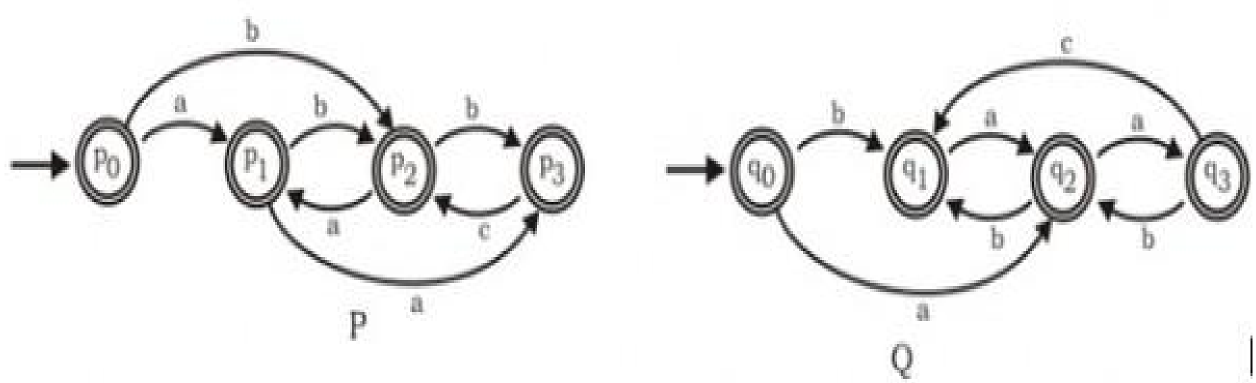
**EPT-TEST- 55(TOC)**
**Total Questions: 15**
**Time: 60 Minutes**

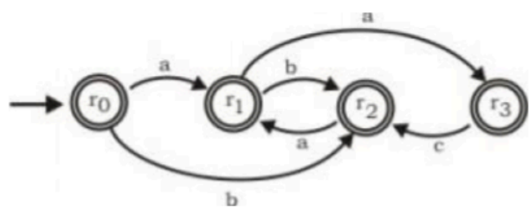
**Q1.[MCQ]**
**Which one of the following regular expressions over {0,1} denotes the set of all strings not containing 100 as a substring?**

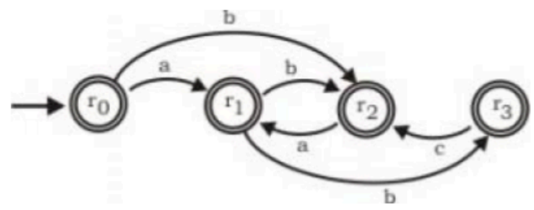
**(A) 0* (1+0)***
**(B) 0*1010***
**(C) 0*1*01***
**(D) 0*(10+1)***

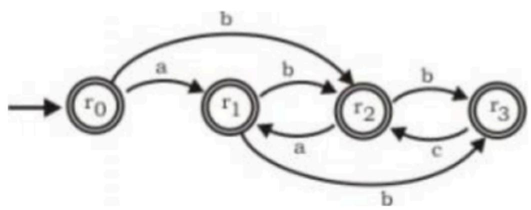
**Q2. [MCQ]**
**Consider the following finite automata P and Q over the alphabet {a, b, c}. The start states are indicated by a double arrow and final states are indicated by a double circle. Let the languages recognized by them be denoted by L(P) and L(Q) respectively.**

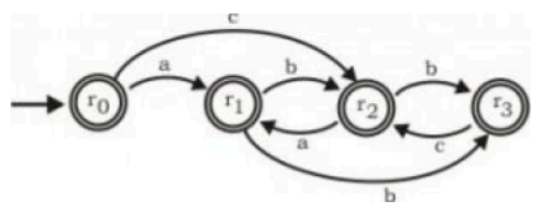


The automation which recognizes the language L(P) ∩ L(Q) is




**Q3. [MCQ]**
**Let L1={ w | w $\in \{0,1\}^*$ & w has at least as many occurrences of (110)' s as (011)' s}.**

**Let L2={w | w$\in\{0,1\}^*$ & w has at least as many occurrences of (000)' s as 111)' }.**

**Which one of the following is TRUE?**
**A. L1 is regular but not L2**
**B. L2 is regular but not L1**
**C. Both L1 and L2 are regular**
**D. neither L1 nor L2 are regular**

