UNIVERSITI TEKNOLOGI MALAYSIA
MIDTERM TEST
SEMESTER II 2014/2015

CODE OF SUBJECT	: SCJ3203 / SCJ3203
NAME OF SUBJECT	: Theory of Computer Science
TIME	: 2.15 PM – 4.45 PM (2 1/2 Hours)
DATE	: 9 May 2015
VENUE	:

INSTRUCTIONS TO THE STUDENTS:

PART A : 10 TRUE / FALSE QUESTIONS   (10 MARKS)
PART B : 2 MATCHING QUESTIONS   (25 MARKS)
PART C : 7 SUBJECTIVE QUESTIONS   (65 MARKS)

THIS PAPER CONSISTS OF 3 PARTS. ANSWER ALL QUESTIONS IN THE SPACE PROVIDED IN THIS QUESTION PAPER. THE MARKS FOR EACH QUESTION IS AS INDICATED.

Attention: All electronic devices (cell phones, smartphones, tablets and other) must be turned off during the examination period and placed them face up on your desk visible to the exam supervisor at all times.

It is not permitted to take your electronic devices into the toilet. You should leave these devices switched off on your desk, not in your pocket.

Name	
Identity card (or matric) Number:	

This examination book consists of **8** printed pages excluding this page.

PART A – TRUE AND FALSE QUESTIONS   [10 marks]

There are **10** questions in this section. For each question, state whether it is TRUE or FALSE and write your answer in the space given. Each question carries 1 marks.

Answer

1. λ is always substring of every string.

2. $L_1L_2 = \{xy \mid x \in L_1 \text{ and } y \in L_2\}$, if $L_1 = \{a, aa\}$ and $L_2 = \{\lambda, b, ab\}$,
    thus $L_1L_2 = \{a, b, aa, ab, aab, aaab\}$.

3. One of the shortest strings in the language represented by $(ab + ba)^*$ is ba.

4. Two example expressions that represent the same set of strings are
    $(0 + 1 + \lambda)^*$ and $(0 + 1)^*$.

5. $R = a^* + b^*$ generates any string with the combination of a's and b's.

6. The string $abbabaabab$ is in the language represented by $(a + bb + bab + abaab)^*$

7. Let S = $\{ab, bb\}$ and let T = $\{ab, bb, bbbb\}$. Then, S* = T*.

8. A regular expression for set of strings over $\{a, b\}$ containing two or more b's is $(a + b)^*b(a + b)^*b(a + b)^*$.

9. The string $aababb$ is in the language represented by grammar $S \rightarrow SaSbS|\varepsilon$.

10. The regular expression for the following finite automata is **b*(ab*a)***.
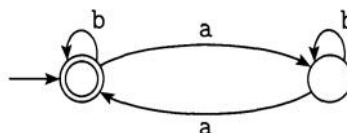
PART B – MATCHING QUESTIONS [25 marks]

There are **2** questions in this section. For each statement given in the first tables (Table 1 and 3) in each question of this section, identify the matching statement from the second tables (Table 2 and 4) and write your answer in the space given.

*[Bahagian ini terdiri daripada **2** soalan. Bagi setiap kenyataan yang diberi di dalam jadual 1 dan 2, kenalpasti pasangannya daripada jadual 3 dan 4. Tuliskan jawapan anda pada ruang yang disediakan.]*

1. Consider the Regular Expressions (RE) in Table 1. Match them with the most suitable Context-free Grammars (CFG) from Table 2. Then write two possible strings of the languages. **[15 marks]**

Table 1.

No.	Regular Expressions (RE)
1.	$a^n b^n$
2.	a*c*b
3.	ab*
4.	a*b
5.	ab*a
6.	a*bc*

Table 2.

Matching no. of RE	Context-free Grammar	Generate 2 possible strings
	$S \rightarrow aS \mid b$	
	$S \rightarrow aSb \mid \lambda$	
	$S \rightarrow aBa$ $B \rightarrow bB \mid \lambda$	
	$S \rightarrow aA$ $A \rightarrow bA \mid \lambda$	
	$S \rightarrow aS \mid bA$ $A \rightarrow cA \mid \lambda$	
	$S \rightarrow aS \mid Bb$ $B \rightarrow cB \mid \lambda$	

2. Consider the Regular Expressions (RE) in Table 3. Match them with the most suitable Finite Automata (FA) from Table 4. **[10 marks]**

Table 3.

