**Department of Computer Science & Engineering**

**University of Asia Pacific (UAP)**

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| **Final Examination** | **Fall 2019** | **3rd Year 1st Semester** |

**Credits: 3**

**Course Title: Theory of Computing**

**Course Code: CSE 307**

**Duration: 3 Hours**

**Full Marks: 150**

**Instructions:**

1. There are **Eight (8)** Questions. Answer all 6 questions. All questions are of equal value. Part marks are shown in the margins.
2. Non-programmable calculators are allowed.

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| 1.a) | Write down the formal definition of Turing Machine. Describe each notation. | 10 |
| b) | Design a Turing Machine for the following expression:  L = 10n1n | 15 |
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| 2.a) | What is the relationship of Pushdown Automata (PDA) with Є-NFA? | 5 |
| b) | Design Pushdown Automata (PDA) that recognizes  i) {anbn | n>0}  ii) {w ∈ {0, 1}\* | w contains at least three 1s } | 20 |
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| 3.a) | Begin with the grammar:   |  | | --- | | S → ASA | aB  A → B | S  B → b | є |  1. Eliminate Є-productions. 2. Eliminate any unit productions in the resulting grammar. 3. Eliminate any useless symbols in the resulting grammar. 4. Put the resulting grammar into Chomsky Normal Form. | 25 |
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| 4.a) | What is Context-free language? Write Context-free grammars for the following languages:   1. All nonempty strings of ‘a’ and ‘b’ that start and end with the same symbol. 2. All strings in the language L = {anb2n, n ≥ 0} | 15 |
| b) | Consider the context-free grammar:    and the string (a + a) \* a.   1. Give a leftmost derivation for the string. 2. Give a rightmost derivation for the string. 3. Give a parse tree for the string | 10 |
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| 5.a) | Let L ={a, b}  Suppose you have constructed the following language:  “The set of all strings consisting of zero or more instances of a or b, and having a substring *bab*.”   1. Write the regular expression for this language. 2. Draw the corresponding NFA. 3. Show the transition table as well DFA diagram | 15 |
| b) | Give a formal description of the Pumping Lemma. Use the Pumping lemma to show that {anbncn | n>0} is not regular. | 10 |
|  | OR |  |
| 5.a) | Consider an NFA that accepts decimal numbers consisting of An optional + or - sign A string of digits A decimal point and       1. Find out the Є-closure for each state. 2. Convert it into DFA. 3. Construct the Transaction Table for the converted DFA. | 15 |
| b) | What is the purpose of the Pumping Lemma in case of regular language? Use the Pumping lemma to show that {0n | n is perfect square} is not regular. | 10 |
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| 6.a) | Minimize the following DFA using table construction algorithm. | 15 |
| b) | Write down the formal definition of Non-deterministic Finite Automata, and describe each notation. | 10 |
|  | OR |  |
| 6.a) | Minimize the following DFA using table construction algorithm. | 15 |
| b) | State the differences between:   1. NFA and Є-NFA 2. NFA and DFA | 10 |