**Q4. [MCQ]**
**Which one of the following regular expressions**

**represents the language L={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) $(0+1)^*(00(0+1)^*11+11(0+1)^*00)(0+1)^*$

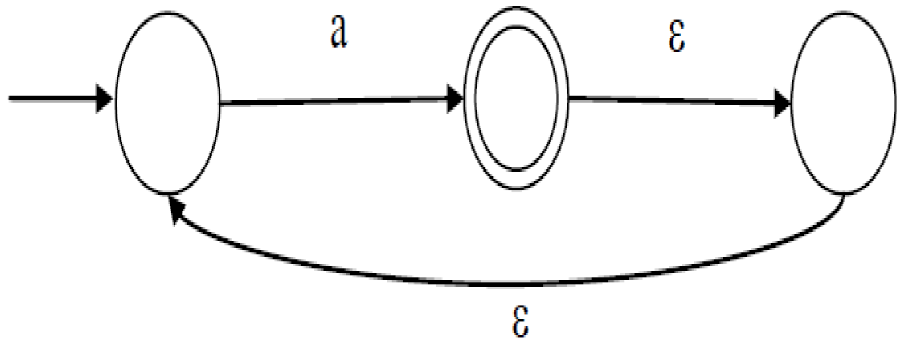
(C) $(0+1)^*00(0+1)^*+(0+1)^*11(0+1)^*$

(D) $00(0+1)^*11+11(0+1)^*00$

**Q5. [MCQ]**
**Which one of the following regular expressions represents the set of all binary strings with an odd number of 1′s ?**

**(A) ((0+1)*1(0+1)*1)*10***
**(B) (0*10*10*)*0*1**
**(C) 10*(0*10*10*)***
**(D) None**

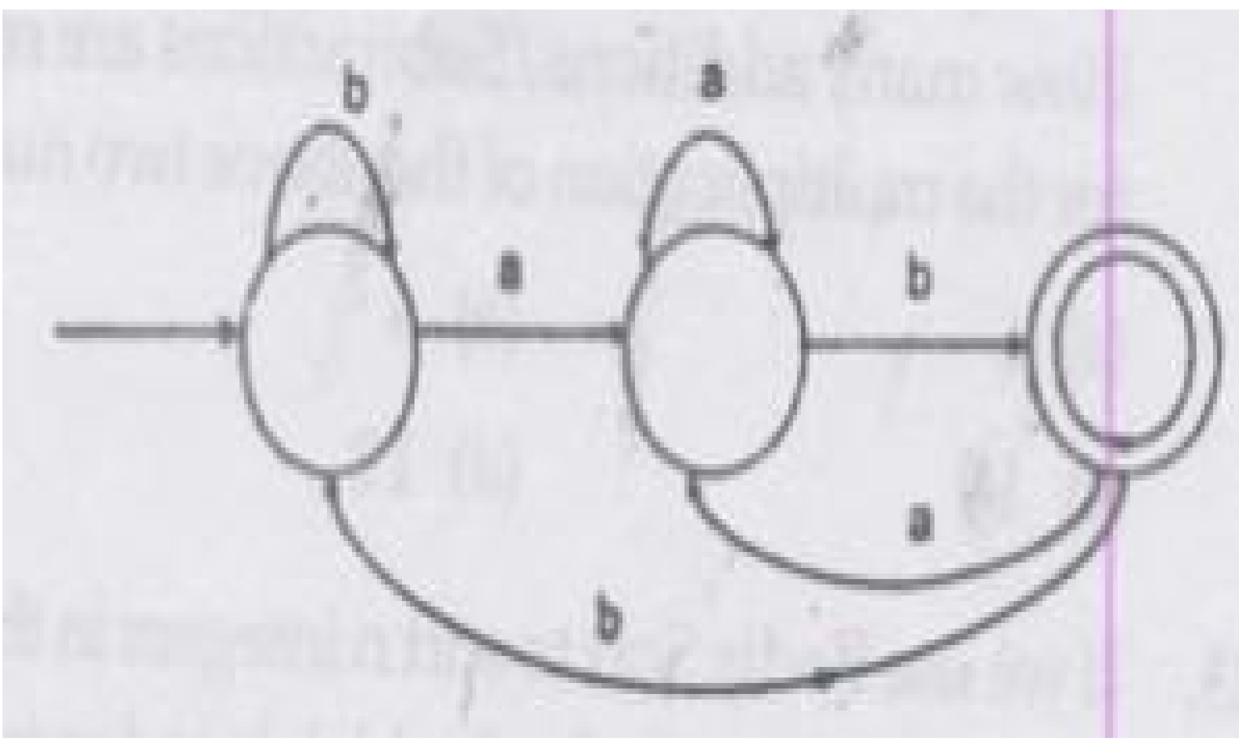
**Q6. [MCQ]**
**What is the complement of the language accepted by the NFA shown below?**




