



# UNIVERSITI TEKNOLOGI MALAYSIA

## MIDTERM TEST SEMESTER II 2011/2012

**CODE OF SUBJECT** : SCJ3203  
**NAME OF SUBJECT** : Theory of Computer Science  
**TIME** : 11.00 AM – 1.00 PM (2 Hours)  
**DATE** : 17 May 2012  
**VENUE** :

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### **INSTRUCTIONS TO THE STUDENTS:**

This paper consists of 13 structured questions. Answer all questions in the space provided. The marks for question is as indicated.

*[Kertas ini mengandungi 13 soalan struktur. Jawab semua soalan pada ruang yang disediakan. Markah setiap soalan adalah seperti yang dinyatakan.]*

### **ANSWER ALL QUESTIONS IN THE SPACES ALLOCATED IN THIS TEST BOOKLET.**

<b>Name</b>	
<b>Identity card (or matric) Number:</b>	
<b>Name of Lecturer</b>	<b>Dr Zalmiyah Zakaria</b>
<b>Subject Code and Section</b>	<b>SCJ3203 Section 01</b>

This examination book consists of 6 printed pages excluding this page.

1. Let  $L_1 L_2 = \{xy \mid x \in L_1 \text{ and } y \in L_2\}$ . If  $L_1 = \{a, aa\}$ ,  $L_2 = \{\lambda, b, ab\}$ , [3 marks]  
then  $L_1 L_2 =$  \_\_\_\_\_
2. Write **regular expressions** to describe each of the following languages: [16 marks]
  - a) All strings over  $\{a, b\}$  that contain exactly two  $b$ 's.  
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  - b) All strings over  $\{a, b\}$  that contain an even number of  $a$ 's.  
\_\_\_\_\_
  - c) All strings over  $\{0, 1\}$  that do not ending with 11.  
\_\_\_\_\_
  - d) All strings over  $\{0, 1\}$  where the length of the string is a multiple of 3.  
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4. Give a description of the following language in your own words.  $L_3 = (0 + 10)^*(1 + \lambda)$  [4 marks]  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. Generate 3 possible strings for each of the following regular expression: [5 marks]
  - a.  $b^*(ba)^*a^*$  = \_\_\_\_\_
  - b.  $(b^* + a^*)(a^* + b^*)$  = \_\_\_\_\_
  - c.  $b^*(a + ba)^*b^*$  = \_\_\_\_\_
  - d.  $0^*(1 + 000^*)^*0^*$  = \_\_\_\_\_
  - e.  $(0^*1^*)000(0 + 1)^*$  = \_\_\_\_\_
6. Generate possible strings for each of the following regular expression recursively (at least for 3 iterations,  $*$  = 0, 1, 2, ... ) : [8 marks]
  - a.  $a(a + b)^*b^+$

b.  $(ab)^* + a^*$

7. Here is a context-free grammar (**CFG**),  $G_1 = (\{S, A\}, \{0, 1\}, P, S)$ , where P is the set of productions:

$S \rightarrow 0S1 \mid 0A1$

[7 marks]

$A \rightarrow 1A \mid 1$

- a) What is the shortest string for this language = \_\_\_\_\_
- b) Show derivation of 3 possible strings from this **CFG** :

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8. Give a regular **expression** (or may be a non-regular) equivalent to the following **CFG**:

$S \rightarrow AB$

[3 marks]

$A \rightarrow 0A1 \mid \lambda$

$B \rightarrow 0B \mid 1B \mid \lambda$

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9. Here is a context-free grammar,  $G_2 = (\{S, A, B\}, \{0, 1\}, P, S)$ , where  $P$  is the set of productions:

$S \rightarrow 0A \mid 1B \mid \lambda$

[9 marks]

$A \rightarrow 1S \mid 0AA$

$B \rightarrow 0S \mid 1BB$

Intuitively, **A** generates strings with one more 1 than 0, **B** generates strings with one more 0 than 1, and **S** generates the strings with equal numbers of 0's and 1's.

- a) Give a leftmost derivation of the string 0011.

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- b) Give a rightmost derivation of the string 001011.

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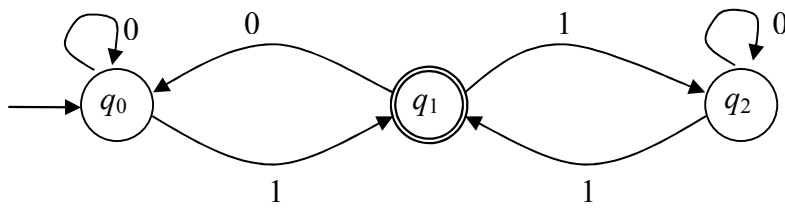
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- c) In the space below, draw a derivation tree for the string 1001.

10. Given the following DFA.

[7 marks]



a) Which of the following strings 0110, 0001, 01001, 0000110 are accepted by this DFA?

0110		0001		01001		0000110	
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b) Give a description of the following language in your own words.

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11. Given  $L_4$  as a language of all strings over  $\{a,b\}$  that contain the substring  $bb$ . [12 marks]

a) Write a **regular expression** for  $L_4$ .

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b) Write a **context free grammar** for  $L_4$  in set notations.

c) Draw a NFA for  $L_4$ .

d) Draw a DFA for  $L_4$ .

12. Let  $L$  be the language consisting of all strings of zero or more 0's followed by one or more 1's, followed by two or more 2's. For example, 001122, 122, and 0111122 are in  $L_5$ ; 012 (too few 2's), and 0112122 (a 2 precedes a 1) are not. [9 marks]

a) Write a regular expression whose language is  $L_5$ .

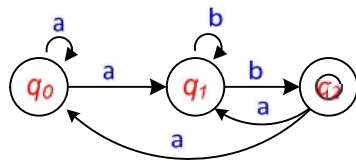
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b) In the space below, draw the transition diagram of a DFA whose language is  $L_5$ .

c) Give a context-free grammar generating the same language. Assuming that  $S$  is the start symbol.

13. Let  $M$  be NFA below:

[14 marks]



a. Construct the transition table of  $M$ .

b. Trace all (or at least four of them) computations of the string **aaabb** in  $M$ .

c. Is **aaabb** in  $L(M)$ ?

d. Give a regular expression for  $L(M)$ .