine when the number of auxiliary memory is :

(a) 0

(b) 1

(c) 1 or more

(d) 2 or more

396. **[Push-Down-Automata | UGC NET CS 2018 JUNE Paper-2]** Pushdown automata can recognize language generated by .

(a) Only context free grammar

(b) Only regular grammar

(c) Context free grammar or regular grammar

(d) Only context sensitive grammar

397. **[Context-Free-Grammar | UGC NET CS 2018 JUNE Paper-2]** To obtain a string of n Terminals from a given Chomsky normal form grammar, the number of productions to be used is :

(a) 2n-1

(b) 2n

(c) n+1

(d) n^2

398. **[Context-sensitive-language | UGC NET CS 2018 JUNE Paper-2]** Context sensitive language can be recognized by a :

(a) Finite state machine

(b) Deterministic finite automata

(c) Non-deterministic finite automata

(d) Linear bounded automata

399. **[Context-Sensitive-Grammar | UGC NET CS 2018 JUNE Paper-2]** The set A={ $0^n 1^n 2^n$ | n=1, 2, 3, ... } is an example of a grammar that is :

(a) Context sensitive

(b) Context free

(c) Regular

(d) None of the above

400. **[Turing-machines | UGC NET CS 2018 JUNE Paper-2]** Consider the following statements( ) :
S1 : There exists no algorithm for deciding if any two Turing machines M1 and M2 accept the same language.
S2 : The problem of determining whether a Turing machine halts on any input is undecidable.
Which of the following options is correct ?

(a) Both S1 and S2 are correct

(b) Both S1 and S2 are not correct

(c) Only S1 is correct

(d) Only S2 is correct

401. **[Languages-and-Grammars | UGC NET CS 2012 Dec-Paper-2]** The 'C' language is

(a) Context free language

(b) Context sensitive language

(c) Regular language

(d) None of the above

402. **[Finite-Automata | UGC NET CS 2012 Dec-Paper-2]** Let L be a set accepted by a nondeterministic finite automaton. The number of states in non-deterministic finite automaton is | Q| . The maximum number of states in equivalent finite automaton that accepts L is

(a) | Q|

(b) 2| Q|

(c) 2| Q| - 1

(d) 2| Q|

403. **[Languages-and-Grammars | UGC NET CS 2013 Dec-paper-2]** The context free grammar for the language

$L = \{ a^n b^m \mid n \leq m + 3, n \geq 0, m \geq 0\}$ is

(a) $S \rightarrow aaa\ A; A \rightarrow aAb \mid B,$
$B \rightarrow Bb \mid \lambda$

(b) $S \rightarrow aaaA \mid \lambda$, $A \rightarrow aAb \mid B,$
$B \rightarrow Bb \mid \lambda$

(c) $S \rightarrow aaaA \mid aa\ A \mid \lambda$, $A \rightarrow aAb \mid B,$
$B \rightarrow Bb \mid \lambda$

(d) $S \rightarrow aaaA \mid aa\ A \mid aA \mid \lambda$, $A \rightarrow aAb \mid B, B \rightarrow Bb \mid \lambda$

404. **[Regular-Language | UGC NET CS 2013 Dec-paper-2]** Given the following statements :
S_1 : If L is a regular language then the language $\{ uv \mid u \in L, v \in L^R \}$ is also regular.
S_2 : $L = \{ ww^R \}$ is regular language. Which of the following is true ?

(a) S_1 is not correct and S_2 is not correct.

(b) S_1 is not correct and S_2 is correct.

(c) S_1 is correct and S_2 is not correct.

(d) S_1 is correct and S_2 is correct.

405. **[Closure-Property | UGC NET CS 2012 June-Paper2]** Consider the following statements :
(I). Recursive languages are closed under complementation.
(II). Recursively enumerable languages are closed under union.
(III). Recursively enumerable languages are closed under complementation.
Which of the above statements are true ?

(a) I only

(b) I and II

(c) I and III

(d) II and III

406. **[Context-Free-Language | UGC NET CS 2011 Dec-Paper-2]** Which one of the following statement is false ?

(a) Context-free languages are closed under union.

(b) Context-free languages are closed under concatenation.

(c) Context-free languages are closed under intersection.

(d) Context-free languages are closed under Kleene closure

407. **[Pumping-Lemma | NIELIT Junior Teachnical Assistant$ $_$2016$$_$ march]** Pick the correct statements The logic of Pumping lemma is a good example of

(a) the Pigeon-hole principle

(b) the divide and conquer technique

(c) recursion

(d) iteration

408. **[Context-Free-Language | NIELIT Junior Teachnical Assistant$ $_$2016$$_$ march]** Any string of terminals that can be generated by the following CFG
S → XY
X → aX | bX | a
Y → Ya | Yb | a

(a) has at least one b

(b) should end in an 'a'

(c) has no consecutive a's or b's

(d) has at least two a's

409. **[Regular-Expression | UGC NET CS 2013 June-paper-2]** Given L1=L(a*baa*) and L2=L(ab*). The regular expression corresponding to language L3 = L1/L2 (right quotient) is given by

(a) a*b

(b) a*baa*

(c) a*ba*

(d) None of the above

410. **[Finite-Automata | UGC NET CS 2013 June-paper-2]** Given a Non-deterministic Finite Automation (NFA) with states p and r as initial and final states respectively and transition table as given below :

	a	b
p	-	q
q	r	s
r	r	s
s	r	s

The minimum number of states required in Deterministic Finite Automation (DFA) equivalent to NFA is

(a) 5

(b) 4

(c) 3

(d) 2

411. **[Finite-Automata | NIELIT Technical Assistant$ $_$2016$$_$ march]** An FSM can be a

(a) of finite tape length, rewinding capability and unidirectional tape movement.

(b) of finite tape length, without rewinding capability and unidirectional tape movement.

(c) of finite tape length, without rewinding capability and bidirectional tape movement.

(d) of finite tape length, rewinding capability and bidirectional tape movement.

412. **[Moore-and-Mealy-Machine | NIELIT Technical Assistant$ $_$2016$$_$ march]** The major difference between a Moore and a Mealy machine is that

(a) the output of the former depends on the present state and the current input

(b) the output of the former depends only on the present state

(c) the output of the former depends only on the current input

(d) none of the above

413. **[Regular-Expression | UGC NET CS 2010 June-Paper-2]** "My Lafter Machin(MLM) recognizes the following strings :
(i) a
(ii) aba
(iii) abaabaaba
(iv) abaabaabaabaabaabaabaabaaba
Using this as an information, how would you compare the following regular expressions ?
(i) $(aba)^{3x}$
(ii) a.(baa)3^x -1. ba
(iii) ab.(aab).^{3x} -1.a

(a) (ii) and (iii) are same, (i) is different.

(b) (ii) and (iii) are not same.

(c) (i), (ii) and (iii) are different.

(d) (i), (ii) and (iii) are same.

414. **[Languages-and-Grammars | UGC NET CS 2010 June-Paper-2]** Which of the following is the most general phase structured grammar ?

(a) Regular

(b) Context-sensitive

(c) Context free

(d) None of the above

415. **[Context-Free-Grammar | UGC NET CS 2009-June-Paper-2]** Any syntactic construct that can be described by a regular expression can also be described by a :

(a) Context sensitive grammar

(b) Non context free grammar

(c) Context free grammar

(d) None of the above

416. **[Regular-Expression | UGC NET CS 2009 Dec-Paper-2]** In a MIU puzzle, either of the letters M, I or U could go as a start symbol. Production rules are given below :
R_1 : U → IU
R_2 : M.x → M.x.x where . .. is string concatenation operator. Given this, which of the following holds for
(i) MIUIUIUIUIU
(ii) MIUIUIUIUIUIUIUIU

(a) Either (i) or (ii) but not both of these are valid words.

(b) Both (i) and (ii) are valid words and they take identical number of transformations for the production.

(c) Both (i) and (ii) are valid words but they involve different number of transformations in the production.

(d) None of these

417. **[Context-Free-Grammar | UGC NET CS 2009 Dec-Paper-2]** Context-free Grammar (CFG) can be recognized by

(a) Finite state automata

(b) 2-way linear bounded automata

(c) pushdown automata

(d) both (B) and (C)

418. **[Regular-Language | CHENNAI MATHEMATICAL INSTITUTE (M.Sc. / Ph.D. Programme in Computer Science)15 May 2013]** Consider the set of all words over the alphabet { x, y, z} where the number of y's is not divisible by 2 or 7 and no x appears after a z. This language is:

(a) regular

(b) not known to be regular

(c) context-free but not regular

(d) recursively enumerable but not context-free

419. **[Finite-Automata | CHENNAI MATHEMATICAL INSTITUTE (M.Sc. / Ph.D. Programme in Computer Science)15 May 2013]** For a binary string x = $a_0 a_1 \cdots a_{n-1}$ define val(x) to be the value of x interpreted as a binary number, where a_0 is the most significant bit. More formally, val(x) is given by

$$\sum_{0 \le i < n} 2^{n-1-i} \cdot a_i.$$

Design a finite automaton that accepts exactly the set of binary strings x such that val(x) is divisible by either 4 or 5.

(a) Descriptive Explanation

420. **[Regular-Language | CHENNAI MATHEMATICAL INSTITUTE(M.Sc. / Ph.D. Programme in Computer Science) 18May 2015]** Let L_1 and L_2 be languages over an alphabet Σ such that $L_1 \subseteq L_2$. Which of the following is true:

    (a) If L_2 is regular, then L_1 must also be regular.

    (b) If L_1 is regular, then L_2 must also be regular.

    (c) Either both L_1 and L_2 are regular, or both are not regular.

    (d) None of the above.

421. **[Regular-Language | CHENNAI MATHEMATICAL INSTITUTE(M.Sc. / Ph.D. Programme in Computer Science) 18May 2015]** Let $\Sigma = \{ a, b\}$. Given a language $L \subseteq \Sigma^*$ and a word $w \in \Sigma^*$, define the languages: Extend(L, w) := $\{ xw \mid x \in L \}$ Shrink(L, w) := $\{ x \mid xw \in L \}$ Show that if L is regular, both Extend(L, w) and Shrink(L,w) are regular.

    (a) Descriptive Explanation

422. **[Regular-Expression | CHENNAI MATHEMATICAL INSTITUTE M.Sc. / Ph.D. Programme in Computer Science (18 May 2017)]** The regular expression (a * + b) * is equivalent to which of the following regular expressions:

    (a) a * b *

    (b) (a * b + b) *

    (c) (a + b *) *

    (d) (a * b) *

423. **[Finite-Automata | CHENNAI MATHEMATICAL INSTITUTE M.Sc. / Ph.D. Programme in Computer Science (18 May 2017)]** Let $\Sigma = \{ a, b, c\}$. Let L even be the set of all even length strings in Σ^* . (a) Construct a deterministic finite state automaton for L even . (b) We consider an operation Erase ab that takes as input a string $w \in \Sigma^*$ and erases all occurrences of the pattern ab from w. Formally, it can be defined as follows:

    $$\mathtt{Erase}_{ab}(w) := \begin{cases} w & \text{if } w \text{ does not contain the pattern } ab \\ \mathtt{Erase}_{ab}(w_1)\ \mathtt{Erase}_{ab}(w_2) & \text{if } w = w_1\ ab\ w_2 \text{ for some } w_1, w_2 \in \Sigma^* \end{cases}$$

    For instance, $\mathtt{Erase}_{ab}(cacb) = cacb$, $\mathtt{Erase}_{ab}(cabcbab) = ccb$ and $\mathtt{Erase}_{ab}(ab) = \epsilon$.

    For a language L, we define $\mathtt{Erase}_{ab}(L)$ to be the set of strings obtained by applying the $\mathtt{Erase}_{ab}$ operation to each string in L:

    $$\mathtt{Erase}_{ab}(L) := \{\mathtt{Erase}_{ab}(w) \mid w \in L\}$$

    Show that $\mathtt{Erase}_{ab}(L_{even})$ is a regular language.

    (a) Descriptive Explanation

424. **[Finite-Automata | CHENNAI MATHEMATICAL INSTITUTE M.Sc. / Ph.D. Programme in Computer Science (18 May 2017)]** Let $\Sigma = \{ a, b\}$. Given words u, v $\in \Sigma^*$, we say that v extends u if v is of the form xuy for some x, y $\in \Sigma^*$. Given a fixed word u, we are interested in identifying whether a finite state automaton accepts some word that extends u. Describe an algorithm that takes as input a finite state automaton (DFA or NFA) A over $\Sigma = \{ a, b\}$ and a word u $\in \Sigma^*$ and reports "Yes" if some word in the language of A extends u and "No" if no word in the language of A extends u.

