

Department of Computer Science & Engineering
University of Asia Pacific (UAP)

Program: B.Sc. in Computer Science and Engineering

Final Examination

Spring 2021

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 **nisha amin**. The first letter of first name and last name are: n and a. 15

Design a Turing Machine for the following expression:

$$L = (n(\text{Blank})(\text{Blank})a)^p \text{ where } p > 0$$

i.e., it looks in the tape:

↓

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

- b) Suppose, my name is **nadia akter**. 15

Design a Turing Machine for the following expression:

$$L = a^*n$$

2. a) If my name is **atia boshir**. (Take first two letters of both first and last names). 12

Design Pushdown Automata (PDA) that recognizes

i) $\{a^{2n}b^{3n} \mid n \geq 0\}$

- ii) $\{w \in \{0, 1\}^* \mid w \text{ contains at least } \underline{\text{(the length of your last name)}} \text{ 0's including empty string}\}$ 12

2. b) Suppose my name is **bijon ray**.

3+3
=6

Then, $\Sigma = \{\text{the letters/symbols of my name}\}$

You have to construct the following language using your own name:

“The set of all strings having a substring of your last name (**‘ray’** for this example)

- i) Write the regular expression for this language.
- ii) Draw the corresponding NFA.

3. a) If my name is **Shah Abu Bakar**.

6*4
=24

Begin with the grammar: $S \rightarrow ASA \mid aB$ $A \rightarrow B \mid S$ $B \rightarrow b \mid \epsilon$	Begin with the grammar: $(fn\ cl) \rightarrow (mn\ cl)(fn\ cl)(mn\ cl) \mid (mn\ sl)(ln\ cl)$ $(mn\ cl) \rightarrow (ln\ cl) \mid (fn\ cl)$ $(ln\ cl) \rightarrow (ln\ sl) \mid \epsilon$ fn = first name, mn = middle name, ln = last name cl = capital letter, sl = small letter
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- 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) What is an ambiguous grammar? Let my name is **ahmed baki**. The first letter of first and last names are: a and b.

6

Prove that below grammar is an ambiguous.

$A \rightarrow A b A$
 $A \rightarrow a$

(Hint: Try to find out a string and then prove the grammar is ambiguous).

4. a) Write a regular expression for a class **C** IP address. Class **C** IP address range is [192.0. 0.0 to 223.255. 255.0]

15

- b) What is the purpose of the *pumping lemma* in case of regular language?
 Let my name is **ahmed baki**. The first letter of first and last names are: a and b.
 Use the *pumping lemma* to show that $\{a^p b^q \mid p, q > 0\}$ is not regular.

15

OR

Please turn over

- a) Write a regular expression for a class A IP address. Class A IP address range is [0.0.0.0 to 127.255.255.255] 15
- b) What is the purpose of the *pumping lemma* in case of regular language? 15
Let my name is **ahmed baki**. The first letter of first and last names are: a and b.
Use the *pumping lemma* to show that $\{a^n b^{2n} \mid n > 0\}$ is not regular.