



4.4.2.3 Regular Expressions

1) A regular expression is a way of describing a set.

a) Write down two different regular expressions that describe the set {a, ab}.

[2 marks]

- **a | ab;**
- **ab?;**

b) Explain the functionality of the | (vertical bar) metacharacter when it is used in a regular expression.

[1 mark]

- **It means either the element (immediately) before or the element (immediately) after // alternation;**

Figure 1 shows sets **S** and **T**. Three dots (...) means the remaining members of the set follow the same pattern as the previous members of the set..

Figure 1

S = {a, abb, abbbb, abbbbbb, ...}

T = {bb, bbbb, bbbbbb, ...}

The members of the set **V** are strings that match the regular expression **a?b+**

Set **W** is formed by the union of sets **S** and **T**.

Set **X** is formed by the set operation **V – W**.

c) Write a regular expression that would match with all the members of the set **W**.

[2 marks]

- **a(bb)*|(bb)+ // a|a?(bb)+ // (a|bb)(bb)***

d) Write a regular expression that would match with all the members of the set **X**

[2 marks]

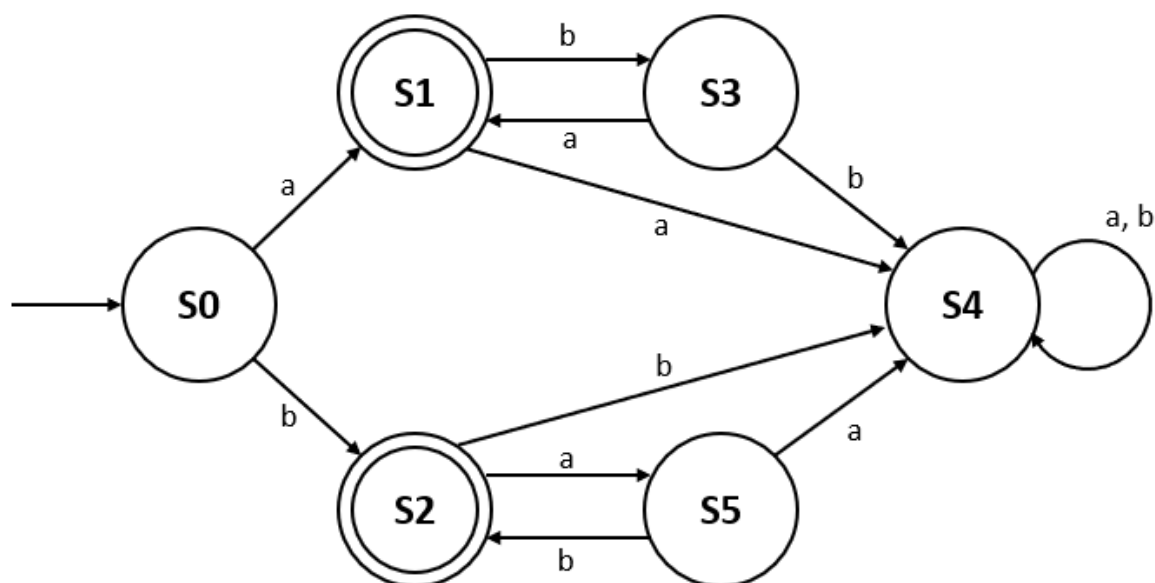
- **(ab|b)(bb)* // a?b(bb)***





2) The state transition diagram for a finite state machine (FSM) is shown in **Figure 2**.

Figure 2



a) Regular expressions can be used to recognise the same strings as FSMs without output.

Write a regular expression that will recognise the same set of strings that are accepted by the FSM shown in **Figure 2**.

[3 marks]

- $a(ba)^* | b(ab)^*$
- `// (a(ba)*)|(b(ab)*)`
- `// b(ab)* | a(ba)*`
- `// (b(ab)*)| (a(ba)*)`
- `// a|b|b(ab)+| a(ba)+`

b) Explain the functionality of the * metacharacter when it is used in a regular expression.

[1 mark]

- **Zero or more of the preceding value**

c) Explain the functionality of the ? metacharacter when it is used in a regular expression.

[1 mark]

- **Zero or one of the preceding value**





- d) Complete **Table 1** to show which of the strings belong to the language defined by the regular expression $1|01^+$.

Table 1

String	Belongs to language (Y/N)?
1	Y
11	N
01	Y
0111	Y
0101	N
111	N
0011	N

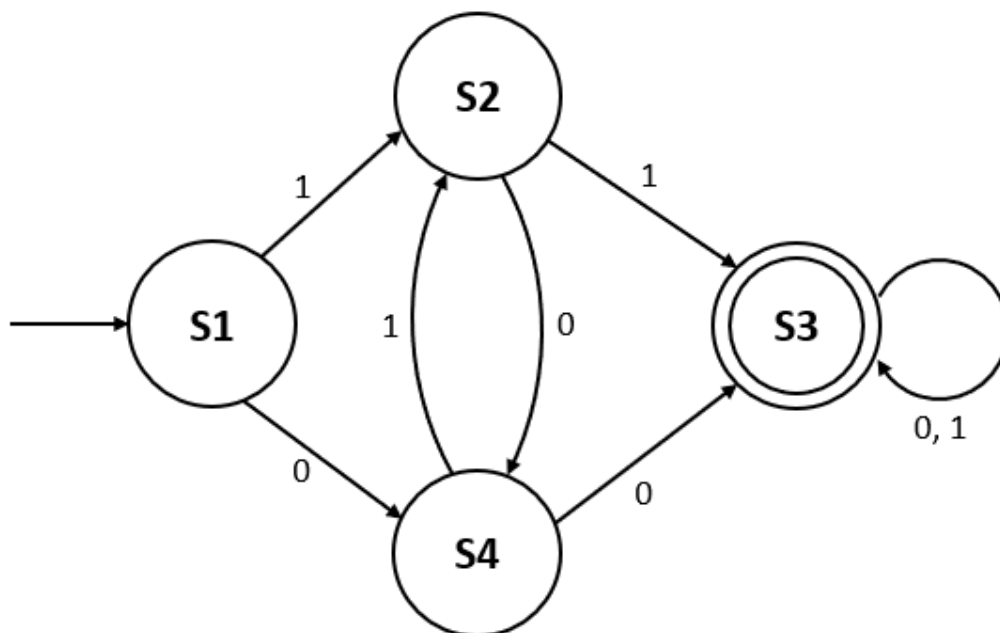
[3 marks]





- 3) A finite state machine (FSM) can be used to define a language: a string is allowed in a language if it is accepted by the FSM that represents the rules of the language. **Figure 3** shows the state transition diagram for an FSM.

Figure 3



Write a regular expression that will recognise the same set of strings that are accepted by the FSM shown in **Figure 3**.

[3 marks]

- $(0|1)^*((00)|(11))(0|1)^*$
- // $(0|1)^*(11(0|1)^*)((00(0|1)^*))$

