UNIVERSITY OF COLOMBO, SRI LANKA

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

Second Year Examination – Semester II – 2018

SCS2112– Automata Theory – (Part B)***TWO (2) HOURS (For both parts A & B)***

Pages: 09

To be completed by the candidate

Examination Index No:

Important Instructions to candidates:

1. The medium of instruction and questions is **English**.
2. Note that questions appear on both sides of the paper. If a page or a part of the question paper is not printed, please inform the supervisor immediately.
3. Write your index number on each and every page of the question paper.
4. This paper has **4** questions across **Part A** and **Part B**.
5. Students are required to answer both **Part A** and **Part B** in **two hours**.
6. Answer **ALL** questions. There are **2** questions in **Part A** (**Question Numbers 1-2**) and **2** questions in **Part B** (**Question Numbers 3-4**) of the paper.
7. All questions carry equal marks (**25** marks).
8. Any electronic device capable of storing and retrieving text including electronic dictionaries and mobile phones are **not allowed**.
9. **Non-Programmable / Programmable** calculators are **not allowed**.

For examiner's use only

| Question No | Marks |
|-------------|-------|
| 3 | |
| 4 | |
| Total | |

Question 3

(a) Briefly explain what are regular languages?

[3 Marks]

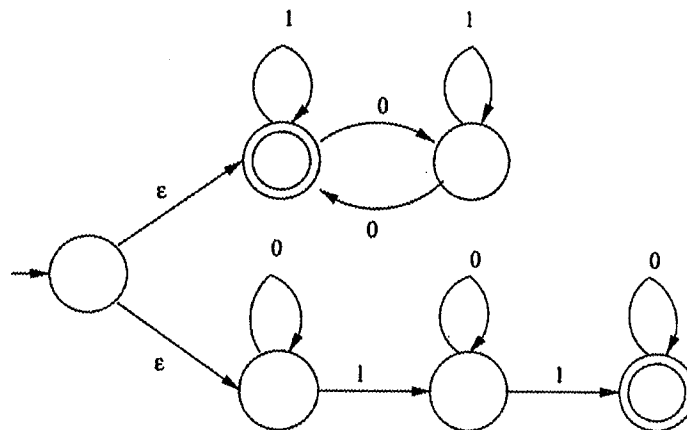
(b) Let $\Sigma = \{1, 0\}$, the regular expression $r = (1+0)^* 1 (1+01)^*$. Find **Ten (10)** elements/strings in $L(r)$, the language generated by the regular expression r , of **length less than five**?

[5 Marks]

- (c) Give **Five (5)** strings that are generated by the regular expression $r_1 = ab^* + ba^* + b^*a + (a^*b)^*$ but not by the regular expression $r_2 = a^* + b^*$. Justify your answer.

[5 Marks]

- (d) Write down the **regular expression** for the given finite automaton



[4 Marks]

- (e) Construct a non-deterministic finite automaton (NFA) to **accept** the language defined by the regular expression:

$$R = (01^*00 + 110^*01^*)$$

[8 Marks]

Question 4

- (a) Briefly explain **right-linear** and **context-free** grammars with an example for each.

[3 Marks]

- (b) Consider the following grammar where $\{S, A, B\}$ is the set of non-terminals, $\{a, b\}$ is the set of terminals and S is the start symbol:

$$S \rightarrow aSa$$

$$S \rightarrow bSb$$

$$S \rightarrow \epsilon$$

- (i) Is this a context free grammar?
(ii) Is this a regular grammar? Justify your answer

[4 Marks]

- (c) Show that the language $L = \{ww^R : w \in \Sigma^*\}$ is not regular. (Use pumping lemma to prove this) [6 Marks]

(d) Remove **ϵ -productions** (nullable variables) from the following grammar

$$S \rightarrow abAB$$

$$A \rightarrow bAB \mid \epsilon$$

$$B \rightarrow BAa \mid A \mid \epsilon$$

[6 Marks]

(e)

- (i) Construct a **non-deterministic push down** automaton (NPDA) that accepts the language $L = \{a^n b^n : n \geq 0\}$.
- (ii) Show that the constructed NPDA accepts the input string **aabb**. (show your steps clearly)

[6 Marks]

