**Theory of Computation**

**UE18CS254**

**Assignment -1**

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**Semester-Section: 4-A**

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**1.**

NFA of the given problem.’

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| State | a | b |
| ->\*{q0, q1, q4, q5} q0 | \*{q3, q4, q5} | {q6} |
| \*{q2, q4, q5} q1 | \*{q4, q5} | {q6, q4} |
| {q6} q2 | \*{q5} | { } |
| \*{q4, q5} q3 | \*{q4, q5} | { } |
| {q6, q3} q4 | \*{q5} | \*{q1} |
| \*{q5} q5 | { } | {q6} |
| \*{q1} q6 | {q2} | { } |
| {q2} q7 | { } | {q3} |
| {q3} q8 | { } | \*{q1} |

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Converted from NFA to DFA. The labels indicate the state numbers of NFA (i.e. in q0 the label is 0,1,4,5 indicates the NFA states.)

**2.**

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The above is the DFA representation of the problem, the labels represent the total amount up to that state. (i.e. In state q10 the label indicates the total amount up to that state is Rs.11).

**3.**

**(i)** The representation indicates that for the state qs, there is a self-loop transition for all symbols in the language (set of symbols/alphabets).

**(ii)** The given representation **isn’t a DFA** since there is a self-loop for all symbols and since there is another transition from qs to another state (i.e. Final State qf) thereby two states for few symbols due to which there are two states that can be taken. Hence this is an **NFA.**

**4.**

**(i)**

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**(ii)**

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**5.**

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By observation we can conclude the regular expression:

**(**1+. 0\*. 1+) \* + (0+. 1\*. 0+) \*

**7.**

**(a)**

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| --- | --- | --- | --- |
| q1 | x |  |  |
| q2 | x | x |  |
| q3\* | x | x | x |
| States | q0 | q1 | q2 |

Final states – q3

Non-Final States – q1, q2

Every pair between them is distinguishable

States q2 and q0 are distinguishable since:

transition (q2, b) -> q3(final state) and transition (q0, b)-> {}

States q2 and q1 are distinguishable since:

transition (q2, b) -> q3(final state) and transition (q1, b)-> {}

States q1 and q0 are distinguishable since:

transition (q1, a)->q2 and transition (q0, a)->q1 then after the new acquired states we realize that q2 will reach final state while q1 wont.

Hence the above DFA is the minimal form DFA.

**(b)**

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| --- | --- | --- | --- | --- | --- |
| q1 | X |  |  |  |  |
| q2\* | X | X |  |  |  |
| q3\* | X | X | X |  |  |
| q4\* | X | X | X | X |  |
| q5 | X | X | X | X | X |
| States | q0 | q1 | q2\* | q3\* | q4\* |

Final States – q2, q3, q4

Non-Final States – q0, q1, q5

Every pair between them is distinguishable

States q5 and q0 are distinguishable since:

q5(a) -> q4(final state) and q0(a)->q1(non-final state)

Similarly, for q5 and q1.

States q4 and a2 are distinguishable since transition (q4, b) -> {} and

transition (q2, b)->q5(non-final state).

Similarly, for all the other pairs.

Hence the above DFA is the minimal form DFA.

**(c)**

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| --- | --- | --- | --- | --- |
| q1\* | X |  |  |  |
| q2\* | X | X |  |  |
| q3 | X | X | X |  |
| q4\* | X | X | X | X |
| States | q0\* | q1\* | q2\* | q3 |

Non-Final States – q3

Final States – q0, q1, q2, q4

Every pair between them is distinguishable

State transition (q4, a) -> q4 and transition (q0, a) -> q1 and again

transition (q4, a) -> q4 and transition (q0, a) -> q2 and again

transition (q4, a) -> q4(final state) and transition (q0, a) -> q3(non-final state) which is a non-final state. Hence, they both are distinguishable.

Similarly, if we follow the similar pattern for rest of the state elements transitions, we see that they are distinguishable.

Hence the above DFA is the minimal form DFA.

**8.**

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DFA to accept strings with even number of a’s and odd number of b’s.

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Complete GTG

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After Removing one state (q1)

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After eliminating q2.

After using the generalized formula, the regular expression is:

((aa+ab(bb)\*ba)\*(b+ab(bb)\*a)(a(bb)\*a)\*(b+a(bb)\*ba))\*(aa+ab(bb)\*ba)\*(b+ab(bb)\*a)(a(bb)\*a)\*