    (a) Descriptive Explanation

425. **[Context-Free-Grammar | UGC NET CS 2007-Dec-Paper-2]** A context free grammar is :

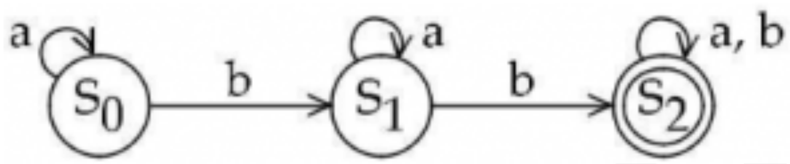
(a) type 0

(b) type 1

(c) type 2

(d) type 3

426. **[Moore-and-Mealy-Machine | UGC NET CS 2007-Dec-Paper-2]** Consider a Moore machine M whose digraph is :



Then L(M), the language accepted by the machine M, is the set of all strings having :

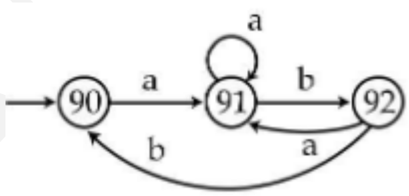
(a) two or more b's.

(b) three or more b's.

(c) two or more a's.

(d) three or more a's.

427. **[Finite-Automata | UGC NET CS 2007 June-Paper-2]** The following deterministic finite automata recognizes :



(a) Set of all strings containing 'ab'

(b) Set of all strings containing 'aab'

(c) Set of all strings ending in 'abab'

(d) None of the above

428. **[Regular-Expression | UGC NET CS 2007 June-Paper-2]** The regular expression given below describes :

r=(1+01)* (0+λ)

(a) Set of all string not containing '11'

(b) Set of all string not containing '00'

(c) Set of all string containing '01'

(d) Set of all string ending in '0'

429. **[Regular-Language | UGC NET CS 2007 June-Paper-2]** Which of the following language is regular :

(a) L = { a^n b^n | n $\geq$ 1 }

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

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

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

430. **[Regular-Expression | CHENNAI MATHEMATICAL INSTITUTE M.Sc. / Ph.D. Programme in Computer Science (18 May 2016)]** For a regular expression e, let L(e) be the language generated by e. If e is an expression that has no Kleene star * occurring in it, which of the following is true about e in general?

(a) L(e) is empty.

(b) L(e) is finite.

(c) Complement of L(e) is empty.

(d) Both L(e) and its complement are infinite.

431. **[DFA | CHENNAI MATHEMATICAL INSTITUTE M.Sc. / Ph.D. Programme in Computer Science (18 May 2016)]** For a string x = a $_0$ a $_1$ $\cdots$ a_{n-1} over the alphabet { 0, 1, 2} , define val(x) to be the value of x interpreted as a ternary number, where a 0 is the most significant digit. More formally, val(x) is given by

$$\sum_{0 \leq i < n} 3^{n-1-i} \cdot a_i .$$

Design a finite automaton that accepts exactly the set of strings x $\in$ { 0, 1, 2} * such that val (x) is divisible by 4.

(a) Explanation

432. **[Turing-machines | CHENNAI MATHEMATICAL INSTITUTE - M.Sc. / Ph.D. Programme in Computer Science (15 May 2014)]** Alan's task is to design an algorithm for a decision problem P . He knows that there is an algorithm A that transforms instances of P to instances of the Halting Problem such that yes instances of P map to yes instances of the Halting Problem, and no instances of P map to no instances of the Halting problem. Which of the following is true.

(a) The existence of A implies the existence of an algorithm for P .

(b) The existence of A implies that there is no algorithm for P .

(c) The existence of A says nothing about whether there is an algorithm for P .

(d) The Halting Problem can be solved using A.

433. **[Languages-and-Grammars | CHENNAI MATHEMATICAL INSTITUTE - M.Sc. / Ph.D. Programme in Computer Science (15 May 2014)]** Let $\Sigma = \{ a, b\}$. For a word $w \in \Sigma^*$, let $n_a(x)$ denote the number of a's in w and let $n_b(x)$ denote the number of b's in w. Consider the following language: $L := \{ xy \mid x, y \in \Sigma^*, n_a(x) = n_b(y)\}$ What can we say about L?

(a) L is regular, but not context-free.

(b) L is context-free, but not regular.

(c) L is Σ^* .

(d) None of these.

434. **[Regular-Language | CHENNAI MATHEMATICAL INSTITUTE - M.Sc. / Ph.D. Programme in Computer Science (15 May 2014)]** Let A be a regular language. Consider the following operations on A: $2A := \{ xy \mid x, y \in A \text{ and } x = y\}$ $A^2 := \{ xy \mid x, y \in A\}$ One of these operations necessarily leads to a regular language and the other may not. Identify which is which. For the regular operation, give a proof that it is regular. For the non-regular operation, give an example of an A such that applying the operation on it results in a non-regular language.

(a) Explanation

435. **[Regular-Language | UGC NET CS 2017 Nov- paper-3]** Pumping lemma for regular language is generally used for proving:

(a) whether two given regular expressions are equivalent

(b) a given grammar is ambiguous

(c) a given grammar is regular

(d) a given grammar is not regular

436. **[Decidability-and-Undecidability | UGC NET CS 2017 Nov- paper-3]** Which of the following problems is undecidable?

(a) To determine if two finite automata are equivalent

(b) Membership problem for context free grammar

(c) Finiteness problem for finite automata

(d) Ambiguity problem for context free grammar

437. **[Finite-Automata | UGC NET CS 2017 Nov- paper-3]** Finite state machine can recognize language generated by __________.

(a) Only context free grammar

(b) Only context sensitive grammar

(c) Only regular grammar

(d) any unambiguous grammar

438. **[Languages-and-Grammars | UGC NET CS 2017 Nov- paper-3]** The language $L = \{ a^i\, b\, c^i \mid i >= 0\}$ over the alphabet $\{ a, b, c\}$ is:

(a) a regular language.

(b) not a deterministic context free language but a context free language.

(c) recursive and is a deterministic context free language.

(d) not recursive.

439. **[Recursive-and-Recursively-Enumerable-Language | UGC NET CS 2017 Nov-paper-3]** Which of the following statements is not correct?

(a) Every recursive language is recursively enumerable.

(b) L = { 0^n 1^n 0^n | n=1, 2 , 3, ...} is recursively enumerable.

(c) Recursive languages are closed under intersection.

(d) Recursive languages are not closed under intersection.

440. **[Context-Free-Grammar | UGC NET CS 2017 Nov- paper-3]** Context free grammar is not closed under:

(a) Concatenation

(b) Complementation

(c) Kleene Star

(d) Union

441. **[Context-Free-Language | UGC NET CS 2017 Nov- paper-3]** Consider the following languages:

L_1 = { a^m b^n | m $\neq$ n}

L_2 = { a^m b^n | m = 2n+1}

L_3 = { a^m b^m | m $\neq$ 2n}

Which one of the following statement is correct ?

(a) Only L_1 and L_2 are context free languages

(b) Only L_1 and L_3 are context free languages

(c) Only L_2 and L_3 are context free languages

(d) L_1 , L_2 and L_3 are context free languages

442. **[Regular-Language | UGC NET CS 2017 Jan- paper-3]** Which of the following are not regular?

(A) Strings of even number of a's.

(B) Strings of a's, whose length is a prime number.

(C) Set of all palindromes made up of a's and b's.

(D) Strings of a's whose length is a perfect square.

(a) (A) and (B) only

(b) (A), (B) and (C) only

(c) (B), (C) and (D) only

(d) (B) and (D) only

443. **[Languages-and-Grammars | UGC NET CS 2017 Jan- paper-3]** Consider the languages L1 = Φ and L2 = { 1} . Which one of the following represents $L_1 * \cup L_1 *L_2 *$?

   (a) $\{ \in \}$

   (b) $\{ \in , 1\}$

   (c) Φ

   (d) 1*

444. **[Closure-Property | UGC NET CS 2017 Jan- paper-3]** Given the following statements :
   (A) A class of languages that is closed under union and complementation has to be closed under intersection.
   (B) A class of languages that is closed under union and intersection has to be closed under complementation.
   Which of the following options is correct?

   (a) Both (A) and (B) are false.

   (b) Both (A) and (B) are true.

   (c) (A) is true, (B) is false.

   (d) (A) is false, (B) is true.

445. **[Context-Free-Grammar | UGC NET CS 2017 Jan- paper-3]** Let G = (V, T, S, P) be a context-free grammar such that every one of its productions is of the form A $\rightarrow$ v, with $|$ v$|$ = K $>$ 1. The derivation tree for any W $\in$ L(G) has a height h such that

   (a) $\log_K |W| \leq h \leq \log_K ((|W| -1) / k-1)$

   (b) $\log_K |W| \leq h \leq \log_K (K|W|)$

   (c) $\log_K |W| \leq h \leq K \log_K |W|$

   (d) $\log_K |W| \leq h \leq ((|W| -1) / k-1)$

446. **[Context-Free-Language | UGC NET CS 2017 Jan- paper-3]** Given the following two languages :

   $L_1 = \{ a^n b^n \mid n \geq 0, n \neq 100\}$

   $L_2 = \{ w \in \{ a, b, c\} * \mid n_a (w) = n_b (w) = n_c (w)\}$

   Which of the following options is correct ?

   (a) Both L_1 and L_2 are not context free language

   (b) Both L_1 and L_2 are context free language.

   (c) L_1 is context free language, L_2 is not context free language.

   (d) L_1 is not context free language, L_2 is context free language.

447. **[Context-Free-Language | UGC NET CS 2017 Jan- paper-3]** Given the following two statements :
   A. L = $\{ w \mid n_a (w) = n_b (w)\}$ is deterministic context free language, but not linear.
   B. L = $\{ a^n b^n \} \cup \{ a^n b^{2n} \}$ is linear, but not deterministic context free language.

Which of the following options is correct ?

(a) Both (A) and (B) are false.

(b) Both (A) and (B) are true.

(c) (A) is true, (B) is false.

(d) (A) is false, (B) is true.

448. **[Turing-machines | UGC NET CS 2017 Jan- paper-3]** Which of the following pairs have different expressive power?

(a) Single-tape-turing machine and multi-dimensional turing machine.

(b) Multi-tape turing machine and multi-dimensional turing machine.

(c) Deterministic pushdown automata and non-deterministic pushdown automata.

(d) Deterministic finite automata and Non-deterministic finite automata

449. **[Languages-and-Grammars | UGC NET CS 2017 Jan- paper-3]** Which of the following statements is false?

(a) Every context-sensitive language is recursive.

(b) The set of all languages that are not recursively enumerable is countable.

(c) The family of recursively enumerable languages is closed under union.

(d) The families of recursively enumerable and recursive languages are closed under reversal.

450. **[Regular-Expression | UGC NET CS 2016 July- paper-3]** The regular expression for the complement of the language L = $\{ a^n b^m \mid n \geq 4, m \leq 3\}$ is:

(a) (λ + a + aa + aaa) b* + a* bbbb* + (a + b)* ba(a + b)*

(b) (λ + a + aa + aaa) b* + a* bbbbb* + (a + b)* ab(a + b)*

(c) (λ + a + aa + aaa) + a* bbbbb* + (a + b)* ab(a + b)*

(d) (λ + a + aa + aaa)b* + a* bbbbb* + (a + b)* ba(a + b)*

451. **[Regular-Language | UGC NET CS 2016 July- paper-3]** Consider the following two languages :

$L_1 = \{ 0^i 1^j \mid \gcd(i, j) = 1\}$

L_2 is any subset of 0*.

Which of the following is correct ?

(a) L_1 is regular and L_2 * is not regular

(b) L_1 is not regular and L_2 * is regular

(c) Both L_1 and L_2 * are regular languages

(d) Both L_1 and L_2 * are not regular languages

452. **[Finite-Automata | UGC NET CS 2016 July- paper-3]** Let L be the language generated by regular expression 0*10* and accepted by the deterministic finite automata M. Consider the relation R_M defined by M. As all states are reachable from the start state, R_M has _____ equivalence classes.

(a) 2

(b) 4

(c) 5

(d) 6

453. **[Context-Free-Language | UGC NET CS 2016 July- paper-3]** Let L = { 0^n 1^n | n $\geq$ 0} be a context free language. Which of the following is correct ?

(a) L′ is context free and L^k is not context free for any k $\geq$ 1.

(b) L′ is not context free and L^k is not context free for any k $\geq$ 1.

(c) Both L′ and L^k is for any k $\geq$ 1 are context free.

(d) Both L′ and L^k is for any k $\geq$ 1 are not context free.

