TOPIC: REGULAR EXPRESSIONS

Write Regular Expression for following languages:

1. ∑ = {0, 1} and String in the Language ends with 1
2. ∑ = {0, 1, 2} and String in the Language ends with 010
3. ∑ = {a, b} and All Strings in the Language contain exactly three b's.
4. ∑ = {0, 1} and All Strings in the Language starts and ends with different symbols.
5. ∑ = {0, 1} and All Strings in the Language starts and ends with same symbols
6. ∑ = {0, 1} and All Strings in the Language starts and ends with same symbols
7. ∑ = {a, b, c} and All Strings in the Language contain exactly three b's.
8. ∑ = {a, b} and All Strings in the Language contain at least three b's.
9. ∑ = {0, 1} and All Strings in the Language contain at least three 1's.
10. ∑ = {0, 1} and All Strings in the Language contain at most three 1's.
11. ∑ = {0, 1, 2} and All Strings in the Language contain at most three 1's
12. ∑ = {0, 1} and All Strings in the Language contain 00 or 11 as substring.
13. ∑ = {0, 1} and All Strings in the Language contain both 00 and 11 as substring.
14. ∑ = {a, b} and String in the Language contain 'aa' as substring.
15. ∑ = {0, 1} and All Strings in the Language end with 00.
16. ∑ = {0, 1} and All Strings in the Language does not end with 00.
17. ∑ = {0, 1} and All Strings in the Language do not contain 00 as substring.
18. ∑ = {0, 1, 2} and All Strings in the Language do not contain 00 as substring.
19. ∑ = {0, 1} and All Strings in the Language contain exactly one pair of 0's
20. ∑ = {0, 1, 2} and All Strings in the Language contain exactly one pair of 1's
21. ∑ = {0, 1} and All Strings in the Language contain exactly one pair of 0's
22. ∑ = {0, 1} and All Strings in the Language contain at most one pair of 0's.
23. ∑ = {0, 1} and All Strings in the Language contain at most one pair of 0's and at most one pair of 1's
24. ∑ = {0, 1} and All Strings in the Language neither contain 00 nor 11 as substring.
25. ∑ = {0, 1} and in each string there are at least two 1's between every pair of 0's.
26. ∑ = {0, 1} and there are equal number of 0's and 1's in every string number of 0's differs from number of 1's by at most 1 and vice versa.
27. ∑ = {0, 1} and string starts with 01 or ends with 01
28. ∑ = {0, 1} and there are even number of 0's and even no of 1's.
29. ∑ = {a, b} and string starts with a and has even length.

30. ∑ = {a, b} and string starts with b and have odd length.
31. ∑ = {a, b} and string ends with a and have even length.
32. ∑ = {a, b} and string ends with b and have odd length.
33. ∑ = {a, b} and if string starts with ‘a’ have odd length, and if it starts with ‘b’ then have even length.
34. L = $(01)^n(11)^m$, n>=1, m>=1
35. L = a^ib^j, i>=2, j>=3
36. ∑ = {a, b, c} where every string contains any number of a’s followed by any number of b’s followed by any number of c’s.
37. ∑ = {a, b, c} and last symbol appears somewhere earlier in the string. E.g. abcac is accepted while abac is rejected.
38. ∑ = {0, 1} and All Strings in the Language do not contain 000 as substring.
39. ∑ = {0, 1} and each string starts with 00 or end with 00
40. ∑ = {0, 1} and each string starts with 00 and end with 00
41. Write R.E. for language containing strings of a’s & b’s not containing ‘ab’ as substring.
42. Write R.E. for language containing strings w of a’s & b’s where |w| mod 3 =2
43. Write R.E. for language containing strings of a’s & b’s with length multiple of 3.
44. Write R.E. for language containing strings of a’s & b’s with even length.
45. Write R.E. for language containing strings of a’s & b’s with odd length.
46. Write R.E. for language containing strings of a’s & b’s with length exactly 2
47. Write R.E. for language containing strings of a’s & b’s with length atleast 2
48. Write R.E. for language containing strings of a’s & b’s with length atmost 2.
49. Regular expression for language L= a^nb^m over ∑= {a, b}, with even number of a’s followed by odd number of b’s.
50. Regular expression over ∑= {0, 1} and 3rd symbol from right end is 1.
51. L= {w: w Є (0/1)* and there are strings that begins and ends with 00 or 11.
52. L= {w: w Є (0/1)* and there are strings that begins or ends with 00 or 11.
53. L= $a^mb^nc^p$ where m, n, p>=1
54. L=$a^mb^{2n}c^{3p}$ where m, n, p>=1
55. L = {w | w ϵ 0^n1^m and n + m is even}

TOPIC: REGULAR EXPRESSIONS

Write Regular Expression for following languages:

