CONFIDENTIAL

UNIVERSITI TEKNOLOGI MALAYSIA

MIDTERM TEST

SEMESTER I 2015/2016

SUBJECT CODE	**: SCSJ3203**
SUBJECT NAME	**: Theory of Computer Science**
TIME	**: 2.15 PM. – 4.45 PM (2 1/2 Hours)**
DATE	**: 26 October 2015**
VENUE	**: N28, BK 1 - BK 5**

INSTRUCTIONS TO THE STUDENTS:

This test book consists of 2 parts:

Part A:	10 Objective Questions	20 marks
Part B:	9 Structured Questions	80 marks

ANSWER ALL QUESTIONS IN THE SPACES PROVIDED IN THIS QUESTION BOOKLET.

Name	
I/C No.	
Year/Course	
Section	
Lecturer's Name	

*(This question booklet consists of **12** pages including this page.)*

Answer sheet for Part A:

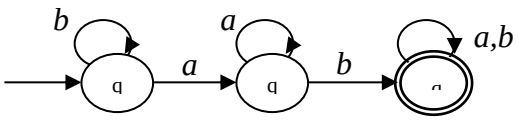
Write all your answers for Part A in the space below.

No.	Answer
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
TOTAL	

SECTION A: TRUE AND FALSE QUESTIONS (20 MARKS)

*There are **10** questions in this section. For each question, state whether it is TRUE or FALSE and write your answer in the answer sheet provided in **Page 2.** Each question carries 2 marks.*

1. If r_1 and r_2 are regular expressions, then r_1-r_2.
2. If L is any language over $\sum$, then $L^+ \subseteq L^*$.
3. Context free grammar is a subset of regular grammar and is obtained by placing restrictions on the form of the right-hand side of the rules.
4. The context-free grammar $S \rightarrow aS \mid bS \mid \lambda$ is equivalent to $(a+b)^*$.
5. The regular expression for the following finite automata is b^*ab.



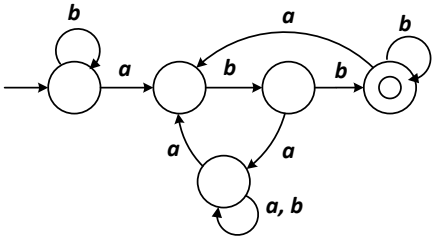
6. The language generated by the grammar $G=(\{S\}, \{a,b\}, \{S \rightarrow aSb \mid \lambda\}, S)$ is $\{a^n b^n \mid n \geq 0\}$.
7. String $aabbcc$ can be obtained by the language $L = \{a^i b^j c^k \mid 0 \leq i + k \leq j\}$.
8. Consider the following context free grammar:

   $S \rightarrow aAbB$

   $A \rightarrow aAb \mid \lambda$

   $B \rightarrow c \mid cB$

   This grammar is a correct description of the language $\{a^i b^j c^k \mid i, j, k > 0, i = j\}$.
9. Given the machine, M. The language recognized by M is $\{w \in \{a, b\}^* \mid$ **every** a **in** w **is followed by exactly two** b**'s**$\}$.



10. A finite automata is **NOT** a good model of computer for regular expressions.

SECTION B: STRUCTURED QUESTIONS (80 MARKS)

Part B consists of 9 structured questions. Answer all questions in the space provided. The marks for each part of the question is as indicated.

1. Find a regular expression for the language ***Odd-Odd*** over the alphabet $\sum \{a, b\}$, consisting of strings with an odd number of $\boldsymbol{a}$'s and an odd number of $\boldsymbol{b}$'s. **[6 Marks]**

2. Given the **TWO** regular expressions as shown below. **[10 Marks]**

$$\boldsymbol{r_1} = \boldsymbol{a}^* + \boldsymbol{b}^*$$

$$\boldsymbol{r_2} = \boldsymbol{ab}^* + \boldsymbol{ba}^* + \boldsymbol{b}^*\boldsymbol{a} + (\boldsymbol{a}^*\boldsymbol{b})^*$$

a. Describe the languages $\boldsymbol{r_1}$ and $\boldsymbol{r_2}$ using a simple English. (4 m)

b. Find a string corresponding to $\boldsymbol{r_1}$ but not in $\boldsymbol{r_2}$ (2 m)

c. Find a string corresponding to both $\boldsymbol{r_1}$ and $\boldsymbol{r_2}$ (2 m)

d. Let say the r_1 is modified that contain the substring ***ab***. Give a **NEW** regular expression for r_1 (2 m)

3. Write **regular expression** to describe each of the following languages: **[10 Marks]**

a. All strings over $\{0,1\}$ that contain the substring 00 or 11 (2 m)

b. All strings over $\{0,1\}$ that begin **AND** end with aa. (2 m)

c. All strings over $\{0,1\}$ that except empty string (2 m)

d. All strings over $\{a,b\}$ that a exists appears quadruple. This means, that every clump of $a's$ contains 4 $a's$ or 8 $a's$ or 12 $a's$ and so on. (2 m)

e. All strings over {a,b} that begin **AND** end with *aa* (2 m)

