UNIVERSITY OF COLOMBO, SRI LANKA
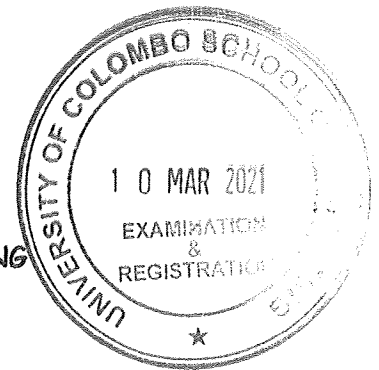
UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

Second Year Examination – Semester II – 2020/2021

SCS2212 – Automata Theory – (Part B)

TWO (2) HOURS (For both parts A & B)

To be completed by the candidate

Examination Index No: ....

Important Instructions to candidates:

1. The medium of instruction and question is **English**.
2. **Write your answers** in **English**.
3. If a page or a part of this question paper is not printed, please inform the supervisor immediately.
4. Note that questions appear on both sides of the paper. If a page is not printed, please inform the supervisor immediately.
5. Write your index number on each and every page of the Question paper.
6. Answer **ALL** questions.
7. This paper has **02** questions and **09** pages.
8. **Part A** of the paper will carry **60** marks and **Part B** of the paper will carry **40** marks.
9. Any electronic device capable of storing and retrieving text including electronic dictionaries and mobile phones are **not allowed**.
10. Calculators are **not allowed**.

For Examiner's use only	
Question No	**Marks**
3	
4	
Total	

Question 3

(a) Fill the blanks in the following statements with suitable words/phrases from the given list.

(5 Marks)

(i) Context-free languages are **not** closed under ....·..... or ....

(ii) .... grammars allow more than one symbol on the LHS of productions.

(iii) A context-free grammar is in ...., if every rule is of the form A → BC or A → a, where a is any terminal and A, B and C are non-terminals.

(iv) Any production of a context-free grammar of the form A → B where A, B ∈ V, is called a .... productions.

(v) A context-free grammar is said to be in .... if all productions have the form A → ax, where a ∈ T and x ∈ V*

List of words/phrases:
{ Context Free, Regular, Union, Unit, Context-Sensitive, Concatenation, Complement, Star-closure, Intersection, Greibach normal form, Chomsky normal form, Useless, Null}
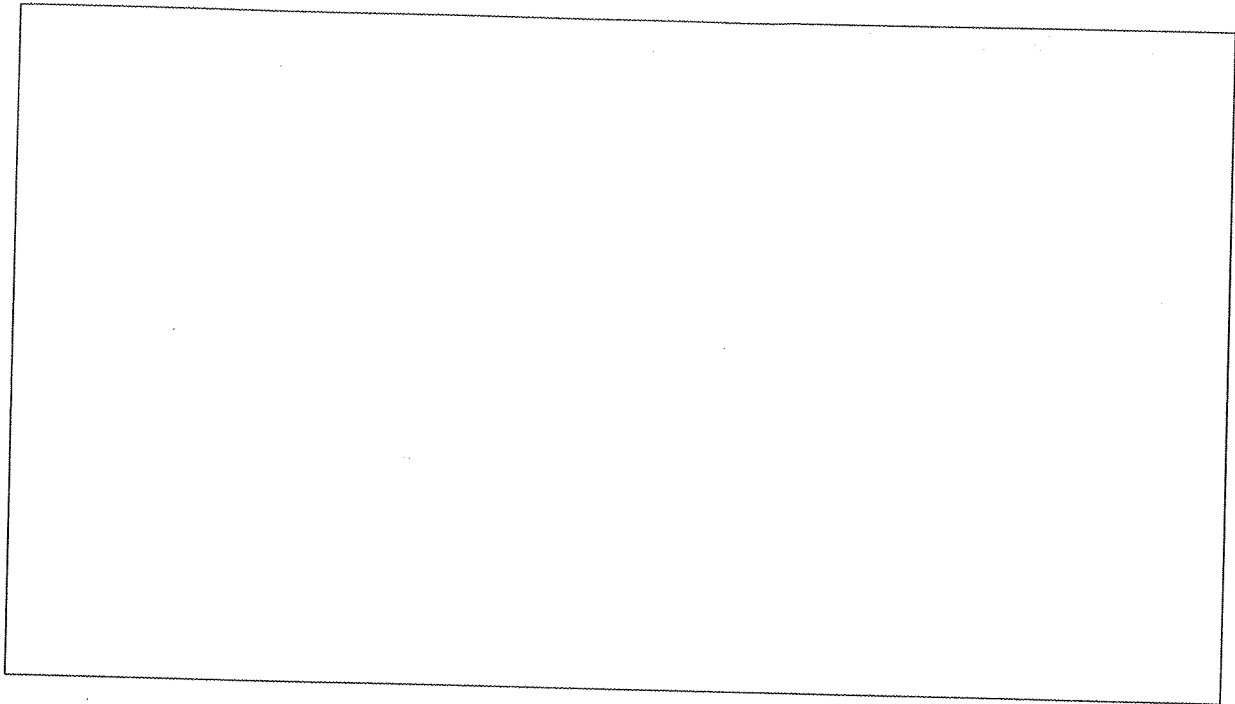
(b) Consider the following grammar with productions.

