Jahangirnagar University
Department of Computer Science and Engineering
3rd Year 1st Semester B.Sc. (Hons.) Final Examination -2020

Course Title: ***Theory of Computation*** Course No: **CSE-309**
Time: **45 Minutes**. Full Marks: **10**

Section-A

[There are 3(**Three**) questions. Answer any 2(**Two**) questions. Figures in the right margin indicate marks.]

1. a) Given $\sum = \{0,1\}$, now ***illustrate*** the state diagram of DFAs that recognize the following languages. 2.5
   i. $\{w|\ w\ contains\ the\ substring\ 0101\}$
   ii. $\{w|\ w\ begins\ with\ 0\ and\ ends\ with\ 1\}$
   iii. $\{w|\ the\ length\ of\ w\ is\ at\ most\ 5\}$
   iv. $\{w|\ w\ contains\ an\ even\ number\ of\ 1's, or\ contains\ exactly\ two\ 0's\}$
   v. $\{w|w\ any\ string\ that\ does\ not\ contain\ exactly\ two\ 0's\}$

   b) Using the pumping lemma ***demonstrate*** that, the following languages are not regular. 2.5
   i. $L_1 = \{a^n b^n c^n | n \geq 0\}$
   ii. $L_2 = \{ww^R | w \in \{x, y\}^*\}$

   c) Professor *Xavier* is working on a Natural Language Processing (NLP) project. The corpus of the project is constructed over the alphabet set $\sum = \{a, b\}$, and each word of the corpus starts and ends with the same character. For preprocessing the corpus *Xavier* needs a regular expression. As *Xavier* is a busy person so he is seeking your help to solve his problem. Now, help Professor *Xavier* by answering the followings: 2.5
   i. ***Illustrate*** the DFA that recognize each word of the corpus.
   ii. ***Construct*** the equivalent regular expression of the above DFA.

Section-B

[There are 2(**Two**) questions. Answer any 1(**One**) question. Figures in the right margin indicate marks.]

2. a) Based on the context free grammar G, answer each of the following questions.

$$P \rightarrow YQY \mid S$$
$$S \rightarrow bTa \mid aTb$$
$$T \rightarrow YTY \mid Y \mid \varepsilon$$
$$Y \rightarrow a \mid b$$

i. ***Identify*** the variables and terminals of G. 1

ii. ***Diagram*** the equivalent PDA of G. 3

iii. ***Distinguish*** between CFG and PDA. 1

b) **Design** a Turing machine M that decides A = $\{a^{2^n} \mid n \geq 2\}$, the language consisting of all strings of $a's$ whose length is a power of 2. 5

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