1. **∑ = {0, 1} and String in the Language ends with 1**

Sol: (0+1)*1

2. **∑ = {0, 1, 2} and String in the Language ends with 010**

Sol: (0+1+2)*010

3. **∑ = {a, b} and All Strings in the Language contain exactly three b's.**

Sol: a*ba*ba*ba*

4. **∑ = {0, 1} and All Strings in the Language starts and ends with different symbols.**

Sol: 0 (0+1)* 1 + 1(0+1)*0

5. **∑ = {0, 1} and All Strings in the Language starts and ends with same symbols**

Sol: 0(0+1)*0 + 1(0+1)*1 + 0 + 1 + ϵ

6. **∑ = {0, 1} and All Strings in the Language starts with 01 or ends with 01**

Sol: 01(0+1)* + (0+1)*01

7. **∑ = {a, b, c} and All Strings in the Language contain exactly three b's.**

Sol: (a + c)*b (a + c)*b (a + c)*b (a + c)*

8. **∑ = {a, b} and All Strings in the Language contain at least three b's.**

Sol: a* b a* b a* b (a + b)* or (a + b)* b (a + b)* b (a + b)* b (a + b)*

9. **∑ = {0, 1, 2} and All Strings in the Language contain at least three 1's.**

Sol: (0 + 2)* 1 (0 + 2)* 1 (0 + 2)* 1 (0 + 1 + 2)*

Or (0 + 1 + 2)* 1 (0 + 1 + 2)* 1 (0 + 1 + 2)* 1 (0 + 1 + 2)*

10. **∑ = {0, 1} and All Strings in the Language contain at most three 1's.**

Sol: 0* + 0* 1 0* + 0* 1 0* 1 0* + 0* 1 0* 1 0* 1 0*

11. **∑ = {0, 1, 2} and All Strings in the Language contain at most three 1's**

Sol: (0 + 2)* + (0 + 2)* 1 (0 + 2)* + (0 + 2)* 1 (0 + 2)* 1 (0 + 2)* + (0 + 2)* 1 (0 + 2)* 1 (0 + 2)* 1 (0+2)*

12. **∑ = {0, 1} and All Strings in the Language contain 00 or 11 as substring.**

Sol: (0 + 1)* (00 + 11) (0 + 1)*

13. **∑ = {0, 1} and All Strings in the Language contain both 00 and 11 as substring.**

Sol: (0 + 1)* 00 (0 + 1)* 11 (0 + 1)* + (0 + 1)* 11 (0 + 1)* 00 (0 + 1)*

14. **∑ = {a, b} and String in the Language contain 'aa' as substring.**

Sol: (a + b) * aa (a + b)*

15. ∑ = {0, 1} and All Strings in the Language end with 00.

Sol: (0 + 1)* 00

16. ∑ = {0, 1} and All Strings in the Language does not end with 00.

Sol: (0 + 1)* (1 + 10) + 0 + ϵ

17. ∑ = {0, 1} and All Strings in the Language do not contain 00 as substring.

Sol: (1 + 01)*(0 + ϵ)

Or (0 + ϵ) (1 + 10)*

18. ∑ = {0, 1, 2} and All Strings in the Language do not contain 00 as substring.

Sol: (1 + 2 + 01 + 02)*(0 + ϵ) or (0 + ϵ) (1 + 2 + 10 + 12)*

19. ∑ = {0, 1} and All Strings in the Language contain exactly one pair of 0's

Sol: (1 + 01)* 00 (1 + 10)*

20. ∑ = {0, 1, 2} and All Strings in the Language contain exactly one pair of 1's

Sol: (0 + 2 + 10 + 12)* 11 (0 + 2 + 01 + 21)*

21. ∑ = {0, 1} and All Strings in the Language contain at most one pair of 0's.

Sol: (1 + 01)*(0 + ϵ) + (1 + 01)* 00 (1 + 10)*

22. ∑ = {0, 1} and All Strings in the Language contain at most one pair of 0's and at most one pair of 1's

Sol: Case 1: No pair of 0's or 1's r1 = (1+ϵ) (01)* (0 + ϵ)

Case 2: No pair of 0's but one pair of 1's r2= (0 + ϵ) (10)*11 (01)*(0 + ϵ)

Case 3: One pair of 0's but No pair of 1's r3 = (1 + ϵ) (01)*00 (10)*(1 + ϵ)

Case 4: one pair of 0's and pair of 1's r4 = (1 + ϵ) (01)*00 (10)* 11(01)*(0 + ϵ) + (0 + ϵ) (10)*11 (01)* 00(10)*(1 + ϵ)

RE = r1 + r2 + r3 + r4

23. ∑ = {0, 1} and All Strings in the Language neither contain 00 nor 11 as substring.