(A) ∅ (B) {ε} (C) $a^*$ (D) {a , ε}

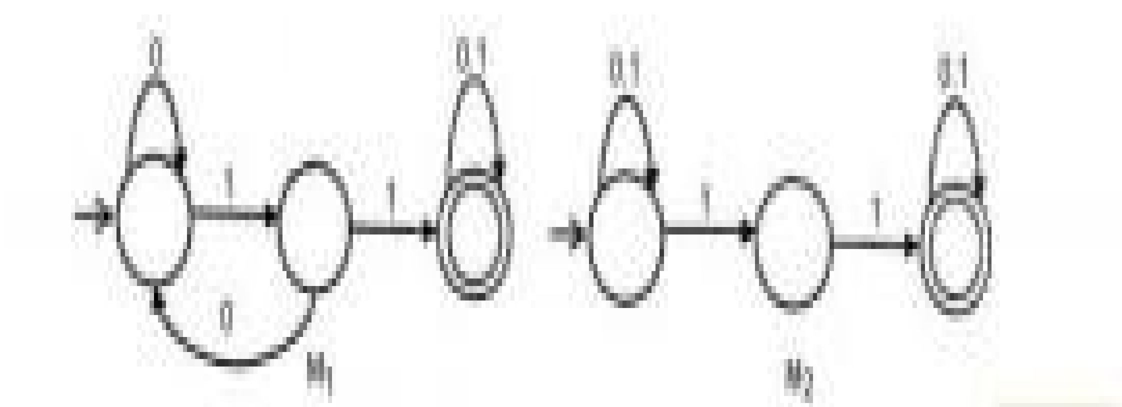
**Q7. [MCQ]**

**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***

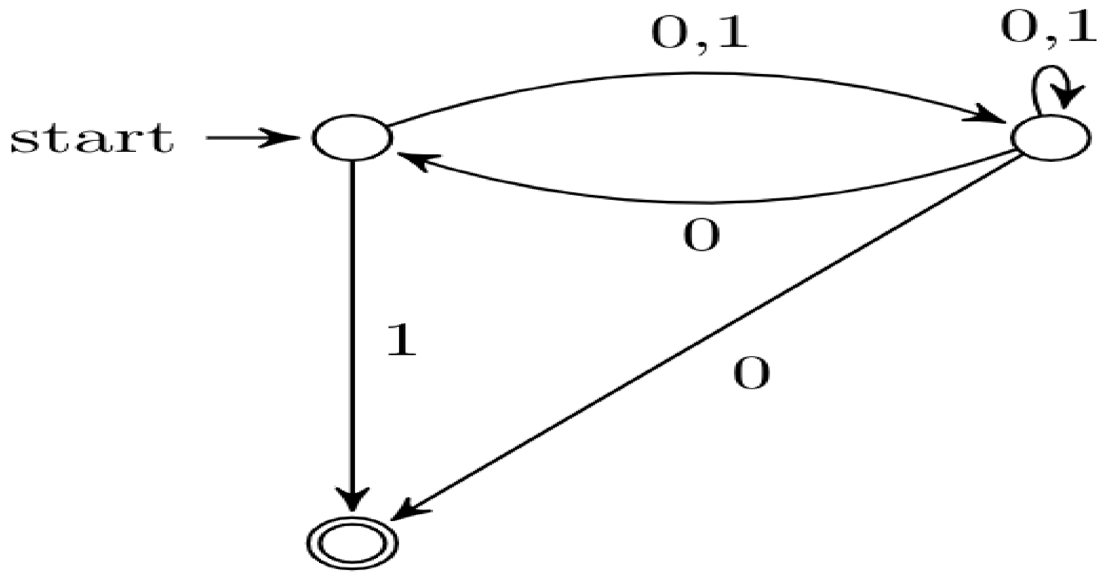
**Q8. [MCQ]**
**Consider the following two finite automata. *M*1 accepts *L*1 and *M*2 accepts *L*2.**