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S → ABb | b
A → aBa
B → A | λ
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(i) Write down the language generated from the above grammar.   **(2 Marks)**

(ii) Check whether the following strings can be accepted from the above grammar. Use left-most derivation to prove your answer.   **(2 Marks)**
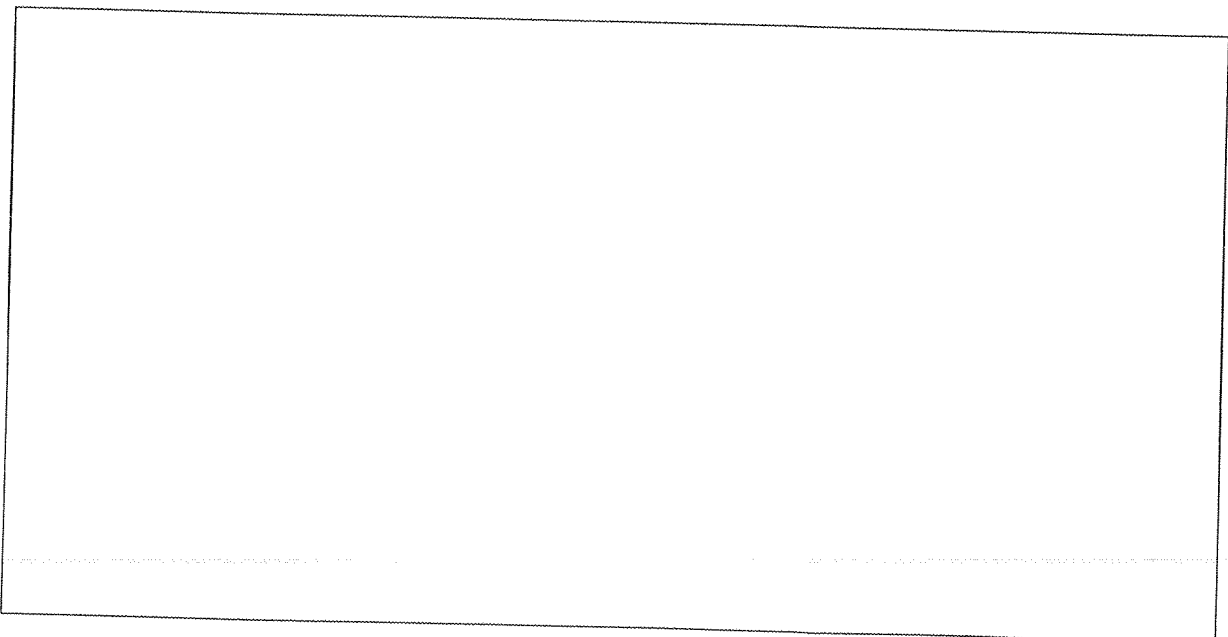
- aaabaaab
- aaaab

(c) Consider the following grammar.