454. **[Turing-machines | UGC NET CS 2016 July- paper-3]** Given a Turing Machine

M = ({ q_0 , q_1 , q_2 , q_3 } , { a, b} , { a, b, B} , δ , B, { q_3 })

Where δ is a transition function defined as

δ (q_0 , a) = (q_1 , a, R)

δ (q_1 , b) = (q_2 , b, R)

δ (q_2 , a) = (q_2 , a, R)

δ (q_3 , b) = (q_3 , b, R)

The language L(M) accepted by the Turing Machine is given as:

(a) aa*b

(b) abab

(c) aba*b

(d) aba*

455. **[Regular-Language | UGC NET CS 2016 Aug- paper-3]** The regular grammar for the language L = { a^n b^m | n + m is even} is given by

(a) $S \rightarrow S_1 \mid S2$
$S_1 \rightarrow a\ S_1 \mid A_1$
$A_1 \rightarrow b\ A_1 \mid \lambda$
$S_2 \rightarrow aaS_2 \mid A_2$
$A_2 \rightarrow b\ A_2 \mid \lambda$

(b) $S \rightarrow S_1 \mid S_2$
$S_1 \rightarrow a\ S_1 \mid aA_1$
$S_2 \rightarrow aaS_2 \mid A_2$
$A_1 \rightarrow b\ A_1 \mid \lambda$
$A_2 \rightarrow b\ A_2 \mid \lambda$

(c) $S \rightarrow S_1 \mid S_2$
$S_1 \rightarrow aaa\ S_1 \mid aA_1$
$S_2 \rightarrow aaS_2 \mid A_2$
$A_1 \rightarrow b\ A_1 \mid \lambda$

$A_2 \rightarrow b\ A_2 \mid \lambda$

(d) $S \rightarrow S_1 \mid S_2$
$S_1 \rightarrow aa\ S_1 \mid A_1$
$S_2 \rightarrow aaS_2 \mid aA_2$
$A_1 \rightarrow bbA_1 \mid \lambda$
$A_2 \rightarrow bbA \mid b$

456. **[Languages-and-Grammars | UGC NET CS 2016 Aug- paper-3]** Let $\Sigma = \{ a, b\}$ and language L = $\{ aa, bb\}$. Then, the complement of L is

(a) $\{ \lambda , a, b, ab, ba\} \cup \{ w\in \{ a, b\}^* \mid |w| > 3\}$

(b) $\{ a, b, ab, ba\} \cup \{ w\in \{ a, b\}^* \mid |w| > 3\}$

(c) $\{ w \in \{ a, b\}^* \mid |w| > 3\} \cup \{ a, b, ab, ba\}$

(d) $\{ \lambda , a, b, ab, ba\} \cup \{ w \in \{ a, b\}^* \mid |w| \geq 3\}$

457. **[Regular-Expression | UGC NET CS 2016 Aug- paper-3]** Consider the following identities for regular expressions:
(a) (r + s)* = (s + r)*
(b) (r*)* = r*
(c) (r* s*)* = (r + s)*
Which of the above identities are true?

(a) (a) and (b) only

(b) (b) and (c) only

(c) (c) and (a) only

(d) (a), (b) and (c)

458. **[Regular-Language | UGC NET CS 2016 Aug- paper-3]** Given the following two languages :
$L_1 = \{ uww^R v \mid u, v, w \in \{ a, b\}^+ \}$
$L_2 = \{ uww^R v \mid u, v, w \in \{ a, b\} +, |u| > |v| \}$
Which of the following is correct ?

(a) L_1 is regular language and L_2 is not regular language.

(b) L_1 is not regular language and L_2 is regular language.

(c) Both L_1 and L_2 are regular languages.

(d) Both L_1 and L_2 are not regular languages.

459. **[Turing-machines | UGC NET CS 2016 Aug- paper-3]** Given a Turing Machine

M = ({ q 0 , q 1 } , { 0, 1} , { 0, 1, B} , δ , B, { q1 })

Where δ is a transition function de ned as

δ (q 0 , 0) = (q 0 , 0, R)

δ (q 0 , B) = (q 1 , B, R)

The language L(M) accepted by Turing machine is given as :

(a) 0* 1*

(b) 00*

(c) 10*

(d) 1*0*

460. **[Context-Free-Grammar | UGC NET CS 2016 Aug- paper-3]** Let G = (V, T, S, P) be a context-free grammar such that every one of its productions is of the form A $\rightarrow$ v, with | v| = k > 1. The derivation tree for any string W $\in$ L (G) has a height such that

(a) h< ((| W| - 1)/k-1)

(b) $\log_k$ | W| < h

(c) $\log_k$ | W| < h < ((| W| - 1)/k-1)

(d) $\log_k$ | W| < = h < = ((| W| - 1)/k-1)

461. **[Languages-and-Grammars | UGC NET CS 2015 Dec - paper-3]** Consider a language A defined over the alphabet Σ ={ 0, 1} as A={ $0^{\lfloor n/2 \rfloor}$ 1^n :n> =0} . The expression $\lfloor$ n/2$\rfloor$ means the floor of n/2, or what you get by rounding n/2 down to the nearest integer.
Which of the following is not an example of a string in A?

(a) 011

(b) 0111

(c) 0011

(d) 001111

462. **[Languages-and-Grammars | UGC NET CS 2015 Dec - paper-3]** The family of context sensitive languages is __________ under union and __________ under reversal.

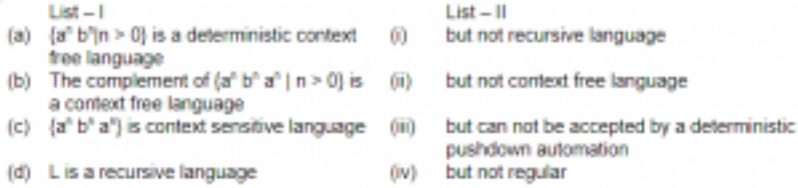
(a) closed, not closed

(b) not closed, not closed

(c) closed, closed

(d) not closed, closed

463. **[Languages-and-Grammars | UGC NET CS 2015 Dec - paper-3]** Match the following:



	List – I		List – II
(a)	$\{a^n b^n \mid n > 0\}$ is a deterministic context free language	(i)	but not recursive language
(b)	The complement of $\{a^n b^n a^n \mid n > 0\}$ is a context free language	(ii)	but not context free language
(c)	$\{a^n b^n a^n\}$ is context sensitive language	(iii)	but can not be accepted by a deterministic pushdown automation
(d)	L is a recursive language	(iv)	but not regular

(a) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

(b) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

(c) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(d) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

464. **[Context-Free-Grammar | UGC NET CS 2015 Dec - paper-3]** The language of all non-null strings of a's can be defined by a context free grammar as follows:

$S \rightarrow aS|\ Sa|\ a$

The word a^3 can be generated by __________ different trees.

(a) two

(b) three

(c) four

(d) five

465. **[Context-Free-Grammar | UGC NET CS 2015 Dec - paper-3]** The context free grammar given by
$S \rightarrow XYX$
$X \rightarrow aX|\ bX|\ \lambda$
$Y \rightarrow bbb$
generates the language which is defined by regular expression:

(a) (a + b)*bbb

(b) abbb(a + b)*

(c) (a + b)*(bbb)(a + b)*

(d) (a + b)(bbb)(a + b)*

466. **[Finite-Automata | UGC NET CS 2015 Dec - paper-3]** There are exactly __________ different finite automata with three states x, y and z over the alphabet { a, b} where x is always the start state.

(a) 64

(b) 56

(c) 1024

(d) 5832

467. **[Context-Free-Language | UGC NET CS 2015 Dec - paper-3]** Given the following two languages:

$L_1 = \{ a^n\ b\ a^n \mid n > 0\}$

$L_2 = \{ a^n\ b\ a^n\ b^{n+1} \mid n > 0\}$

Which of the following is correct ?

(a) L_1 is context free language and L_2 is not context free language

(b) L_1 is not context free language and L_2 is context free language

(c) Both L_1 and L_2 are context free languages

(d) Both L_1 and L_2 are not context free languages

468. **[Decidability-and-Undecidability | UGC NET June-2019 CS Paper-2]** Which of the following problems is/are decidable problem(s) (recursively enumerable) on a Turing machine M?
(a) G is a CFG with L(G)=ϕ
(b) There exist two TMs M 1 and M2 such that L(M) $\subseteq$ { L(M 1)UL(M 2)} = language of all TMs
(c) M is a TM that accepts w using a most $2^{|w|}$ cells of tape

(a) (a) and (b) only
(b) (a) only
(c) (a), (b) and (c)
(d) (c) only

469. **[Turing-machines | UGC NET June-2019 CS Paper-2]** For a statement
A language L $\subseteq$ Σ * is recursive if there exists some Turing machine M
Which of the following conditions is satisfied for any string w?

(a) If w $\in$ L, then m accepts w and M will not halt
(b) If w $\notin$ L, then M accepts w and M will halt by reaching at final state
(c) If w $\notin$ L, then M halts without reaching to acceptable state
(d) If w $\in$ L, then M halts without reaching to an acceptable state

470. **[Languages-and-Grammars | UGC NET June-2019 CS Paper-2]** Match List-I with List-II:
Where L1 : Regular language
L2 : Context-free language
L3 : Recursive language
L4 : Recursively enumerable language

List-I	List-2
(a) L'_3 U L_4	(i) Context-free language
(b) L'_2 U L_3	(ii) Recursively enumerable language
(c) $L_1{}^* \cap L_2$	(iii) Recursive language

Choose the correct from those given below:

(a) (a)-(ii); (b)-(i); (c)-(iii)
(b) (a)-(ii); (b)-(iii); (c)-(i)
(c) (a)-(iii); (b)-(i); (c)-(ii)
(d) (a)-(i); (b)-(ii); (c)-(iii)

471. **[Context-Free-Grammar | UGC NET June-2019 CS Paper-2]** How can the decision algorithm be constructed for deciding whether context-free language L is finite?
(a) By Constructing redundant CFG in CNF generating language L
(b) By constructing non-redundant CFG G in CNF generating language L
(c) By constructing non-redundant CFG in CNF generating language L-{ $\wedge$ } ($\wedge$ stands for null)
Which of the following is correct?

(a) (a) only

(b) (b) only

(c) (c) only

(d) None of(a),(b) and (c)

472. **[Regular-Expression | UGC NET June-2019 CS Paper-2]** How many states are there in a minimum state automata equivalent to regular expression given below? regular expression is a*b(a+b)

(a) 1

(b) 2

(c) 3

(d) 4

473. **[Languages-and-Grammars | UGC NET June-2019 CS Paper-2]** Consider the following grammar:

S$\rightarrow$ XY

X$\rightarrow$ YaY | a and y $\rightarrow$ bbX

Which of the following statements is/are true about the above grammar?

(a) Strings produced by the grammar can have consecutive three a's

(b) Every string produced by the grammar have alternate a and b

(c) Every string produced by the grammar have at least two a's

(d) Every string produced by the grammar have b's in multiple of 2.

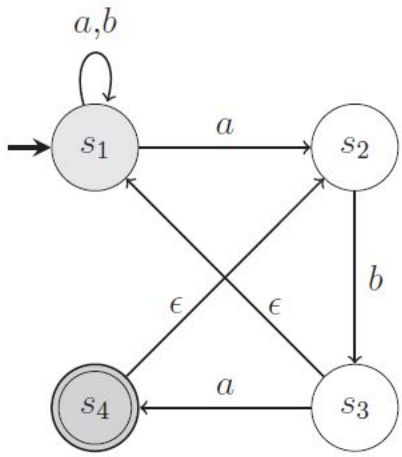
(a) (a) only

(b) (b) and (c) only

(c) (d) only

(d) (c) and (d) only

474. **[Regular-Expression | TIFR PHD CS & SS 2018]** Consider the following non-deterministic automaton, where s1 is the start state and s_4 is the final (accepting) state. The alphabet is { a, b} . A transition with label can be taken without consuming any symbol from the input.



(a) (a + b)* aba

(b) aba(a + b)* aba

(c) (a + b)aba(b + a)*

(d) aba(a + b)*

(e) (ab)* aba

475. **[Languages-and-Grammars | TIFR PHD CS & SS 2018]** Consider the language $L \subseteq \{ a,b,c\}^*$ defined as $L = \{ a^p b^q c^r : p = q \text{ or } q = r \text{ or } r = p\}$. Which of the following answers is TRUE about the complexity of this language?

(a) L is regular but not context-free.

(b) L is context-free but not regular.

(c) L is decidable but not context-free.

(d) The complement of L, defined as $L' = \{ a, b, c\}^* \ L$, is regular.

(e) L is regular, context-free and decidable.

476. **[Languages-and-Grammars | TIFR PHD CS & SS 2018]** Define the language $\text{INFINITE}_{DFA} = \{ A | \text{ A is a DFA and } L(A) \text{ is an infinite language}\}$, where

A denotes the description of the deterministic finite automata (DFA). Then which of the following about INFINITE_{DFA} is TRUE:

(a) It is regular.

(b) It is context-free but not regular.

