Department of Computer Science & Engineering

University of Asia Pacific (UAP)

Program: B.Sc. in Computer Science and Engineering

Final Examination	**Fall 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.*

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

Design a Turing Machine for the following expression:
   $L = (n(Blank)a)^n$ where n>0
i.e., it looks in the tape:

B	B	B	B	n	B	a	n	B	a	n	B	a	B	B	B	B	B

(in the above, the example is given for n = 3 for your understanding where 'B' stands for a Blank)

b) Suppose, my name is **n**adeem **a**hmed. `15`

Design a Turing Machine for the following expression:
   $L = na^+n$

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

Design Pushdown Automata (PDA) that recognizes `12`
   i) $\{a^n b^{n+2} \mid n > 0\}$

   ii) $\{w \in \{0, 1\}^* \mid w$ contains **at most (<u>the length of your first name</u>)** 1's $\}$ `12`

2. **b)** Let Σ = {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: (fn cl) → (mn cl)(mn cl)(mn cl) | (ln cl) (mn cl) → (mn sl) (mn cl) | (ln cl) (ln cl) → ϵ
$S \rightarrow AAA \mid B$ $A \rightarrow aA \mid B$ $B \rightarrow \epsilon$	
	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 **n**adeem **a**hmed. The first letter of first and last names are: n̲ 6
and a̲.

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

4. **a)** Write a regular expression for a class **B** IP address. Class **B** IP address range is 15
[128.0.0.0 to 191.255.255.255]

b) What is the purpose of the *pumping lemma* in case of regular language? Use the 15
pumping lemma to show that $\{a^{p+1}b^{q+2} \mid n > 0\}$ is not regular. Here p, q is the respective
length of your own first and last name.

OR

Please turn over

a) Write a regular expression for a class E IP address. Class E IP address range is [240.0.0.0 to 255.255.255.255]   15

b) What is the purpose of the *pumping lemma* in case of regular language? Use the *pumping lemma* to show that $\{0^n1^{2n} \mid n \text{ is the multiple of your first name length}\}$ is not regular.   15