Sol: (1+ϵ) (01)* (0 + ϵ)

24. ∑ = {0, 1} and All Strings in the Language neither contain 00 nor 11 as substring.

Sol: (1 + ϵ) (01)*(0 + ϵ)

25. ∑ = {0, 1} and in each string there are at least two 1's between every pair of 0's.

Sol:(1 + 011)*(ϵ + 0 + 01)

26. ∑ = {0, 1} and there are equal number of 0's and 1's in every string, in any prefix number of 0's differs from number of 1's by at most 1 and vice versa.

Sol: (01 + 10)*

27. ∑ = {0, 1} and string starts with 01 or ends with 01

Sol: 01 (0 + 1)* + (0 +1) *01

28. ∑ = {0, 1} and there are even number of 0's and even no of 1's.

Sol: (00 + 11 + (01 + 10) (00 + 11)* (01 + 10))*

29. ∑ = {a, b} and string starts with a and has even length.

Sol: a (a + b) ((a + b) (a + b))*

30. ∑ = {a, b} and string starts with b and have odd length.

Sol: b ((a + b) (a + b))*

31. ∑ = {a, b} and string ends with a and have even length.

Sol: ((a + b)(a + b))* (a + b) a

32. ∑ = {a, b} and string ends with b and have odd length.

Sol: ((a + b)(a + b))* b

33. ∑ = {a, b} and if string starts with 'a' have odd length, and if it starts with 'b' then have even length.

Sol: a ((a + b) (a + b))* + b (a + b) ((a + b) (a + b))*

34. L = $(01)^n(11)^m$, n>=1, m>=1

Sol: 01(01)*(11)*11

35. L = a^ib^j, i>=2, j>=3

Sol: aaa*bbbb*

36. ∑ = {a, b, c} where every string contains any number of a's followed by any number of b's followed by any number of c's.

Sol: a*b*c*

37. ∑ = {a, b, c} and last symbol appears somewhere earlier in the string. E.g. abcac is accepted while abac is rejected.

Sol: (a + b + c)* (a (a + b + c)* a + b (a + b + c)* b + c (a + b + c)* c)

38. ∑ = {0, 1} and All Strings in the Language do not contain 000 as substring.

Sol: (1 + 01 + 001)* (00 + 0 + ϵ)

39. ∑ = {0, 1} and each string starts with 00 or end with 00

Sol: 00 (0 + 1)* + (0 +1)*00

40. ∑ = {0, 1} and each string starts with 00 and end with 00

Sol: 00 (0 + 1)* 00 + 000

41. Write R.E. for language containing strings of a's & b's not containing 'ab' as substring.

Sol: b*a*

42. Write R.E. for language containing strings w of a's & b's where |w| mod 3 =2

Sol: ((a + b)(a + b)(a + b)) * (a + b) (a + b)

43. Write R.E. for language containing strings of a's & b's with length multiple of 3.

Sol: $((a + b)^3)^*$

44. Write R.E. for language containing strings of a's & b's with even length.

Sol: ((a + b)(a + b)) *

45. Write R.E. for language containing strings of a's & b's with odd length.

Sol: ((a + b)(a + b)) * (a + b)

46. Write R.E. for language containing strings of a's & b's with length exactly 2

Sol: (a + b) (a + b)

47. Write R.E. for language containing strings of a's & b's with length at least 2

Sol: (a + b) (a + b)(a + b)*

48. Write R.E. for language containing strings of a's & b's with length atmost 2.

Sol: (Є + a + b) (Є + a + b)

49. Regular expression for language L= $a^n b^m$ over ∑= {a, b}, with even number of a's followed by odd number of b's.

Sol: (aa)*(bb)*b

50. Regular expression over ∑= {0, 1} and 3rd symbol from right end is 1.

Sol: (0 + 1)* 1 (0 + 1) (0 + 1)

51. L= {w: w Є (0/1)* and there are strings that begins and ends with 00 or 11.

Sol: 00 (0 + 1)* 00 + 11 (0 + 1)* 11

52. L= {w: w Є (0/1)* and there are strings that begins or ends with 00 or 11.

Sol: 00 (0 + 1)* + (0 + 1)*00 + 11 (0 + 1)* + (0 + 1)* 11

53. L= $a^m b^n c^p$ where m, n, p>=1

Sol: aa*bb*cc*

54. L=$a^m b^{2n} c^{3p}$ where m, n, p>=1

Sol: aa*bb(bb)*ccc(ccc)*

55. L = {w | w ϵ $0^n 1^m$ and n + m is even}

Sol: (00)*(11)* + 0(00)*(11)*1 {either both are even or both are odd}

56. L = {w | w ϵ $0^n 1^m$ and n + m is odd}

Sol: (00)*(11)*1 + 0(00)*(11)* {even 0's with odd 1's or Odd 0's with even 1's}