

23CSE303 – Theory of Computation (September 2025)

Tutorial 3 – Regular Expressions

1. Write Regular Expressions for the following Languages.

- a) Strings containing exactly 2 b's over $\Sigma=\{a,b\}$
- b) Starts with 'ab' and ends with 'ba'
- c) Even length string
- d) No consecutive a's
- e) Alternating 0's and 1's over $\Sigma=\{0,1\}$
- f) Atleast one b over $\Sigma=\{a,b\}$
- g) Exactly two 0's over $\Sigma=\{0,1\}$
- h) Atleast two a's and three b's over $\Sigma=\{a,b\}$
- i) First and last characters are the same
- j) Contains substring 'ab' atleast twice
- k) No occurrence of the string 'ab'
- l) Starts with 'a' and contains only one 'b'
- m) Begins with 'b' and contain exactly three 'a'
- n) Exactly two consecutive a's
- o) No more than three b's
- p) Number of a is divisible by 3
- q) Not starting with 'b'
- r) Exactly one occurrence of 'ba'
- s) String of length 3
- t) Atleast one 'b' and no consecutive a's
- u) Starts with a, ends with b, containing no 'aa'
- v) Start with a, but not having consecutive bs
- w) Do not contain 01 over $\Sigma=\{0,1\}$
- x) Starts and ends with different symbols over $\Sigma=\{a,b\}$

2. Consider the following two regular expressions over the alphabet $\{0,1\}$:

$$r=0^*1^* \quad s=01^*+10^*$$

The total number of strings of length less than or equal to 5 , which are neither in r nor in s, is _____

[Gate 2024]

3. The length of the shortest string NOT in the language (over $\Sigma=\{a,b\}$) of the following regular expression is _____.

$$R = a^*b^*(ba)^*a^*$$

[Gate 2014]

4. Let $L = \{ w \in (0+1)^* \mid w \text{ has even number of } 1\text{'s} \}$ 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 $(0^*10^*1)^*(0^*10^*1)^*$
- B $0^*(10^*10^*)^*0^*(10^*10^*)^*$
- C $0^*(10^*1^*)^*0^*0^*(10^*1^*)^*0^*$
- D $0^*1(10^*1)^*10^*0^*1(10^*1)^*10^*$

5. Which one of the following languages over the alphabet $\{0,1\}$ is described by the regular expression: $(0+1)^*0(0+1)^*0(0+1)^*$? [Gate 2009]

- 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