(c) It is Turing decidable (recursive).

(d) It is Turing recognizable but not decidable.

(e) Its complement is Turing recognizable but it is not decidable.

477. **[Finite-Automata | UGC NET CS 2015 June Paper-3]** Minimal deterministic finite automaton for the language $L = \{ 0\ n \mid n \geq 0, n \neq 4\}$ will have:

(a) 1 final state among 5 states

(b) 4 final states among 5 states

(c) 1 final state among 6 states

(d) 5 final states among 6 states

478. **[Regular-Expression | UGC NET CS 2015 June Paper-3]** The regular expression corresponding to the language L where L = { x ∈ { 0, 1} *| x ends with 1 and does not contain substring 00 } is:

(a) (1 + 01) * (10 + 01)

(b) (1 + 01) * 01

(c) (1 + 01) * (1 + 01)

(d) (10 + 01) * 01

479. **[Finite-Automata | UGC NET CS 2015 June Paper-3]**

. The transition function for the language L = {w|n_a (v
given by: δ (q_0, a) = q_1 ; δ (q_0, b) = q_2 δ (q_1, a) = q_0 ;
(q_2, b) = q_0 δ (q_3, a) = q_2 ; δ (q_3, b) = q_1 The initial ar
are:

(a) q_0 and q_0 respectively

(b) q_0 and q_1 respectively

(c) q_0 and q_2 respectively

(d) q_0 and q_3 respectively

480. **[Context-Free-Grammar | UGC NET CS 2015 June Paper-3]** A context free grammar for L = { w | n_0 (w) > n 1 (w) } is given by:

(a) S → 0 | 0 S | 1 S S

(b) S → 0 S | 1 S | 0 S S | 1 S S | 0 | 1

(c) S → 0 | 0 S | 1 S S | S 1 S | S S 1

(d) S → 0 S | 1 S | 0 | 1

481. **[Recursive-and-Recursively-Enumerable-Language | UGC NET CS 2015 June Paper-3]** Given the following two statements:
S 1 :If L 1 and L 2 are recursively enumerable languages over Σ , then L 1 ∪ L 2 and L 2 ∩ L 2 are also recursively enumerable.
S 2 : The set of recursively enumerable languages is countable. Which of the following is correct ?

(a) S 1 is correct and S 2 is not correct

(b) S 1 is not correct and S 2 is correct

(c) Both S 1 and S 2 are not correct.

(d) Both S 1 and S 2 are not correct.

482. **[Context-Free-Grammar | UGC NET CS 2015 June Paper-3]** Given the following grammars:
G 1 : S $\rightarrow$ AB| aaB
A $\rightarrow$ aA | $\in$
B $\rightarrow$ bB | $\in$
G2: S $\rightarrow$ A| B
A $\rightarrow$ aAb | ab
B $\rightarrow$ abB | $\in$
Which of the following is correct?

(a) G 1 is ambiguous and G 2 is unambiguous grammars

(b) G 1 is unambiguous and G 2 is ambiguous grammars

(c) both G 1 and G 2 are ambiguous grammars

(d) both G 1 and G 2 are unambiguous grammars

483. **[Context-Free-Grammar | UGC-NET DEC-2019 Part-2]** Let G = (V, T, S, P) be any context-free grammar without any λ -productions or unit productions. Let K be the maximum number of symbols on the right of any production P. The maximum number of production rules for any equivalent grammar in Chomsky normal form is given by:

(a) (K - 1) | P| + | T| - 1

(b) (K - 1) | P| +| T|

(c) K | P| + | T| - 1

(d) K | P| + | T|

484. **[Context-Free-Language | UGC-NET DEC-2019 Part-2]** Consider the following languages:
L_1 = { a^n b^n c^m } $\cup$ { a^n b^m c^m } , n. m $\geq$ o
L_2 = { ω ω ^{R} | $\omega \in$ { a, b} *} Where R represents reversible operation.
Which one of the following is (are) inherently ambiguous language(s)?

(a) only L_1

(b) only L_2

(c) both L_1 and L_2

(d) neither L_1 nor L_2

485. **[Regular-Language | UGC-NET DEC-2019 Part-2]**

Consider $\sum = (w.x)$ and $T = \{x, y, z\}$. Define homomorphism h by

$h(x) = xyz$

$h(w) = zxyy$

If L is the regular language denoted by T= (w + x*)(ww)*, then the regular language h(L) is given by

(a) (z x yy + xy) (z x yy)

(b) (zxyy + (xzy)*) (zxyy zxyy)*

(c) (zxyy + xyz) (zxyy)*

(d) (zxyy + (xzy)* (zxyy zxyy)

486. **[Turing-machines | UGC-NET DEC-2019 Part-2]** Consider the following statements: S_1 : These exists no algorithm for deciding if any two Turning machine M_1 and M_2 accept the same language. S_2 : Let M_1 and M_2 be arbitrary Turing machines. The problem to determine $L(M_1) \subseteq L(M_2)$ is undecidable. Which of the statements is (are) correct?

(a) Only S_1

(b) Only S_2

(c) Both S_1 and S_2

(d) Neither S_1 nor S_1

487. **[Languages-and-Grammars | UGC-NET DEC-2019 Part-2]** Consider the following grammar :
$S \rightarrow 0A|\ 0BB$
$A \rightarrow 00A|\ \lambda$
$B \rightarrow 1B|\ 11C$
$C \rightarrow B$

Which language does this grammar generate?

(a) L(00) * 0+(11)*1)

(b) L(0(11)* + 1(00)*)

(c) L((00)*0)

(d) L(0(11) *1)

488. **[Post-correspondence-problem | UGC-NET DEC-2019 Part-2]**
Let A = (001, 0011, 11, 101} and B = (01, 111, 111, 010} . Similarly, let C = { 00, 001, 1000} and D = { 0, 11,011} .

Which of the following pairs have a post-correspondence solution?

(a) Only pair (A, B)

(b) Only pair (C, D)

(c) Both (A, B) and (C, D)

(d) Neither (A, B) nor (C, D)

489. **[Languages-and-Grammars | UGC-NET DEC-2019 Part-2]**
Consider the following grammars :

$G_1 : S \to aSb \mid bSa \mid aa$
$G_2 : S \to aSb \mid bSa \mid SS \mid$
$G_3 : S \to aSb \mid bSa \mid SS \mid a$
$G_4 : S \to aSb \mid bSa \mid SS \mid SSS \mid$

Which of the following is correct w.r.t. the above grammars?

(a) G_1 and G_3 are equivalent

(b) G_2 and G_3 are equivalent

(c) G_2 and G_4 are equivalent

(d) G_3 and G_4 are equivalent

490. **[Languages-and-Grammars | UGC-NET DEC-2019 Part-2]** Consider the language L={ n> 2} on Σ ={ a,b} . Which ch one of the following generates the language L?

(a) S $\rightarrow$ aA | a,A $\rightarrow$ aAb | b

(b) S $\rightarrow$ aaA | λ , A $\rightarrow$ aAb| λ

(c) S $\rightarrow$ aaaA | a, A $\rightarrow$ aAb| λ

(d) S $\rightarrow$ aaaA | λ , A $\rightarrow$ aAb| λ

491. **[Context-Free-Language | UGC-NET DEC-2019 Part-2]**
Consider the following statements with respect to the language L = { a^n b^n | n $\geq$ 0}

S_1 : L^2 is context free language
S_2 : L^k is context-free language for any given k ≥ 1
S_3 : $\overline{L}$ and L^* are context free languages

Which one of the following is correct?

(a) only S_1 and S_2

(b) only S_1 and S_3

(c) only S_2 and S_3

(d) S_1 , S_2 and S_3

492. **[Languages-and-Grammars | CIL Part - B]** If every production is of the form where or of the form , then the grammer is said to be of:

(a) Type 3

(b) Type 1

(c) Type 0

(d) Type 2

493. **[Languages-and-Grammars | CIL Part - B]** Which of the following represents the language over the set A={ a,b} consisting of all words beginning with one or more a's and followed by the same number of b's?

(a) L= { a,ab,ab^2 ,...}

(b) L= { a^m b^n :m,m> 0,n> 0}

(c) L= { a^m b^m :m> 0}

(d) L= { b^m ab^n :m0,n0}

494. **[Regular-Expression | CIL Part - B]** Let L be the language on A={ a,b,c} which consists of all words of the form w=a^r b^s c^t where r,s,t> 0. Which of the following is the valid regular expression 'r' such that L=L(r)?

(a) r= a*b*c

(b) r= aa*bb*c

(c) r= aa*b*cc

(d) r= aa*bb*cc*

495. **[Context-Free-Language | ISRO CS 2020]** Context free languages are closed under

(a) Union , intersection

(b) Union , kleene closure

(c) Intersection, complement

(d) Complement, kleene closure

496. **[Regular-Language | ISRO CS 2020]** Which of the following is true?

(a) Every subset of a regular set is regular

(b) Every finite subset of non-regular set is regular

(c) The union of two non regular set is not regular

(d) Infinite union of finite set is regular

497. **[Languages-and-Grammars | ISRO CS 2020]** The language which is generated by the grammar S aSa | bSb | a | b over the alphabet { a,b} is the set of

(a) Strings that begin and end with the same symbol

(b) All odd and even length palindromes

(c) All odd length palindromes

(d) All even length palindromes

498. **[Finite-Automata | ISRO CS 2020]** Minimum number of states required in DFA accepting binary strings not ending in "101" is

(a) 3

(b) 4

(c) 5

(d) 6

499. **[Languages-and-Grammars | ISRO CS 2020]** A grammar is defined as
$A \rightarrow BC$
$B \rightarrow x \mid Bx$
$C \rightarrow B \mid D$
$D \rightarrow y \mid Ey$
$E \rightarrow z$
The non-terminal alphabet of the grammar is

(a) { A,B,C,D,E}

(b) { B,C,D,E}

(c) { A,B,C,D,E,x,y,z}

(d) { x,y,z}

500. **[Context-Free-Grammar | APPSC-2016-DL-CS]** Which of the following CFG's can't be simulated by a Finte State Machine?

(a) $S - < Sa \mid b$

(b) $S - > aSb \mid ab$

(c) $S - < abX, X -> cY, Y - > d \mid aX$

(d) None of the given options

501. **[Languages-and-Grammars | APPSC-2016-DL-CS]** Which of the following is true for the language { a^p] p is a prime]

(a) It is not accepted by a Turing Machine

(b) It is regular but not context-free

(c) It is context-free but not regular

(d) It is neither regular nor context-free, bt accepted by Turing machine

502. **[Languages-and-Grammars | APPSC-2016-DL-CS]** The language L={ 0^i 21^i | $i \geq 0$ } over the alphabet { 0.1, 2} is:

(a) Not recursive

(b) Is recursive and is a deterministic CFL

(c) Is a regular language

(d) Is not a deterministic CFL but a CFL

503. **[Turing-machines | CIL 2020]** Consider the following problem X
"Given a Turing Machine M over the input alphabet Σ any state q of M and word Σ *, does the computation of M on w visit the state q"

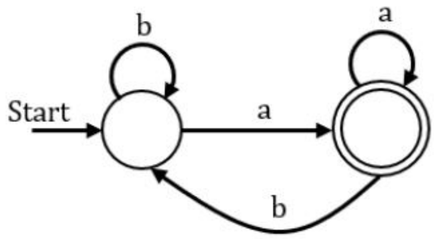
(a) X is undecidable but partially decidable

(b) X is not a decision problem

(c) X is decidable

(d) X is undecidable but not even partially decidable

504. **[Finite-Automata | CIL 2020]** Consider the FA shown in fig below which language is accepted by the FA:



(a) (a+b)*a

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

(c) b+a*b*

(d) b+a*b

505. **[Context-Free-Grammar | CIL 2020]** Which is equivalent CFG without useless symbols for the given grammar:

$S \rightarrow PQ \mid p, \ P \rightarrow p$

(a) $S \rightarrow PQ$

(b) $S \rightarrow p$

(c) $S \rightarrow P, P \rightarrow p$

(d) $S \rightarrow P \mid p, P \rightarrow p$

506. **[Languages-and-Grammars | CIL 2020]** The language generated by following grammar is:
S –> aSa | bSb | ∈

(a) Even length palindrome

(b) a∧ m b∧ n n> =0, m> =0

(c) Odd length palindrome

(d) a∧ n b∧ m n> =1, m> =1

507. **[Languages-and-Grammars | CIL 2020]** The language { a^m b^n c^{m+n} | m, n> =1} is:

(a) Regular

(b) Type 0 but context sensitive

(c) Context free but not regular

(d) Context sensitive but not context free

508. **[Finite-Automata | CIL 2020]** Let L be the set of all binary strings whose last two symbols are the same. The number of states in the minimum state deterministic finite state automaton accepting languages is ____

(a) 2

(b) 5

(c) 8

(d) 3

509. **[Languages-and-Grammars | CIL 2020]** Which of the following statement is false?