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

A. $L1 = L2$
B. $L1 \subset L2$
C. $L1 \cap LC = \varnothing$
D. *None*

**Q9. [MCQ]**
**Consider the NFA M shown below.**

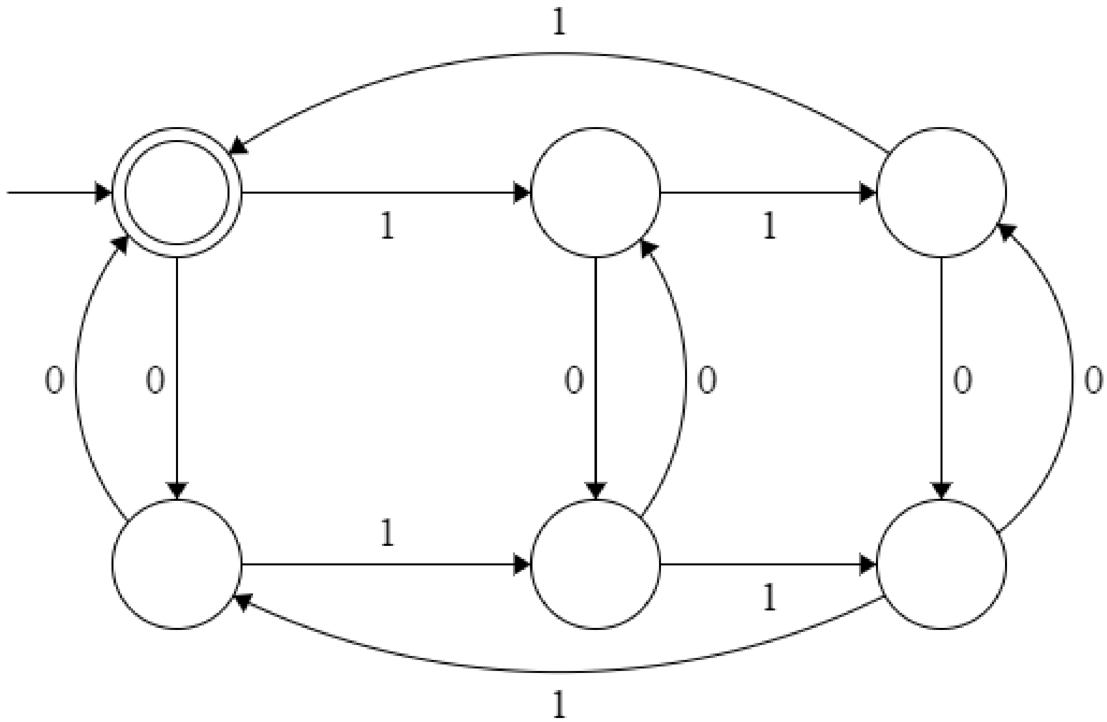



**Let the language accepted by M be L. Let L1 be the language accepted by the NFA M1, obtained by changing the accepting state of M to a non-accepting state and by changing the non-accepting state of M to accepting states. Which of the following statements is true ?**
**(A) $L1 = \{0, 1\}^* - L$**

**(B) L1 = {0, 1}***
**(C) L1 $\subseteq$ L**
**(D) L1 = L**

**Q10. [MCQ]**

**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**

**Q11. [MCQ]**

**Which of the following are decidable?**

1. **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**

**Q12. [MCQ]**

**Which of the following problems are decidable?**

**1) Does a given program ever produce an output?**
**2) If L is context-free language, then, is L'(complement of L) also context-free?**
**3) If L is a regular language, then, is L'(complement of L) also regular?**
**4) If L is a recursive language, then, is L'(complement of L) also recursive?**
**(A) 1,2,3,4  (B) 1,2  (C) 2,3,4  (D) 3,4**

**Q13. [MCQ]**

**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 ϵ 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 statements is correct?**
**(A) Only I and II are undecidable**
**(B) Only II is undecidable**
**(C) Only II and IV are undecidable**
**(D) Only I, II and III are undecidable**

**Q14. [MCQ]**
**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 $w \in L(R)$?**
**II. Given a context-free grammar G, is $L(G)=\varnothing$**
**III. Given a context-free grammar G, is $L(G)=\Sigma^*$ for some alphabet Σ?**
**IV. Given a Turing machine M and a string w, is $w \in L(M)$?**

