Department of Computer Science & Engineering

University of Asia Pacific (UAP)

Program: B.Sc. in Computer Science and Engineering

Final Examination	**Spring 2020**	**3rd Year 1st Semester**
Course Code: CSE 307	**Course Title: Theory of Computation**	**Credits: 3**
Full Marks: 120* (Written)		**Duration: 2 Hours**

* Total Marks of Final Examination: 150 (Written: 120 + Viva: 30)

Instructions:
1. There are **Four (4)** Questions. Answer all of them. All questions are of equal value. Part marks are shown in the margins.
2. Non-programmable calculators are allowed.
3. *Use your own name, id in the answer script whenever required as instructed in the classroom.*

1. a) Let, my name is *nadeem ahmed*. The first letter of first and last names are: <u>n</u> and <u>a</u>.   15

Design a Turing Machine for the following expression:
$$L = n^n a^{2n} \text{ where } n>0$$

b) Suppose, my name is *nadeem ahmed*. The first letter of last name is: <u>n</u>. Then length of my last name is: 5 which is an **odd number**. (it might be even number in your case, then you have to design for even number)   15

Design a Turing Machine for the following expression:
$$L = a^n \text{, } \textbf{here superscript n is 1,3,5,7, … … odd number.}$$

2. a) If my name is <u>**a**</u>bul <u>**b**</u>ashar. (Take first two letters of both first and last names).   12 + 12

Design Pushdown Automata (PDA) that recognizes
i) $\{a^n b^n \mid n>0\}$

ii) $\{w \in \{0, 1\}^* \mid w$ contains at least **(the length of your first name)** 1's $\}$

b) Let $\sum$ = {the letters/symbols of your own name}   6

Suppose you want to construct the following language:

"The set of all strings that either start with *your first name* or *last name*."

i) Write a regular expression for this language.

ii) Draw a corresponding NFA.

3. **a)** If my name is **S̲hah A̲bu B̲akar**.   24

Begin with the grammar:	Begin with the grammar:
S → ASA | aB A → B | S B → b | ε	(fn cl) → (mn cl)(fn cl)(mn cl) | (mn sl)(ln cl) (mn cl) → (ln cl) | (fn cl) (ln cl) → (ln sl) | ε fn = first name, mn = middle name, ln = last name cl = capital letter, sl = small letter

  i)   Eliminate ε-productions.
  ii)   Eliminate any unit productions in the resulting grammar.
  iii) Eliminate any useless symbols in the resulting grammar.
  iv)   Put the resulting grammar into Chomsky Normal Form.

b) Suppose, my name is *nadeem ahmed*. The first letter of first and last names are: n̲ and   6
a̲.

Write a context-free grammar for the following languages:
  $L = n^n a^{2n}$

4. **a)**
Let Σ = {the letters/symbols of your own name}   15

Suppose you want to construct the following language:

  "The set of all strings that accept any string of *your first name length* but will not

accept your name as a string."

  Draw a corresponding NFA.

b) What is the purpose of the *pumping lemma* in case of regular language? Use the   15
pumping lemma to show that $\{a^p b^q c^r \mid n>0\}$ is not regular. Here p, q, r is the respective
length of your own first, middle and last name.

OR

Please turn over

a) Suppose, my id is 14101010. First two digits (14) stand for admission year 2014, then next digit (1) stand for Spring semester (i.e. 2 stands for Fall semester), then 01 which stands CSE department (0x indicates another department), and last three digits (010) stands for my class roll.   15

Now, write your own id and then write a regular expression for all the id(s) of your class. Please note:

- Year is same as your current admission year including last two previous years (i.e. in this scenario admission years are: 2014, 2013, 2012).
- It includes **only the semester** where you belong.
- The range of class roll is 001 to 999. **But** 005, 015, 025 … 995 cannot belong to this group. These class roll numbers have different purpose and cannot be used as student id(s).

b) What is the purpose of the *pumping lemma* in case of regular language? Use the *pumping lemma* to show that $\{0^n \mid n$ is the multiple of your first name length$\}$ is not regular.   15