BITS, Pilani- K K Birla Goa Campus

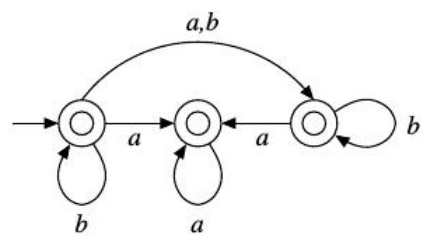
Course: CS F351	**Mid Semester Examination Marks: 60**	Date: 01/10/2019
Theory of Computation	**Weightage:** 30% **Mode:** Closed Book	Duration: 120 min

Note: No marks will be given if the justification for your answer is not provided.

1. (a) Let L_1 be the regular language of the regular expression $a^*b^* + b^*a^*$. Give an example of a string $\{a, b\}$ which is not in L_1. **[2]**

   (b) Design a DFA which accepts L_1 (You may consider any method). **[8]**

2. Consider the following NFA (over the alphabet $\{a, b\}$)



   (a) What is the shortest string *not* accepted by this NFA? **[2]**

   (b) Let L_1 denote the set of all strings not accepted by this NFA. Write a regular expression for L_1. **[3]**

   (c) Convert the regular expression of Part (b) to an equivalent NFA. **[5]**

3. Let L_1 and L_2 be regular languages over the alphabet Σ. Define the language $L_3 = \{\alpha\beta\gamma \mid \alpha\gamma \in L_1, \beta \in L_2\}$, that is, L_3 is obtained by inserting strings in L_2 inside strings in L_1. Prove that L_3 is regular too. **[10]**

4. Using Pumping Lemma prove that $L = \{w : w = w^R, w \in \{0, 1\}^*\}$ is not regular (This is the language of binary palindromes). Where w^R denotes the reverse of the string w. **[10]**

5. Let α be a string (over some alphabet Σ). By odd(α), we refer to the string obtained by deleting symbols at all even positions of α. That is, if $\alpha = a_1a_2a_3 \dots a_n$, then odd($\alpha$) $=a_1a_3a_5 \dots a_{n'}$, where "n'" is n or $n-1$ according as whether n is odd or even. For a language$L \subseteq \Sigma^*$, define odd(L) $=\{odd(\alpha) \mid \alpha \in L\}$. Prove that if L is regular, then odd(L)is regular too. **[10]**

6. (a) Give an example of a non-regular language L for which the asterate L^* is regular. **[4]**

   (b) Suppose that L_1 and L_2 are two languages (over the same alphabet) given to you such that both L_1 and L_1L_2 are regular. Prove or disprove: L_2 must be regular too. **[6]**

END