(a) Every regular language is also a context free language

(b) Every non deterministic turing machine can be converted to an equivalent deterministic Turing machine

(c) Every subset of recursively enumerable set is recursive

(d) Every NFA can b converted into equivalent DFA

510. **[Regular-Language | CIL 2020]** Which one of the following is TRUE?

(a) Every regular grammar is LL(1) and every regular set does not have an LR(1) grammar

(b) Every regular grammar is not LL(1) and every regular set does not have an LR(1) grammar

(c) Every regular grammar is LL(1) and every regular has an LR(1) grammar

(d) Every regular grammar is not LL(1) and every regular set has an LR(1) grammar

511. **[Finite-Automata | CIL 2020]** Number of states in DFA accepting the following languages is:
L = { a^n b^{2m} | n, m> =1}

(a) m

(b) n

(c) 5

(d) 2

512. **[Context-Free-Language | CIL 2020]** Which of the following is/are correct
I. A language is context free if and only if it accepted by PDA
II. PDA is a finite automata with push down stack

(a) Only II is true

(b) Both I and II are false

(c) Both I and II are true

(d) Only I is true

513. **[Context-Free-Grammar | CIL 2020]** The class of context-free grammar is not closed under ____ operations

(a) Concatenation

(b) Intersection

(c) Star

(d) Union

514. **[Decidability-and-Undecidability | CIL 2020]** Which of the following problems are undecidable?

I. Membership problem in context-free languages
II. Whether a given context-free languages is regular
III. Whether a finite state automation halts on all inputs
IV. Membership problem for type 0 languages

(a) III and IV

(b) I and IV

(c) I and II

(d) II and IV

515. **[Regular-Language | TNPSC-2012-Polytechnic-CS]** If L_1 and L_2 are context free language and R is a regular set. Which one of the languages below is not necessarily a context free language?

(a) $L_1 L_2$

(b) $L_1 \cap L_2$

(c) $L_1 \cup R$

(d) $L_1 \cup L_2$

516. **[Context-Sensitive-Grammar | TNPSC-2012-Polytechnic-CS]** CSG can be recognized by

(a) push-down automata

(b) 2 way linear bounded automaton

(c) finite state automata

(d) none of these

517. **[Regular-Expression | TNPSC-2012-Polytechnic-CS]** Consider the following grammar:

$$\begin{aligned} S &\rightarrow Ax \mid By \\ A &\rightarrow By \mid Cw \\ B &\rightarrow x \mid Bw \\ C &\rightarrow y \end{aligned}$$

Which of the regular expressions describes the same set of strings as the grammar?

(a) xw+y+xw*yx+ywx

(b) xwy+xw*xy*ywx

(c) xw*y+xw*yx+ywx

(d) xwxy+xww*yywx

518. **[Recursive-and-Recursively-Enumerable-Language | TNPSC-2012-Polytechnic-CS]** Recursively enumerable languages are not closed under

(a) Union

(b) Intersection

(c) Complementation

(d) Concatenation

519. **[Turing-machines | TNPSC-2012-Polytechnic-CS]** Turing machine is more powerful than FMs because

(a) Tape movement is confined to one direction

(b) It has no finite state

(c) It has the capability to remember arbitrarily long sequences of input symbols

(d) None of these

520. **[Finite-Automata | TNPSC-2012-Polytechnic-CS]** Which of the following statements is wrong?

(a) The language accepted by finite automata is the languages denoted by regular expressions.

(b) For every DFA there is a regular expression denoting its language

(c) For a regular expression r, there does not exist any NFA with transit that accepts L(r)

(d) None of these

521. **[Finite-Automata | TNPSC-2012-Polytechnic-CS]** Can a DFA simulate NFA?

(a) No

(b) Yes

(c) Sometimes

(d) Depends of NFA

522. **[Regular-Expression | TNPSC-2012-Polytechnic-CS]** Let a and b be the regular expressions, then $(a^* \cup b^*)^*$ is not equivalent to

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

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

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

(d) $(a \cup b)$

523. **[Regular-Language | TNPSC-2012-Polytechnic-CS]** If L_1 and L_2 are two regular language defined as
L_1 = (000, 001, 0, 010) and L_2 = (00, 01, 0), then the number of strings in $L_1 \cup L_2$ will be

(a) 7

(b) 6

(c) 5

(d) 8

524. **[Finite-Automata | TNPSC-2012-Polytechnic-CS]** Two finite state machines are said to be equivalent if they

(a) Have same number of states

(b) Have same number of edges

(c) Have same number of states and edges

(d) Recognize same set of tokens

525. **[Languages-and-Grammars | TNPSC-2012-Polytechnic-CS]** The number of productions of the following grammar is

$$\begin{aligned} E &\rightarrow E{+}T \mid T \\ T &\rightarrow T{*}F \mid F \\ F &\rightarrow E \mid \mathrm{id} \end{aligned}$$

(a) 5

(b) 3

(c) 6

(d) 4

526. **[Context-Free-Grammar | TNPSC-2012-Polytechnic-CS]** CFG can be recognized by a

(a) push-down automata

(b) 2-way linear bounded automata

(c) both (A) and (B)

(d) none of these

527. **[Context-Free-Language | TNPSC-2012-Polytechnic-CS]** The language L = { a^n b^m c^n d^m | n≥ 1, m≥ 1}

(a) Is context free

(b) Is not context free

(c) Abstract problem of checking number of formal and actual parameters

(d) Both (B) and (C).

528. **[Languages-and-Grammars | TNPSC-2012-Polytechnic-CS]** What is the highest type number which can be applied to the following grammar?

$S \rightarrow Aa,\ A \rightarrow Ba,\ B \rightarrow abc$

(a) Type 0

(b) Type 1

(c) Type 2

(d) Type 3

529. **[Finite-Automata | APPSC-2012-DL-CS]** If the two finite state machines are equivalent, then they should have the same number of

(a) States

(b) Edges

(c) States and Edges

(d) None of the above

530. **[Finite-Automata | TNPSC-2017-Polytechnic-CS]** If there are 'n' number of states in NFA, then its equivalent DFA may contain atmost ________ number of states.

(a) 2^n

(b) n

(c) n^2

(d) 2^{n+1}

531. **[Finite-Automata | TNPSC-2017-Polytechnic-CS]** To get the PDA, the CFG should be in the form of :

(a) CFG

(b) GNF

(c) RE

(d) CNF

532. **[Context-Free-Grammar | TNPSC-2017-Polytechnic-CS]** One of the uses of CNF is to turn parse tree into :

(a) AVL trees

(b) Binary search trees

(c) Binary trees

(d) None of the above

533. **[Turing-machines | TNPSC-2017-Polytechnic-CS]** If there is a Turing machine that enumerates L in canonical order, L is:

(a) ambiguous

(b) right - recursive

(c) left - recursive

(d) recursive

534. **[Regular-Language | TNPSC-2017-Polytechnic-CS]** The Language L = $\{ a^p \mid p$ is prime $\}$ is :

(a) regular

(b) not regular

(c) accepted by NFA with $\in$

(d) None

535. **[Regular-Language | UGC NET CS 2014 June-paper-3]** Let L be any language. Define even (W) as the strings obtained by extracting from W the letters in the even-numbered positions and even(L) = $\{$ even (W) $\mid$ W $\in$ L$\}$. We define another language Chop (L) by removing the two leftmost symbols of every string in L given by Chop(L) = $\{$ W $\mid$ v W $\in$ L, with $\mid$ v $\mid$ = 2$\}$. If L is regular language then

(a) even(L) is regular and Chop(L) is not regular.

(b) Both even(L) and Chop(L) are regular.

(c) even(L) is not regular and Chop(L) is regular.

(d) Both even(L) and Chop(L) are not regular.

536. **[Languages-and-Grammars | UGC NET CS 2014 June-paper-3]**
Match the following :

List - I List - II

a. Chomsky Normal form i. S $\rightarrow$ b S S | a S | c

b. Greibach Normal form ii. S $\rightarrow$ a S b | ab

c. S-grammar iii. S $\rightarrow$ AS | a

A $\rightarrow$ SA | b

d. LL grammar iv. S $\rightarrow$ a B S B

B $\rightarrow$ b

(a) a-iv, b-iii, c-i, d-ii

(b) a-iv, b-iii, c-ii, d-i

(c) a-iii, b-iv, c-i, d-ii

(d) a-iii, b-iv, c-ii, d-i

537. **[Languages-and-Grammars | UGC NET CS 2014 June-paper-3]**
Given the following two languages :

L1 = $\{ a^n b^n \mid n > 1\} \cup \{ a\}$

L2 = $\{ w C w^R \mid w \in \{ a, b\} ^*\}$

Which statement is correct ?

(a) Both L1 and L2 are not deterministic.

(b) L1 is not deterministic and L2 is deterministic.

(c) L1 is deterministic and L2 is not deterministic.

(d) Both L1 and L2 are deterministic.

538. **[Regular-Language | UGC NET CS 2014 Dec - paper-3]**
Given two languages :

$L_1 = \{ (ab)^n a^k \mid n > k, k \geq 0\}$

$L_2 = \{ a^n b^m \mid n \neq m\}$

Using pumping lemma for regular language, it can be shown that

(a) L_1 is regular and L_2 is not regular.

(b) L_1 is not regular and L_2 is regular.

(c) L_1 is regular and L_2 is regular.

(d) L_1 is not regular and L_2 is not regular.

539. **[Regular-Expression | UGC NET CS 2014 Dec - paper-3]** Regular expression for the complement of language L = $\{ a^n\ b^m \mid n \geq 4, m \leq 3\}$ is

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

(b) a* bbbbb*

(c) None of the above

540. **[Languages-and-Grammars | UGC NET CS 2014 Dec - paper-3]** Given the recursively enumerable language (L_{RE}), the context sensitive language (L_{CS}), the recursive language (L_{REC}), the context free language (L_{CF}) and deterministic context free language (L_{DCF}). The relationship between these families is given by

(a) LCF $\subseteq$ LDCF $\subseteq$ LCS $\subseteq$ LRE $\subseteq$ LREC

(b) LCF $\subseteq$ LDCF $\subseteq$ LCS $\subseteq$ LREC $\subseteq$ LRE

(c) LDCF $\subseteq$ LCF $\subseteq$ LCS $\subseteq$ LRE $\subseteq$ LREC

(d) LDCF $\subseteq$ LCF $\subseteq$ LCS $\subseteq$ LREC $\subseteq$ LRE

541. **[Languages-and-Grammars | UGC NET CS 2014 Dec - paper-3]**

Match the following :

List – I	List – II
a. Context free grammar	i. Linear bounded automaton
b. Regular grammar	ii. Pushdown automaton
c. Context sensitive grammar	iii. Turing machine
d. Unrestricted grammar	iv. Deterministic finite automaton

(a) a-ii, b-iv, c-iii, d-i

(b) a-ii, b-iv, c-i, d-iii

(c) a-iv, b-i, c-ii, d-iii

(d) a-i, b-iv, c-iii, d-ii

542. **[Context-Free-Language | UGC NET CS 2014 Dec - paper-3]**
According to pumping lemma for context free languages :

Let L be an infinite context free language, then there exists some positive integer m such

that any w $\in$ L with | w | $\geq$ m can be decomposed as w = u v x y z

(a) with | vxy | $\leq$ m such that uvi xyi z $\in$ L for all i = 0, 1, 2

(b) with | vxy | $\leq$ m, and | vy | $\geq$ 1, such that uvi xyi z $\in$ L for all i = 0, 1, 2, ...

(c) with | vxy | $\geq$ m, and | vy | $\leq$ 1, such that uvi xyi z $\in$ L for all i = 0, 1, 2, ...

(d) with | vxy | $\geq$ m, and | vy | $\geq$ 1, such that uvi xyi z $\in$ L for all i = 0, 1, 2, ...

543. **[Languages-and-Grammars | TIFR PHD CS & SS 2019]** Let the language D be defined on the binary alphabet { 0, 1} as follows:
D := { w ∈ { 0, 1} * | substrings 01 and 10 occur an equal number of times in w}
.
For example, 101 ∈ D while 1010 (∈)' D. Which of the following must be TRUE of the language D?

(a) D is regular
(b) D is context-free but not regular
(c) D is decidable but not context-free
(d) D is decidable but not in NP
(e) D is undecidable

544. **[Regular-Expression | TIFR PHD CS & SS 2019]** Consider the following non-deterministic automaton, where s1 is the start state and s4 is the final (accepting) state. The alphabet is a, b . A transition with label s can be taken without consuming any symbol from the input.
https://solutionsadda.in/wp-content/uploads/2020/04/tifr-7.jpg
Which of the following regular expressions corresponds to the language accepted by this automaton?