No.	Regular Expressions (RE)
1.	a*b*
2.	(a + b)*
3.	(ab)*

Table 4.

Matching no. of RE	Finite Automata (FA)

4.	(ab)*ba	
5.	(ab*a)*	
6.	b(a+ab)* + ab*	
7.	((a+b)(a+b))*	
8.	(b + ab)*	
9.	(ab)*(ba)*	
10.	(ab $\cup$ aba)*	

PART C – SUBJECTIVE QUESTIONS   **[65 MARKS]**

_____

This part consists of 7 structured questions. Answer all questions in the space provided. The marks for each part of the question is as indicated.

1.   For each of the following regular expressions in Table 1, give TWO strings that are IN (member of) the language it represents and give two that are NOT (not member of) :

Table 1.   (8 marks)

Regular expressions	IN the language	NOT IN the language
a*b*		
(ab)*		
a(ba)*a		
a(a + b)*b		

2.   Consider the language S*, where S = {*ab*, *ba*}.   (5 marks)

   a)   Write out all the strings in S* that have six or fewer letters.

   _____

   _____

   b)   Can any string in this language contain the substrings *aaa* or *bbb*? _____

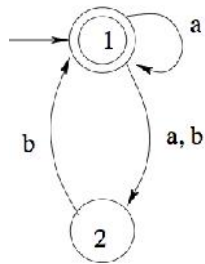   c)   What is the shortest string that is **NOT** in this language? _____

3.   Write regular expressions to describe each of the following languages:

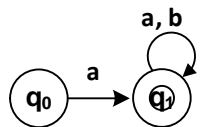   a)   The strings over {*a*, *b*} that begin OR end with *aa*.   (3 marks)

   _____

   b)   The strings over {*a*, *b*} that begin AND end with *aa*.   (3 marks)

   _____

   c)   The strings over {*a*, *b*} contain exactly two *b*'s.   (3 marks)

   _____

4.   Convert the following finite automata to a regular expression.   (6 marks)

a)   _____.

b)   _____.

5.   You are given a finite automaton M with states q_0, q_1, q_2, q_3 having q_0, q_1, q_2 as final states and {*a, b, c*} as input alphabet. The transition functions are given by the table:

u	a	b	c
q_0	q_0	q_1	q_2
q_1	q_3	q_1	q_2
q_2	q_3	q_3	q_2
q_3	q_3	q_3	q_3

a)   Draw a state diagram for M. Is it a DFA or NFA? _____   (4 mark)

b)   Give a regular expression for the language accepted by M. _____

(3 marks)

c)   Give 2 possible strings accepted by M.   (2 marks)
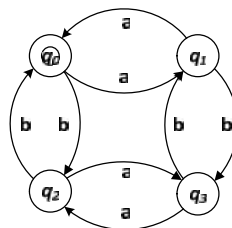
_____

d)   Trace the computations that process the strings *abbbbc*.   (3 marks)

6. Design a finite automata for the following languages.   (6 marks)

   a)   The language L = {$w \in$ {a, b} : w contains the substring *aa*}.

   b)   The language of all strings over {a, b} containing exactly two *a*'s.

1. Let M be the finite automata below:

   a)   Fill in the following values: Q = _____, Σ = _____, S = _____, F = _____

                                                                              (2 marks)

   a)   Construct the transition table of M. Is this FA is a deterministic FA or not?   (2 marks)

b)   Trace the computations that process the strings *ab*, *bb*, *aab* and *baba*.   (4 marks)

a)   Which of the strings in (b) are accepted by M? _____ (1 marks)

d)   Give a regular grammar for the language accepted by M.   (3 marks)

8.   Let G be the grammar
                S → aSbb | A
                A → cA | c

   a)   Give a derivation of string *aacbbbb.*   (2 marks)

b)   Build the derivation tree for the derivation in part (a).   (2 marks)

c)   Use set notations to define L(G).   (3 marks)

- END OF QUESTIONS -