4. Let G be the grammar **[10 Marks]**

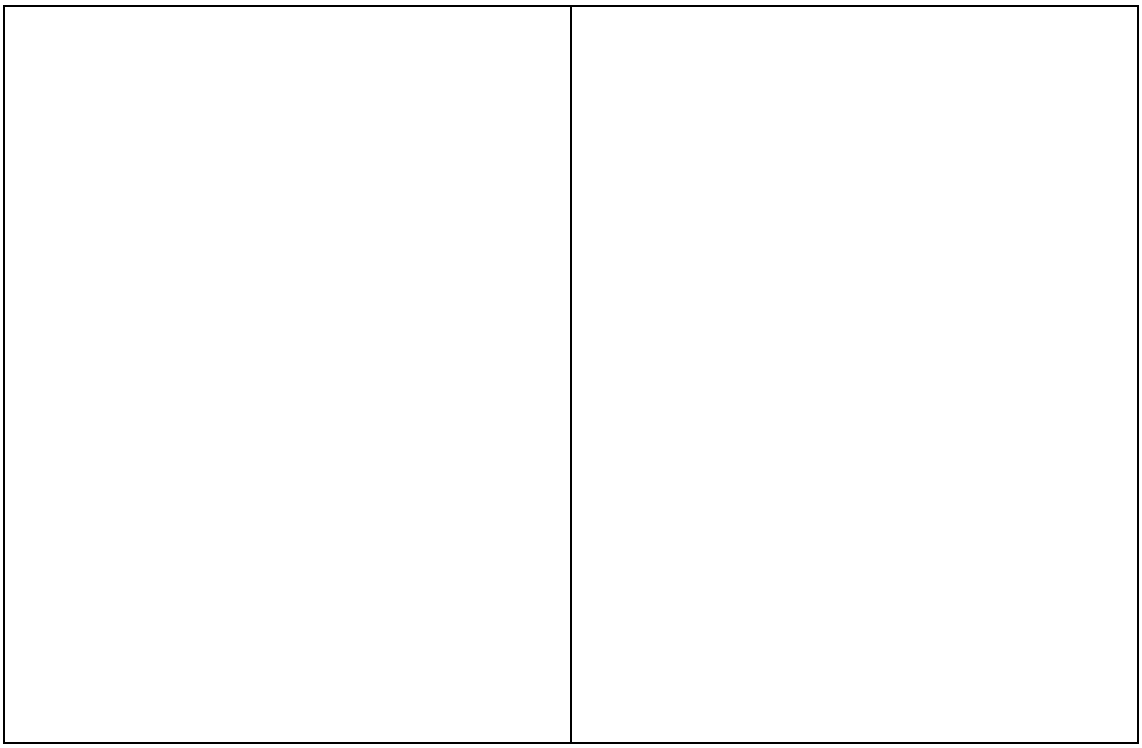
$$S \rightarrow AB$$
$$A \rightarrow aA \mid \lambda$$
$$B \rightarrow bB \mid bC$$
$$C \rightarrow cC \mid \lambda$$

a. Give a regular expression for $L(G)$ (2 m)

b. Construct leftmost derivations of the string *aaabbc*.. (2 m)

c. Construct leftmost derivations of the string *aaabbc*.. (2 m)

d. Build the derivation trees for the derivations from part **(b)** and **(c)** . (4 m)



(b) **(c)**

5. Let M be a finite automaton as shown below: **[10 Marks]**

$$Q = \{q_0, q_1, q_2, q_3, q_4\}, \Sigma = \{a, b\}, S = q_0, F = \{q_3\}$$

δ	a	b
q_0	q_1	q_4
q_1	q_2	q_4
q_2	q_4	q_3
q_3	q_3	q_3
q_4	q_4	q_4

a. Draw a state diagram for M. (4 m)

b. Give a regular expression for the language accepted by ***M***. (2 m)

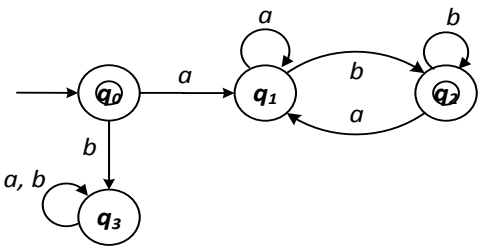
c. Trace the computations that process for strings ***aaba***, ***abab*** and ***baab*** (3 m)

aaba	***abab***	***baab***

d. Which of the strings in (c) are accepted by ***M*** ? (1 m)

6. Write grammar generating $\{x^n y^{2n} : n \geq 0\}$ **[4 Marks]**

7. Given the state diagram finite automaton, ***M*** **[10 Marks]**



a. Write a regular grammar that generates the language $L(M)$. (4 m)

b. Trace the computation that process for strings ***abab*** and ***aababb***. (3 m)

abab ***aababb***

c. Give a derivation tree in part (b) . (3 m)

abab	*aababb*

8. Given the pseudo-code in Table 1. **[10 Marks]**

Table 1. Pseudo-code

```
AUTOMATIC DOOR IN SHOPPING CENTERS

1. States: OPEN or CLOSED
   1.1. Initial: always closed
   1.2. Final: CLOSED
2. Input: detection of people at both sides of door
   2.1. FRONT → a person is on the front side
                (in front of the door)
   2.2. REAR → a person in on the rear side
   2.3. BOTH → people are standing on both sides
   2.4. NEITHER → no one is standing on either side
3. Rules:
   3.1. Only one side has detection of people → OPEN
   3.2. Both sides have detection of people → OPEN
   3.3. Both sides have no detection of people →
   CLOSED
```

a. Write the state diagram of the automatic door (4 m)

b. Describe the state diagram in set notation. (3 m)

c. Find the regular expression. (3 m)

9. Let M be a finite automaton defined by $Q = \{q_0, q_1, q_2\}$; $\Sigma = \{a, b\}$; $q_0 = q_0$; $F = \{q_0\}$ and transition function is: **[10 Marks]**

δ	a	b
q_0	q_1	q_1
q_1	q_0	q_0
q_2	$q0$	$q0$

a. Give a state diagram for M. (2 m)

b. Trace the computation that process for strings ***ba, ab, abbb*** and ***baba***. (4 m)

ba ***ab***

abbb ***baba***

c. Which of the strings in (b) are accepted by ***M***? (1 m)

d. Give a regular expression for the language accepted by M? (3 m)

- END OF QUESTIONS -