(a) $(a + b)^*$ aba
(b) $(a + b)^*$ ba^*
(c) $(a + b)^*$ $ba(aa)^*$
(d) $(a + b)^*$
(e) $(a + b)^*$ baa^*

545. **[Languages-and-Grammars | TIFR PHD CS & SS 2017]** Let L be the language over the alphabet { 1, 2, 3, (,)} generated by the following grammar (with start symbol S, and non-terminals { A, B, C}): S → AB C A → (B → 1B | 2B | 3B B → 1 | 2 | 3 C →) Then, which of the following is TRUE?

(a) L is finite
(b) L is not recursively enumerable
(c) L is regular
(d) L contains only strings of even length
(e) L is context-free but not regular

546. **[Regular-Expression | TIFR PHD CS & SS 2017]** Which of the following regular expressions correctly accepts the set of all 0/1-strings with an even (possibly zero) number of 1s?

(a) $(10^*\ 10^*\ )^*$
(b) $(10^*\ 10^*\ 1)^*$
(c) $0^*\ 1(10^*\ 1)^*\ 10^*$
(d) $0^*\ 1(0^*\ 10^*\ 10^*\ )^*\ 10^*$
(e) $(0^*\ 10^*\ 1)^*\ 0^*$

547. **[Languages-and-Grammars | TIFR PHD CS & SS 2017]** Consider the following grammar G with terminals { [,] } , start symbol S, and non- terminals { A, B, C} :
S → AC | SS | AB C → SB
A → [
B →]
A language L is called prefix-closed if for every x∈ L, every prefix of x is also in L. Which of the following is FALSE?

(a) L(G) is context free

(b) L(G) is infinite

(c) L(G) can be recognized by a deterministic push down automaton

(d) L(G) is prefix-closed

(e) L(G) is recursive.

548. **[Languages-and-Grammars | TIFR PHD CS & SS 2016]** Which language class has the following properties?
It is closed under union and intersection but not complement.

(a) Regular language

(b) Context-free languages

(c) Recursive languages

(d) Recursively enumerable languages

(e) Languages that are not recursively enumerable

549. **[Languages-and-Grammars | TIFR PHD CS & SS 2016]**

Consider the following language

$$\text{PRIMES} = \left\{ \underbrace{111\cdots11}_{p \text{ times}} : p \text{ is prime} \right\}.$$

Then, which of the following is TRUE?

(a) PRIMES is regular

(b) PRIMES is undecidable

(c) PRIMES is decidable in polynomial time

(d) PRIMES context free but not regular

(e) PRIMES is NP-complete and P $\neq$ NP

550. **[Push-Down-Automata-and-Finite-Automata | TIFR PHD CS & SS 2015]** Let B consist of all binary strings beginning with a 1 whose value when converted to decimal is divisible by 7.

(a) B can be recognised by a deterministic finite state automaton.

(b) B can be recognised by a non-deterministic finite state automaton but not by a deterministic finite state automaton.

(c) B can be recognised by a deterministic push-down automaton but not by a non-deterministic finite state automaton.

(d) B can be recognised by a non-deterministic push-down automaton but not by a deterministic push-down automaton.

(e) B cannot be recognised by any push down automaton, deterministic or non-deterministic

551. **[Regular-Expression | TIFR PHD CS & SS 2015]** Let a, b, c be regular expressions. Which of the following identities is correct ?

(a) (a + b)* = a*b*

(b) a(b + c) = ab + c

(c) (a + b)* = a* + b*

(d) (ab + a)*a = a(ba + a)*

(e) None of the above

552. **[Countability | TIFR PHD CS & SS 2015]**

Let $\Sigma_1 = \{a\}$ be a one letter alphabet and $\Sigma_2 = \{a, b\}$ be a two letter alphabet. A language over an alphabet is a set of finite length words comprising letters of the alphabet. Let $\mathcal{L}_1$ and $\mathcal{L}_2$ be the set of languages over Σ_1 and Σ_2 respectively. Which of the following is true about $\mathcal{L}_1$ and $\mathcal{L}_2$:

(a) Both are finite.
(b) Both are countably infinite.
(c) $\mathcal{L}_1$ is countable but $\mathcal{L}_2$ is not.
(d) $\mathcal{L}_2$ is countable but $\mathcal{L}_1$ is not.
(e) Neither of them is countable.

(a) a

(b) b

(c) c

(d) d

(e) e

553. **[Regular-Language | TIFR PHD CS & SS 2015]**

Consider the languages

$$\begin{aligned} L_1 &= \{a^m b^n c^p \mid (m = n \vee n = p) \wedge m + n + p \geq 10\} \\ L_2 &= \{a^m b^n c^p \mid (m = n \vee n = p) \wedge m + n + p \leq 10\} \end{aligned}$$

State which of the following is true?

(a) L_1 and L_2 are both regular.
(b) Neither L_1 nor L_2 is regular.
(c) L_1 is regular and L_2 is not regular.
(d) L_1 is not regular and L_2 is regular.
(e) Both L_1 and L_2 are infinite.

(a) a

(b) b

(c) c

(d) d

(e) e

554. **[Regular-Language | TIFR PHD CS & SS 2014]** Consider the following three statements:-
i) Intersection of infinitely many regular languages must be regular.
ii) Every subset of a regular language is regular.
iii) If L is regular and M is not regular then L · M is necessarily not regular.
Which of the following gives the correct true/false evaluation of the above?

(a) true, false, true

(b) false, false, true

(c) true, false, true

(d) false, false, false

(e) true, true, true

555. **[Languages-and-Grammars | TIFR PHD CS & SS 2014]** Let L be a given context-free language over the alphabet { a, b} . Construct L1, L2 as follows.
Let L1 = L - { xyx | x, y ∈ { a, b} * } , and L2 = L · L. Then

(a) Both L1 and L2 are regular

(b) Both L1 and L2 are context free but not necessarily regular

(c) L1 is regular and L2 is context free.

(d) L1 and L2 both may not be context free

(e) L1 is regular but L2 may not be context free

556. **[Languages-and-Grammars | TIFR PHD CS & SS 2014]** Which the following is FALSE?

(a) Complement of a recursive language is recursive

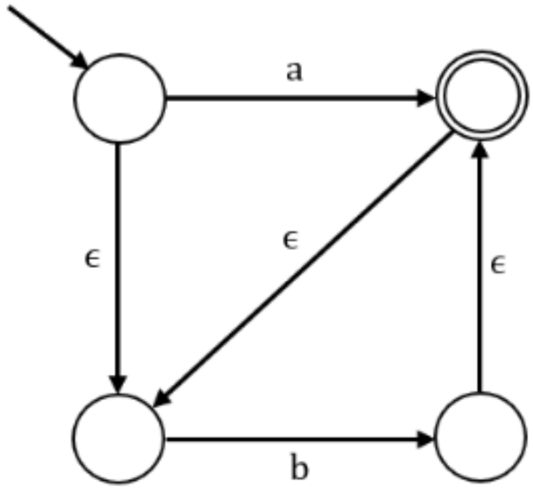
(b) A language recognized by a non-deterministic Turing machine can also be recognized by a deterministic Turing machine

(c) Complement of a context free language can be recognized by a Turing machine.

(d) If a language and its complement are both recursively enumerable then it is recursive

(e) Complement of a non-recursive language can never be recognized by any Turing machine.

557. **[Finite-Automata | HCU PHD CS MAY 2019]**
What is the language of the Non-deterministic Finite Automaton(NFA) on Σ ={ a,b} given below?



(a) a* b*

(b) a· b′

(c) a + b′

(d) (ab)′

(e) None of the above

558. **[Context-Free-Grammar | HCU PHD CS MAY 2019]**
The language of the following CFG on Σ = { a, b} given by

S $\rightarrow$ aSb I SS I $\in$

with n^a (w) denoting the number of a′s present in w is

(a) { a$\wedge$ nb$\wedge$ n : n $\geq$ 0}

(b) { w: n_a (w) = n_b (w) and n_a (v) > = n_b (v) where v is any prefIx of w}

(c) { w: n_a (w) $\neq$ n_b (w)}

(d) { w: n_a (w) = n_b (w)}

559. **[Decidability-and-Undecidability | HCU PHD CS MAY 2019]** Consider the ultimate software verification problem: A software that can verify any program submitted as input to check if it is correct or not. This problem is

(a) Undecidable

(b) Decidable

(c) Context Free

(d) NP-Hard

560. **[Languages-and-Grammars | HCU PHD CS MAY 2019]** Which of the following statements is FALSE?

(a) For every Non-deterministic PDA there exists an equivalent DPDA

(b) For every Non-deterministic TM there exists an equivalent deterministic TM

(c) For every regular expression there exists an equivalent NFA

(d) For every NFA there exists an equivalent DFA

561. **[Languages-and-Grammars | TIFR PHD CS & SS 2012]** Which of the following statements is TRUE?

(a) Every Turing machine recognizable language is recursive

(b) The complement of every recursively enumerable language is recursively enumerable

(c) The complement of a recursive language is recursively enumerable.

(d) The complement of a context free language is context free

(e) The set of turing machines which do not halt on empty input forms a recursively enumerable set

562. **[Languages-and-Grammars | TIFR PHD CS & SS 2020]** Consider the following statements.
1. The intersection of two context-free languages is always context-free.
2. The super-set of a context-free language is never regular.
3. The subset of a decidable language is always decidable.
4. Let Σ = { a, b, c} . Let L ⊆ Σ be the language of all strings in which either the number of occurrences of a is the same as the number of occurrences of b OR the number of occurrences of b is the same as the number of occurrences of c. Then, L is not context-free.
Which of the above statements are true?

(a) Only (1)

(b) Only (1) and (2)

(c) Only (1),(2) and (3)

(d) Only (4)

(e) None of (1), (2), (3), (4) are true

563. **[Languages-and-Grammars | TIFR PHD CS & SS 2020]** Consider the context-free grammar below (s denotes the empty string, alphabet is { a, b}):
S → ∈ | aSb| bSa| SS.
What language does it generate?

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

(b) $(abba)^* + (baab)^*$

(c) $(aabb)^* + (bbaa)^*$

(d) Strings of the form a^n b^n or b^n a^n , n any positive integer

(e) Strings with equal numbers of a and b

564. If L_1 be the class of languages accepted by finite state machines and L_2 be the class of languages represented by regular expressions then, **[PSC HSST 2014]**

(A) $L_1 \cap L_2 = \phi$

(B) $L_2 \subseteq L_1$

(C) $L_1 \subset L_2$

(D) $L_1 = L_2$

565. Which of the following regular expression over 0,1 denotes the set of all strings not containing 100 as substring? **[PSC HSST 2014]**

(A) $0^*1^*01^*$

(B) 0^*1010^*

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

(D) $0^*(10+1)^*$

566. Among the following, which one is NOT a regular expression? **[PSC HSST 2014]**

(A) $(1+2+0)^*(1+2)$

(B) $[(0+1)-(0b+a1)^*(a+b)]*$

(C) $[(a+b)^*(aa+bb)]^*$

(D) $(01+11+10)^*$

567. If language $L = \{0,1\}^*$, then the reversed language $L^R =$ **[PSC HSST 2012]**

(A) $\{0,1\}^*$

(B) $\{\}$

(C) $\{0\}^*$

(D) $\{1\}^*$

568. The language accepted by a Push down Automata: **[PSC HSST 2012]**

(A) Type0

(B) Type1

(C) Type2

(D) Type3

569. If grammar $G = (N, \sum, P, S)$ with non terminal $N = \{S\}$, terminals $\sum = \{0,1\}$ and production rules.
$S \to 0S, S \to S1, S \to 0$, then L(G)= ? **[PSC HSST 2012]**

(A) 0^*01^*

(B) 0^*1^*

(C) 0^*11^*

(D) 0^*1^*0

570. The Automation accepting the regular expression of any number of a's is: **[PSC HSST 2011]**

(A) a^*

(B) ab^*

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

(D) a^*b^*c

571. Recursively enumerable languages are not closed under: **[PSC HSST 2011]**

(A) Union

(B) Intersection

(C) Complementation

(D) Concatenation

572. The Grammar that produce more than one Parse tree for same sentence is: **[PSC HSST 2011]**

(A) Ambiguous

(B) Unambiguous

(C) Complementation

(D) Concatenation Intersection

573. For a given grammar, which among the following parsing tables are likely to have the most number of states? **[PSC HSST 2005]**

(A) SLR

(B) LALR

(C) LR(0)

(D) LR(1)

574. Consider the following grammar:
$S \rightarrow (S)$
$S \rightarrow x$
Which of the following statements is (are) true?
(i) The grammar is ambiguous
(ii) The grammar is suitable for top-down parsing
(iii) The grammar is suitable for bottom-up parsing **[PSC HSST 2005]**

(A) (iii) only

(B) (ii) only

(C) (i) only

(D) (ii) and (iii)

575. Which of the following operations is context free languages not closed under? **[PSC HSST 2005]**

(A) Union

(B) Closure

(C) Intersection

(D) Substitution

576. Which of the following characteristics of a programming language is best specified using a context-free grammar?

[PSC HSST 2005]

(A) Identifier length

(B) Maximum level of nesting

(C) Operator precedence

(D) type compatibility

577. Deterministic and non-deterministic models of which among the following automata have non-equivalent powers?

[PSC HSST 2005]

(A) FA

(B) PDA

(C) LBA

(D) TM

578. Which among the following types of languages are accepted both by Finite Automata and Push down automata? **[PSC HSST 2005]**

(A) Regular

(B) context free

(C) Context sensitive

(D) none of the above

579. Consider the following two languages over a, b.
L1- the set of strings beginning and ending with an a
L2- the set of strings with same number of a's and b's
Which of the following is true about L1 and L2? **[PSC HSST 2005]**

(A) L1 and L2 are both regular

(B) L1 is regular and L2 is context-free but not regular

(C) Neither L1 nor L2 is regular, but both are context-free

(D) L1 is context free but not regular and L2 is not context free

580. Which one of the following regular expressions is NOT equivalent to the regular expression $(a + b + c)^*$ **[PSC HSST 2006]**

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

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

(C) $((ab)^* + c^*)^*$

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

581. Context Sensitive Grammar can be recognized by a **[PSC HSST 2006]**

(A) Finite state machine

(B) Push down automata

(C) Deterministic PDM

(D) Linearly bounded memory machine

582. Which among the following problems is undecidable? **[PSC Lect.IT 2006]**

(A) Given a grammar G and a string w, to determine whether w is in L(G)

(B) Given a grammar G1 and G2, to determine whether L(G1)=L(G2)

(C) For an arbitrary grammar G, to determine whether L(G) is empty.

