Department of Computer Science and Engineering
University of Barishal
Final Examination
3rd Year 2nd Semester, Session: 2020-21

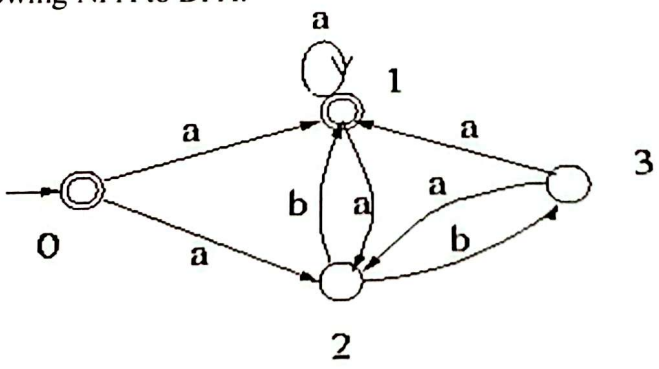
Course Code: CSE-3203 **Course Title: Theory of Computation**
Total time: 3.00 hours **Total marks: 60.0**

(Note: Answer any five set of questions from the followings)

1. a) Define a Turing Machine and explain a pushdown automaton. 1+3
   b) Show that any language recognized by a multitape Turing machine is recursively enumerable. 6
   c) What do you know about context-free grammar's? 2

2. a) Provide definitions and examples for the following terms: 2+2+2
   i) Alphabet, ii) String, and iii) language
   b) Give a regular expression for the following language B over the alphabet {a, b}. 4
   B = {w | w does not contain the substring aaa}.
   c) Under what circumstances is an expression referred to as a regular expression? 2

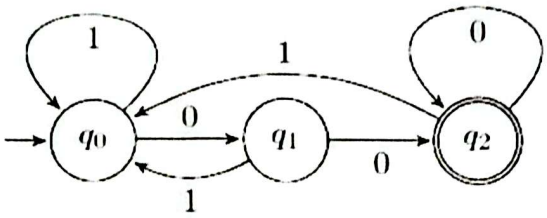
3. a) Use the pumping lemma to prove that the language $A = \{ 0^{2n} 1^{3n} 0^{n} \mid n \geq 0 \}$ is not context free. 5
   b) Convert the following NFA to DFA. 4



   c) State the Pumping Lemma for regular languages. 3

4. a) Summarize the principal closure properties for regular languages. 3
   b) Convert DFA's to regular expressions by eliminating states. 5
   c) Prove that if L is a regular language over alphabet Σ, then $\bar{L} = \Sigma^* - L$ is also a regular language. 4

5. a) Construct a context-free grammar for the following DFA: 5



b) Show that the grammar ({S}, {a, b}, R, S) with rules R = S → aS | aSbS | ϵ is ambiguous. 4

c) Explain inverse homomorphism. 3

6. a) Explain in detail the three types of operations on languages that are represented by regular expression operations. 4

b) Prove that if we add a finite set of strings to a regular language, the result is a regular language. 5

c) Write the closure properties of regular languages. 3

7. a) Prove that the following are not regular languages: 2+2

(i) The set of strings of 0′s and 1′s beginning with 1, such that when interpreted as an integer, that integer is a prime.

(ii) The set of strings of the form 0 *i*1 *j* such that the greatest common divisor of i and j is 1.

b) State the properties of a parse tree. Construct a parse tree for the following string: 4

$$S \rightarrow S\,S+ \mid S\,S* \mid a$$

c) Prove that every language defined by a regular expression is also defined by a finite automaton. 4

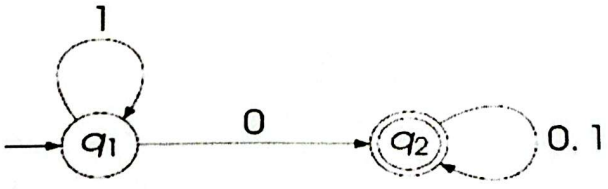
8. a) State formal definition of the finite automata. Give an example. 4

b) Consider the regular expression (a(cd)*b)* . 2+2

(i) Find a string over {a, b, c, d}^{4} which matches the expression.

(ii) Find a string over {a, b, c, d}^{4} which does not match the expression.

c) Transform the following NFA to the ∈-NFA: 4



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