<SEN>	→ <NP> <VP>		<A>	→ a | the
<NP>	→ <CP-N> | <CP-N> <PP>		<N>	→ boy | girl | flower
<VP>	→ <CP-V> | <CP-V> <PP>		<V>	→ presents | likes | sees
<PP>	→ <P> <CP-N>		<P>	→ with
<CP-N>	→ <A> <N>			
<CP-V>	→ <V> | <V> <NP>			

(CP-complex, N-noun, A- article, PP-prepositional phrase, V-verb, P - Preposition)

(i)   Draw a parse tree for the following sentence using the above grammar   (2 Marks)

the boy presents the girl with a flower

(ii)   Show that the above grammar is ambiguous by showing the above sentence has two different left-most derivations. (**Hint**: Use derivation trees)   **(3 Marks)**
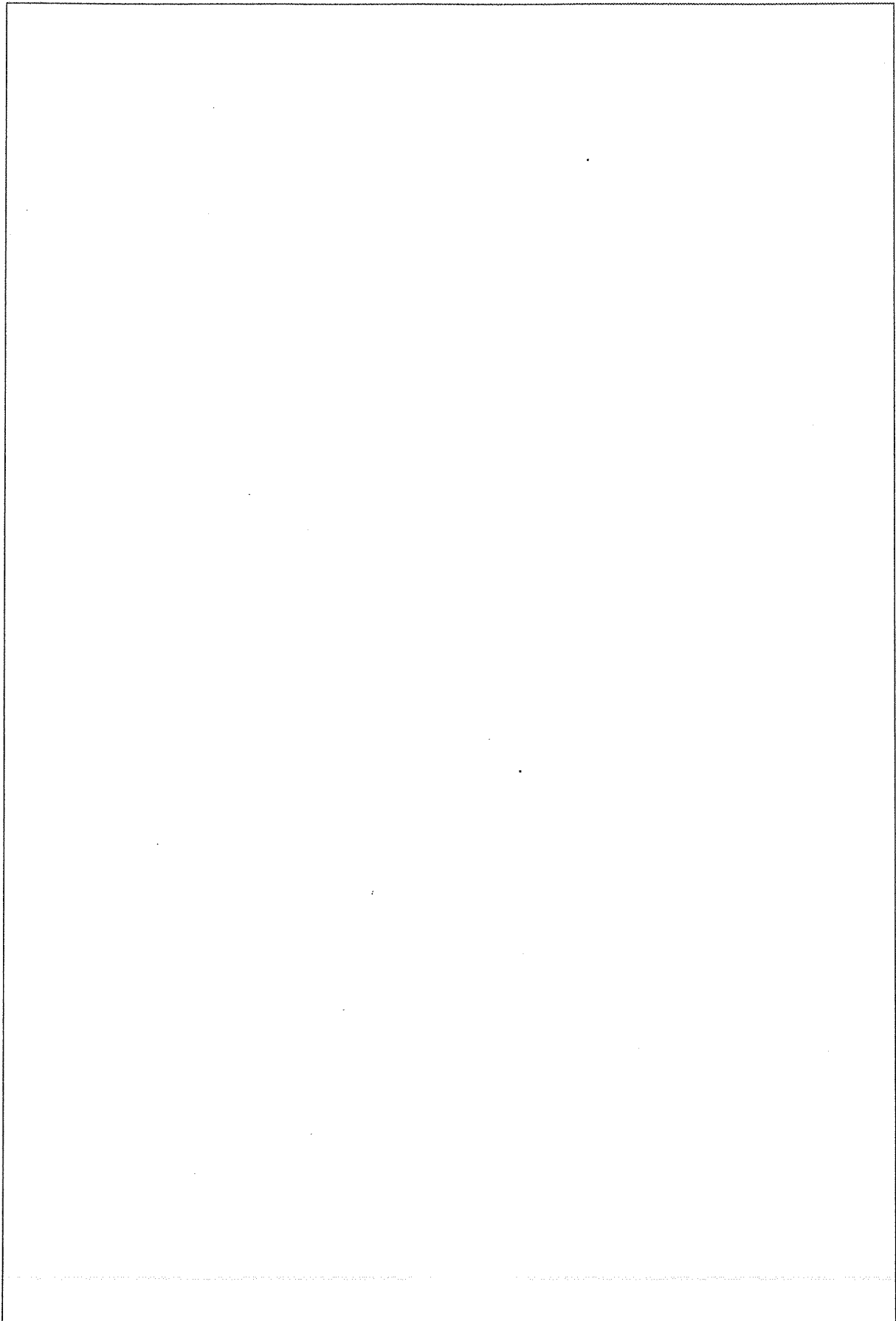
(d) Consider the following grammar.