(D) All of the above.

583. Which one of the following regular expressions is NOT equivalent to the regular expression $((ab)^* + c^*)^*$? **[PSC AP.IT 2016]**

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

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

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

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

584. Which of the following statements is TRUE about the regular expression 01^*0 ? **[PSC AP.IT 2016]**

(A) It represents a finite set of finite strings

(B) It represents an infinite set of finite strings

(C) It represents an infinite set of infinite strings

(D) It represents a finite set of infinite strings

585. Let L be a context free language and M a regular language. Then the language $L \cup M$ is:

[PSC AP.IT 2016]

(A) Always regular

(B) Always a deterministic context free language

(C) Never regular

(D) Always a context free language

586. Which of the following problem is undecidable? **[PSC Pgmr 2015]**

(A) Membership problem for CFL

(B) Membership problem for regular sets

(C) Fitness problem for FSAs

(D) Ambiguity problem of CFGs

587. Every context sensitive language is: **[PSC Pgmr 2015]**

(A) Recursive enumerable language

(B) Recursive language

(C) Context free language

(D) Context sensitive language

588. Grammar recognized by a FSM is: **[PSC Pgmr 2015]**

(A) Only context free grammar

(B) Only context sensitive grammar

(C) Only regular grammar

(D) All of these

589. Consider the following grammar:
$S \to ABSc|Abc$
$BA \to AB$
$Bb \to bb$
$Ab \to ab$
$Aa \to aa$
Which of the following sentences can be derived by the above grammar? **[PSC Lect.CSE 2015]**

(A) aab

(B) abcc

(C) abbc

(D) abc

590. The automaton that can recognize context. free languages is: **[PSC Lect.CSE 2010]**

(A) finite state automata only

(B) push down automata only

(C) Turing machine only

(D) both push down automata and turfing machine.

591. The strings that belong to the language generated by the grammar $S \to 0S1, S \to 01$ can be :

[PSC Lect.CSE 2010]

(A) Generated by a DFA only

(B) Generated by a PDA only

(C) Generated either by a DFA or by a PDA

(D) None of these

592. Which of the following ordered pair of characters from the set (a, b) is the correct choice for the characters # and * respectively in the string abab#*aa if it is to be accepted by a finite automaton whose equivalent regular expression is $a(ba + ab)^*a$: **[PSC Lect.CSE 2010]**

(A) a, a

(B) a, b

(C) b, a

(D) b, b

593. The CFG $S \to ab/abS$ generates a language that is equivalent to the one generated by the regular expression: **[PSC Lect.CSE 2010]**

(A) ab^*

(B) $(ab)^*$

(C) $ab^*.ab$

(D) $(ab)^*ab$

594. Given the two languages L1 = $(a+b)^*a$ and L2 = $b(a+b)^*$, the language that is the intersection of L1 and L2 is : **[PSC Lect.CSE 2010]**

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

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

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

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

595. Which of the following regular expressions generate(s) no string with two consecutive l's?
I. $(1+0)(01+0)^*$
II. $(01+10)^*$
III. $(0+1)^*(0+\varepsilon)$ **[PSC Lect.CSE 2010]**

(A) I only

(B) II only

(C) III only

(D) I and 11 only

596. If L_1 is a context free language and L_2 is a regular language, which of the following is true?

[PSC Lect.CSE 2010]

(A) $L_1.L_2$ is not context free

(B) $L_1 \cap L_2$ is context free

(C) $\neg L_l$ is context free

(D) $\neg L_2$ is not regular

597. Given $L_l = \{0^n 1^n 2^n | n \geq 1\}$, $L_2 = \{$ x | x is a palindrome in $(0+1)^*$ $\}$ and $L_3 = \{a.(a+b)^*\}$, identify the incorrect statement from the following set **[PSC Lect.CSE 2010]**

(A) L_1 is context sensitive and L_2 is context free

(B) L_2 is context free and L_3 is regular

(C) L_1 is context free and L_2 is context free

(D) L_1 is context sensitive and L_3 is regular

598. Pick out the non-equivalent form (regular expression / grammar) of the language generated by the grammar $S \rightarrow aS|bS|a|b|\varepsilon$: **[PSC Lect.CSE 2010]**

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

(B) $(a^*b^*)^*$

(C) $S \rightarrow Sa|Sb|a|b|\varepsilon$

(D) $(ab)^*$

599. The language generated by the following context free grammar $s \rightarrow AB, A \rightarrow aA|bA|b, B \rightarrow bB|aB|b$ has strings that **[PSC Lect.CSE 2010]**

(A) have at least one b

(B) should end in ab

(C) have no consecutive a's or b's

(D) none of the above

600. The Context Free Grammar with the productions $S \rightarrow AB, A \rightarrow 0A|1, B \rightarrow 1B|0$ generates the language over $\{0,1\}^*$ which is given by the set ? **[PSC Lect.CSE 2010]**

(A) 0^*110^*

(B) 0^*11^*0

(C) $\{0^n10^{2n}|n \geq 1\}$

(D) None of these.

601. Which among the following is the most general phrase structured grammar ? **[PSC HSST 2014]**

(A) Context - Sensitive

(B) Context - Free

(C) Regular

(D) None of the above

602. The language class accepted by finite automata is: **[PSC Lect. 2009]**

(A) recursively enumerable

(B) context sensitive

(C) context free

(D) regular

603. Consider the regular expression $R = (ab + abb)^*$ Which of the following string is NOT in the set denoted by R? **[PSC Lect. 2009]**

(A) ababab

(B) abbbab

(C) abbabbab

(D) ababbabbab

604. Given an arbitrary non-deterministic finite automation (NFA) with N states, the maximum number of states in an equivalent minimized DFA is at least **[SET 2010]**

(A) N^2

(B) 2^N.

(C) 2N

(D) N!

605. The smallest finite automation which accepts the language $\{x|$ length of x is divisible by 3 $\}$ has

[SET 2010]

(A) 2 states

(B) 3 states

(C) 4 states

(D) 5 states

606. Assuming $P \neq NP$, which of the following is true? **[LBS AP 2014]**

(A) NP-complete=NP

(B) $NP - complete \cap P = \phi$

(C) NP-hard = NP

(D) P = NP-complete

607. Which of the following pairs have different expressive power? **[LBS AP 2014]**

(A) Deterministic finite automata (DF and Non-deterministic finite automata (N F

(B) Deterministic pushdown automata (DPDA) and Nondeterministic pushdown automata (NPDA)

(C) Deterministic single-tape Turing machine and Nondeterministic single tape Turing machine

(D) Single-tape Turing machine and multi-tape Turing machine .

608. Consider the languages
$L1 = \{WW^R|W \in \{O,1\}^*\}$
$L2 = \{W\#W^R|W \in \{O,1\}^*$ where # is a special symbol$\}$
$L2 = \{WW|W \in \{O,1\}^*$
which of the following is true? **[LBS AP 2014]**

(A) L1 is a deterministic CFL

(B) L2 is a deterministic CFL

(C) L3 is a CFL, but not a deterministic CFL

(D) L3 is a deterministic CFL

609. Let w be any string of length n in $\{0,1\}^*$. Let L be the set of all sub-strings of w.What is the minimum number of states in a non-deterministic finite automaton that accepts L?

[LBS AP 2014]

(A) n-1

(B) n

(C) n+1

(D) 2^{n-1}

610. Which of the following problems are decidable?
1. Does a given program ever produce an output?
2. lf L is a context-free language, then, is L′ also context-free?

3. If L is a regular language, then, is L' also regular?
4. lf L is a recursive language, then, is L' also recursive? **[LBS AP 2014]**

(A) 1,2,3,4

(B) 1,2

(C) 2,3,4

(D) 3,4

611. given the language $L = \{ab, aa, baa\}$, which of the following strings are in L*
1.abaabaaabaa
2.aaaabaaaa
3.baaaaabaaaaab
4.baaaaaaabaa **[LBS AP 2014]**

(A) 1,2 and 3

(B) 2,3,and 4

(C) 1,2 and 4

(D) 1,3 and 4

612. consider the following problem X
Given a Turing machine M over the input alphabet Σ, any state q of M and a word $W \in \Sigma^*$ does the computation of M on w visit the state q?
Which of the following statements about X is correct? **[LBS AP 2014]**

(A) X is undecidable but partially decidable

(B) X is decidable

(C) X is undecidable and not even partially decidable

(D) X is not a decision problem

613. Let S and T be the languages over$\Sigma = \{a, b\}$ represented by the regular expression $(a + b^*)^*$ and $(a + b)^*$, respectively. Which of the following is true? **[CAPE AP 2015]**

(A) $S \subset T$

(B) $T \subset S$

(C) S = T

(D) $S \cap T$

614. Which of the following definitions below generates the same language as L where $L = \{a^n b^n | n \geq 1\}$
i. $E \rightarrow aEb|ab$
ii. $ab|(a^*abb^*)$
iii. a^+b^+ **[CAPE AP 2015]**

(A) i) only

(B) (i) and (ii)

(C) (ii) and iii)

(D) (ii) only

615. Two regular expressions are equivalent if **[CAPE AP 2015]**

(A) Their set of final states of NFA are same

(B) One can write a program which exhaustively test all strings

(C) Transition diagram of both are same

(D) Their minimal states DFA are same

616. Given the language $L = \{ab, aa, baa\}$ which of the following strings are in L*?
1.abaabaaabaa
2.aaaabaaaa
3.baaaaabaaaab
4.baaaaabaa **[CAPE AP 2014]**

(A) 1,2 and 3

(B) 2, 3 and 4

(C) 1,2 and 4

(D) 1,3 and 4

617. Consider a language L for which there exists a Turing Machine (T M), T, that accepts every word in L and either rejects or loops for every word that is not in L. The language L is **[CAPE AP 2014]**

(A) NP hard

(B) NP complete

(C) Recursive

(D) Recursively enumerable

618. Pumping lemma is generally used for **[PSC Computer Progr 2013]**

(A) a given grammar is not regular

(B) a given grammar is regular

(C) whether two given regular expression is equivalent

(D) none of the above

619. $S \rightarrow aSa|bSb|a|b$. The language generated by the above grammer over the alphabet a,b is the set of: **[PSC Computer Progr 2013]**

(A) all palindromes

(B) all odd-length palindromes

(C) strings that begin and end with the same symbol

(D) all even-length palindromes

620. If string of a language L can be effectively enumerated in lexicographic (ie., alphabetic) order which of the following statement is true? **[PSC Computer Progr 2013]**

(A) L is necessarily finite

(B) L is regular but not necessarily finite

(C) L is context free but not necessarily finite

(D) L is recursive but not necessarily context free

621. Which is true for ε closure of a state : **[PSC Computer Progr 2013]**

(A) All the states reachable from the state with input null excluding the state

(B) The state only

(C) All the other states

(D) All the states reachable from the state with input null

622. Turing machine is the machine format of .... language **[PSC Computer Progr 2013]**

(A) Type 0

(B) Type 1

(C) Type 2

(D) Type 3

623. Which among the following problems is undecidable? **[PSC Lect. IT 2004]**

(A) Given a grammar G and a string w, to determine whether w is in L(G)

(B) Given grammars G1 and G2, to determine whether L(G1) = L(G2).