**(A) I and IV only**
**(B) II and III only**
**(C) II, III and IV only**

**(D) III and IV only**

**Q15. [MCQ]**

**Let <M> be the encoding of a Turing machine as a string over $\sum$= {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**

**Q16. [MCQ]**

**Which of the following languages are undecidable? Note that $\langle M \rangle$ indicates encoding of the Turing machine M.**

$L_1 = \{ \langle M \rangle \mid L(M) = \varnothing \}$

$L_2 = \{ \langle M,w,q \rangle \mid$ M on input w reaches state q in exactly 100 steps $\}$

$L_3 = \{ \langle M \rangle \mid L(M)$ is not recursive $\}$

$L_4 = \{ \langle M \rangle \mid L(M)$ contains at least 21 members $\}$

A. $L_1$, $L_3$, and $L_4$ only

B. $L_1$ and $L_3$ only

**C.** $L_2$ **and** $L_3$ **only**

**D.** $L_2$**,** $L_3$**, and** $L_4$ **only**

## Q17. [MCQ]

For a Turing machine $M$, $\langle M \rangle$ denotes an encoding of $M$. Consider the following two languages.

$$L_1 = \{\langle M \rangle \mid M \text{ takes more than 2021 steps on all inputs}\}$$
$$L_2 = \{\langle M \rangle \mid M \text{ takes more than 2021 steps on some input}\}$$

Which one of the following options is correct?

A. Both $L_1$ and $L_2$ are decidable
B. $L_1$ is decidable and $L_2$ is undecidable
C. $L_1$ is undecidable and $L_2$ is decidable
D. Both $L_1$ and $L_2$ are undecidable

## ANSWERS

## A1. D

**A regular expression denoting a language (set of**

**strings) means it should generate all string in L and not generate any string not in L"**

a. - generates 100
b. generate 100
c. start trying strings in lexicographic order-0,1,00,01,10,...), doesn't generate 1
d. is the correct answer

**A2. A**

**Manual checking by taking some strings will make it easy**

**A3. A**

**110110110110110110**

**In this string 110 six times, observe properly 011 five times, so indirectly both are counting.**

**DFA possible for L1 but not for L2**

**A4. B**

**Set of all binary strings having two consecutive 0s and two consecutive 1s**

***Anything* 00 *Anything* 11 *Anything* + *Anything* 11 *Anything* 00 *Anything***

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

**And it is the same after taking common.**

$(0+1)^*[(00(0+1)^*11 + 11(0+1)^*00)](0+1)^*$

**So, option B is the answer, neither they said Both are immediate nor they give a predefined order, so it should be as above**

**A5. D**
**A6. B**
**A7. A**
**A8. A**
**A9. B**
**A10. A**
**Check minimal strings like epsilon, 11100, 111, 00,.....**
**A11. B**
**Directly from Table**

**A12. D**
**Directly from Table**
**A13. D**
**Directly from Table**
**A14. D**
**Directly from Table**
**A15. B**
**All valid strings will go to halt final but invalid strings may go to infinite loop.So it is recursively enumerable( valid halt, invalid strings anything can happen) but undecidable ( because of infinite loop)**

**A16. A**
**$L_1 = \{ \langle M \rangle \mid L(M)=\varnothing \}$ is emptiness problem of TM, which is Undecidable**
**$L_2 = \{ \langle M,w,q \rangle \mid$ M on input w reaches state q in exactly 100 steps $\}$ is decidable as we can run the TM for 100 steps and see if it reaches state q.**
**$L_3 = \{ \langle M \rangle \mid L(M)$ is not recursive $\}$ is undecidable**

$L_4 = \{ \langle M \rangle \mid L(M)$ contains at least 21 members $\}$ is undecidable. It may or may not halt

Only $L_2$ is decidable. Option (A) is correct.

**A17. A**

**Here, both L1 and L2 are decidable as we can have a systematic procedure in deciding them (correctly saying if an input is in L or not)**

**For both L1 and L2 we have to monitor the TM for 2021+1 steps for all possible inputs of size 2021**

**If for all the inputs M is taking more than 2021 steps, then it means for all larger strings also it must take more than 2021 steps and we can answer “yes” for**

**L1 or else “no”.**

**If for none of the inputs M is taking more than 2021 steps then it means even for any larger string M won’t be taking more than 2021 steps. So, we can answer “no” for**

**L2 or else “yes”.**

**Thus we correctly decided both L1 and L2.**