$$S \rightarrow abAB$$
$$A \rightarrow aAB \mid \lambda$$
$$B \rightarrow BAb \mid A \mid \lambda$$

(i) Remove all λ – productions, unit productions and useless productions from the above grammar. **(3 Marks)**

(ii) Convert the resultant grammar into Chomsky normal form. **(3 Marks)**

Question 4

(a) Briefly explain why Finite Automata cannot accept all context-free languages. Show examples to prove your answer.

(3 Marks)

(b) Is the language $L = \{a^n b^n : n \geq 1\} \cup \{b\}$ deterministic? Justify your answer. **(3 Marks)**

(c) Construct a non-deterministic pushdown automata (NPDA) that accepts the language
L = $\{a^3b^nc^n: n \geq 0\}$ (5 Marks)

(d) Consider the following pushdown automata.
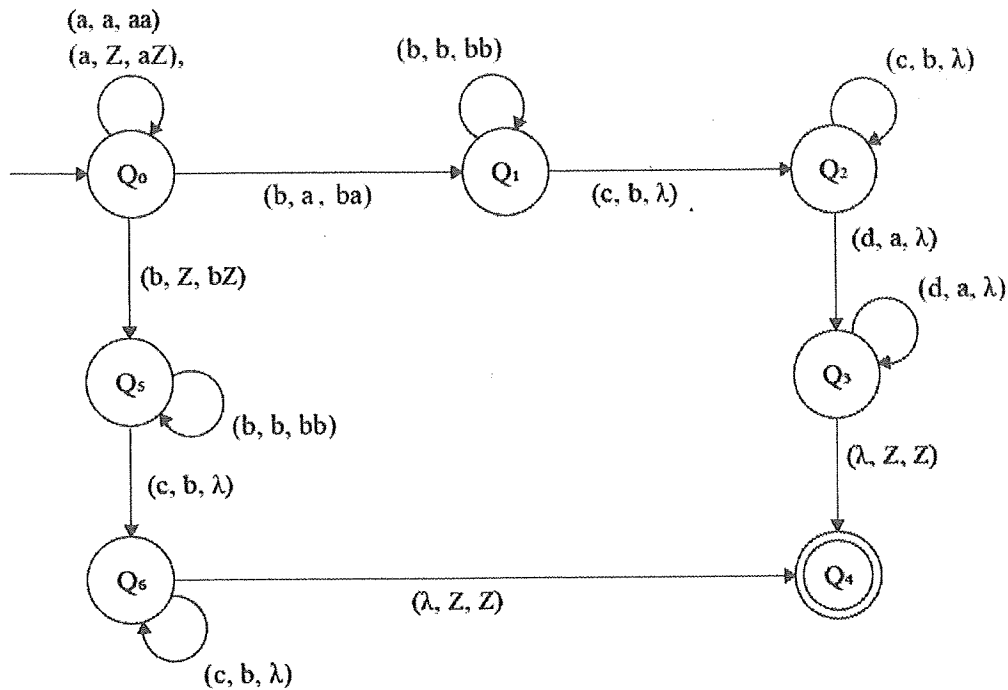
i.   What is the language accepted from the above pushdown automata (PDA)?   (4 Marks)

8

ii. Modify the above pushdown automata to accept the following strings:

(a) **ad, aadd, aaaddd, ...**
(b) empty input string

iii. What is the language accepted from the new PDA

(5 Marks)

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