(C) For an arbitrary grammar G, to determine whether L(G) is empty.

(D) All of the above

624. Which among the following is an NP-Complete problem? **[PSC Lect. IT 2004]**

(A) 3SAT Problem

(B) Travelling Salesman

(C) Graph 3-coloring

(D) All of the above

625. Any DFA for the regular expression "$(a/b)^*(a+b)\ (a+b)$........$(a+b)$", where (n-1) (a+b)'s at the end must have at least .... states. **[PSC Lect. Poly 2008]**

(A) N

(B) n(n-1)

(C) 2n

(D) 2n(n-1)

626. Let $\Sigma = \{a,b,c,d,e,f\}$. The number of strings in Σ^* of length 4 such that no symbol repeated in a string is : **[PSC Lect. Poly 2008]**

(A) 24

(B) 6^4

(C) 256

(D) 360

627. Context Free Grammar G which accepts palindromes over the symbol p and q. Production is given by **[PSC S/M Manager 2013]**

(A) $S \rightarrow \varepsilon/pSp/qSq$

(B) $S \rightarrow \varepsilon / pSq$

(C) $S \rightarrow \varepsilon / pSp / qRp$

(D) None of the above

628. A language L is NP complete if $L \in NP$ and L is: **[PSC Lect. Engg 2007]**

(A) Recursively enumerable

(B) Recursive

(C) NP-hard

(D) in Co-NP

629. In some programming language, an identifier is defined to be a letter followed by any number of letters or digits. If L and D denote the sets of letters and digits respectively, then which of the following regular expressions define that identifier. **[PSC Lect. Engg 2007]**

(A) $(L \cup D)$*

(B) $L.(L \cup D)$*

(C) $(L.D)^*$

(D) $L(L.D)^*$

630. CSG can be recognized by a : **[PSC VHSE 2006]**

(A) FSM

(B) PDA

(C) DPDM

(D) linearly bounded memory machine

631. Pumping lemma is generally used for providing **[PSC VHSE 2006]**

(A) a given grammar is regular

(B) a given grammar is not regular

(C) whether two given regular expressions are equivalent

(D) none of the above

632. Recursively enumerable languages are not closed under **[PSC VHSE 2006]**

(A) union

(B) intersection

(C) complementation

(D) concatenation

633. Let $\Sigma = \{X, Y\}$ be an alphabet. The string of length seven over Σ are listed in dictionary order.What is the first string after xxxxyxx that is a palindrome? **[CAPE 2012]**

(A) xxxxyxy,

(B) xxxyxxx

(C) xxyxyxx

(D) xxyyyxx

634. A language can be proved to be context free by designing **[CAPE 2012]**

(A) a PDA

(B) a CFG

(C) Either(A) or (B)

(D) Neither(A) or (B)

635. The power of Turing machine is equivalent to the languages of .... grammars

[CAPE 2012]

(A) Regular

(B) Context free

(C) Unrestricted

(D) Context sensitive

636. If L_1 and L_2 are languages recognized by machines M_1 and M_2 with n and m states respectively then the machine M recognizing $L_1.L_2$ will contain how many states? Assume that the new automation is constructed using Thompson construction

[CAPE 2012]

(A) m

(B) n

(C) n-m

(D) n+m

637. Consider two productions $S \to aA$ and $A \to b|\varepsilon$ after removing the nullable variables A, $S \to aA$ will be, **[CAPE 2012**
]

(A) $S \to a$

(B) $S \to A$

(C) $S \to aA$

(D) Both A and C

1.2 Solutions

1. B	8. A	15. A	22. D	29. C	36. A	43. B	50. B
2. D	9. B	16. B	23. C	30. D	37. B	44. C	51. A
3. B	10. D	17. C	24. B	31. B	38. A	45. B	52. A
4. B	11. A	18. A	25. D	32. B	39. D	46. C	53. A
5. A	12. D	19. C	26. D	33. C	40. A	47. A	54. A
6. D	13. B	20. D	27. C	34. A	41. A	48. A	55. C
7. B	14. A	21. D	28. A	35. D	42. C	49. D	56. B

57. C	92. C	127. A	162. B	197. A	232. D	267. C	302. B
58. A	93. C	128. A	163. B	198. B	233. B	268. A	303. B
59. D	94. B	129. A	164. B	199. C	234. D	269. C	304. B
60. D	95. D	130. B	165. B	200. A	235. A	270. A	305. A
61. B	96. C	131. B	166. D	201. A	236. A	271. C	306. D
62. D	97. D	132. D	167. A	202. B	237. D	272. D	307. A
63. C	98. B	133. B	168. B	203. E	238. C	273. B	308. D
64. D	99. B	134. A	169. C	204. D	239. A	274. C	309. B
65. C	100. D	135. A	170. C	205. E	240. C	275. D	310. B
66. B	101. D	136. A	171. C	206. D	241. C	276. D	311. B
67. B	102. A	137. C	172. A	207. A	242. B	277. C	312. B
68. C	103. C	138. B	173. A	208. D	243. C	278. A	313. D
69. B	104. B	139. D	174. D	209. C	244. A	279. C	314. D
70. B	105. D	140. A	175. C	210. D	245. D	280. D	315. D
71. D	106. A	141. A	176. C	211. A	246. B	281. A	316. B
72. C	107. B	142. A	177. A	212. A	247. C	282. A	317. A
73. B	108. B	143. B	178. C	213. A	248. A	283. D	318. C
74. C	109. B	144. B	179. D	214. C	249. A	284. C	319. B
75. D	110. A	145. A	180. A	215. D	250. D	285. B	320. D
76. A	111. B	146. E	181. E	216. B	251. D	286. B	321. C
77. C	112. A	147. C	182. A	217. A	252. D	287. C	322. D
78. C	113. A	148. D	183. C	218. A	253. D	288. D	323. C
79. D	114. A	149. A	184. E	219. C	254. C	289. A	324. C
80. B	115. D	150. D	185. E	220. B	255. D	290. D	325. D
81. D	116. C	151. D	186. F	221. D	256. B	291. D	326. B
82. D	117. C	152. D	187. F	222. C	257. D	292. B	327. C
83. A	118. C	153. B	188. E	223. B	258. A	293. C	328. C
84. C	119. A	154. B	189. E	224. A	259. B	294. B	329. D
85. C	120. A	155. B	190. E	225. B	260. D	295. A	330. B
86. C	121. B	156. D	191. E	226. A	261. D	296. D	331. A
87. A	122. B	157. B	192. E	227. D	262. B	297. B	332. C
88. B	123. A	158. A	193. A	228. B	263. D	298. A	333. E
89. B	124. B	159. C	194. B	229. A	264. D	299. B	334. D
90. A	125. A	160. D	195. B	230. C	265. D	300. B	335. D
91. B	126. B	161. D	196. B	231. A	266. A	301. B	336. B

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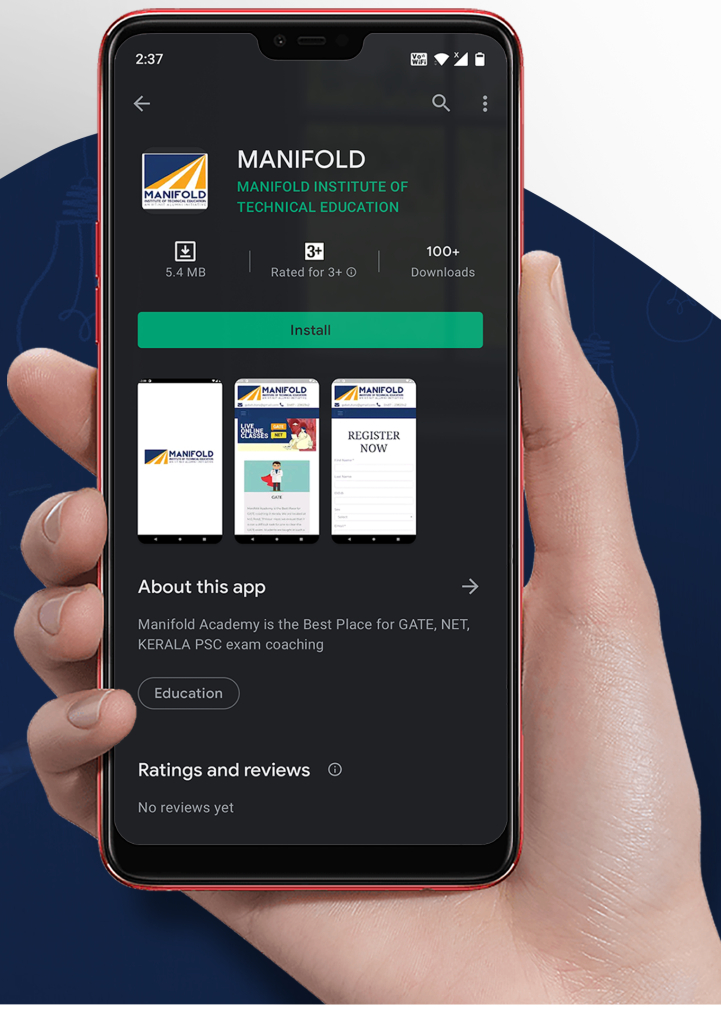

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337. A	366. D	395. D	424. A	453. C	482. C	511. C	540. D
338. B	367. A	396. C	425. C	454. C	483. B	512. C	541. B
339. A	368. C	397. A	426. A	455. D	484. A	513. B	542. B
340. A	369. E	398. D	427. D	456. D	485. B	514. D	543. A
341. B	370. C	399. A	428. B	457. D	486. C	515. B	544. C
342. C	371. B	400. A	429. C	458. A	487. C	516. B	545. C
343. C	372. C	401. B	430. B	459. B	488. A	517. C	546. E
344. B	373. B	402. A	431. A	460. D	489. C	518. C	547. D
345. C	374. D	403. D	432. C	461. C	490. D	519. C	548. D
346. A	375. B	404. C	433. C	462. C	491. D	520. C	549. C
347. B	376. B	405. B	434. A	463. C	492. B	521. B	550. A
348. D	377. B	406. C	435. D	464. C	493. C	522. D	551. D
349. A	378. C	407. A	436. D	465. C	494. D	523. B	552. E
350. C	379. C	408. D	437. C	466. D	495. B	524. D	553. D
351. D	380. A	409. C	438. C	467. A	496. B	525. C	554. D
352. A	381. A	410. B	439. D	468. C	497. C	526. C	555. C
353. B	382. D	411. B	440. B	469. C	498. B	527. D	556. E
354. B	383. C	412. B	441. D	470. B	499. A	528. D	557. E
355. B	384. A	413. D	442. C	471. C	500. B	529. D	558. D
356. A	385. B	414. B	443. A	472. C	501. D	530. A	559. A
357. D	386. B	415. C	444. C	473. D	502. B	531. B	560. A
358. B	387. B	416. C	445. A	474. A	503. A	532. C	561. C
359. A	388. C	417. D	446. C	475. B	504. A	533. D	562. E
360. C	389. D	418. A	447. B	476. C	505. B	534. B	563. E
361. C	390. A	419. A	448. C	477. D	506. A	535. B	
362. D	391. C	420. D	449. B	478. C	507. C	536. D	
363. D	392. A	421. A	450. D	479. D	508. B	537. D	
364. C	393. C	422. C	451. B	480. C	509. C	538. D	
365. B	394. D	423. A	452. D	481. D	510. D	539. C	

564. D. Both represents Regular Language

565. (A) $0^*1^*01^*$ This is false. ε is not present in this expression
    (B) 0^*1010^*. This False. Same as above.
    (C) $0^*(1^*0)^*$ This is false. We cannot generate the string 1
    (D) $0^*(10+1)^*$ This should be True

566. B

567. A. Since $L = L^R = \Sigma^*$

568. C

569. A

570. A

571. C
572. A
573. D
574. A
575. C
576. C
577. B
578. A
579. B
580. C
581. D
582. B
583. A,B,C,D
584. B
585. D
586. D
587. A,B,D
588. C
589. C
590. D
591. B
592. B
593. D
594. C
595. None of the choices are correct
596. B
597. C
598. D
599. D
600. B
601. B
602. D
603. B
604. B
605. 3-states
606. B
607. B
608. B
609. C
610. D
611. 1,2,3 and 4
612. A
613. C
614. A
615. D
616. C
617. D
618. A
619. B
620. D
621. D
622. A
623. B
624. D
625. A
626. 6 * 5 * 4 * 3 = 360
627. A
628. C
629. B
630. D
631. B
632. C
633. B
634. C
635. C
636. D
637. D