Cairo University – Faculty of Graduate Studies for Statistical Research

Department: COMPUTER SCIENCE

Academic Year: 2018-2019 Semester: Summer

Date: 01-10-2019 Level: Diploma

Course Title:	Course code:	Time:	Exam Points:	# Exam. Sheets:
Compiler Construction	CS510	3 Hours	100	2

Q1) answer the following questions(8Points)

1.1) Why does the lexer use regular languages but the parser use context-free languages?

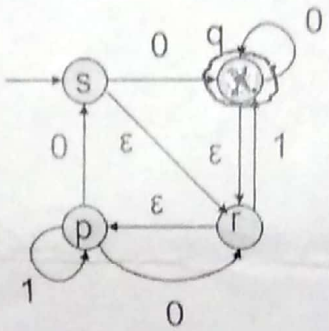
1.2) What are the tasks of lexical analyzer?

Q2) Scanning Questions (35Points)

2.1)True or false? Are the following regular expressions exactly equivalent? Justify(7Pints).

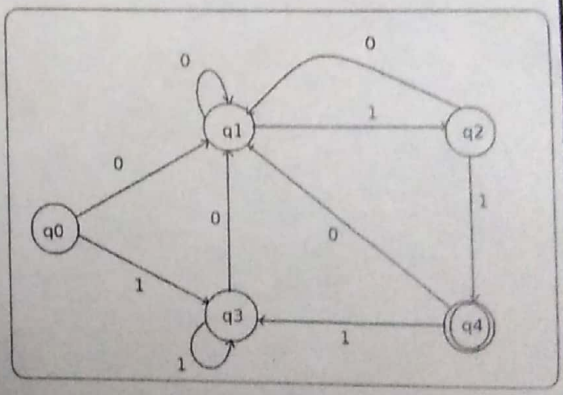
a)	$x?\,x^*$	x^*
b)	$y^*\|z^*$	$(y\|z)^*$
c)	a^*b^*	(ab)*
d)	$(a\|b\|\varepsilon)^*$	(a|b)*
e)	$(a\|b)?$	a?|b?

2.2) Build an equivalent DFA for the following NFA using subset construction Algorithm (7Points)



2.3) Given RE a|bc? , construct NFA using Thompson's construction (7Points)

2.4) Minimize the following DFA using Hopcroft's Algorithm (7Points)



2.5) Use of FLEX: (7Points)
Write a flex scanner to recognize integers positive, negative and with no leading zeroes.

Q3) Code Generation Questions (7Points)

Write the three address code instructions for the following code fragment.

```
Wile (i<5){
        a=b+1;
        i++;
      }
c=a;
```

Good Luck

Q4) Semantic Analysis (6Points)

Consider the following attribute grammar

Grammar	Semantic Rule
S → A Sign	S.val = A.val; A.sign = Sign.sign; print(A.val);
Sign → +	Sign.sign = 1
Sign → -	Sign.sign = 0
A → n	A.val = value(n)

A → A1 , n	A1.sign = A.sign;
	if(A.sign = 1) then
	A.val = min (A1.val,value(n));
	else
	A.val = max(A1.val,value(n));

a) Explain the overall operation of this attribute grammar and indicate which of the attributes are either synthesized or inherited.

b) Give an attributed parse tree for the string "5,2,3-" and evaluate the attributes in the attributed parse tree.

Q5) Parsing Questions (44Points)

5.1) Consider the following grammar(6 Marks):

$$E \rightarrow id \mid (E)E \mid E.E$$

Run the recursive descent parsing algorithm (with backtracking) on the following input:**(id)((id))**,Clearly and concisely show the steps and the final result.

5.2) Consider the following grammar G2(16points).

$$S \rightarrow \{L\} \mid x$$
$$L \rightarrow L, S \mid S$$

a) compute the first and Follow set for each non-terminal

b) construct parsing table

c) Is this grammar LL(1) Grammar? Justify your answer.

d) Construct the parsing stack for the Input $\{x, x, x\}$

5.3)Consider the following grammar(16Points):

$$S \rightarrow S\# \mid S.id \mid id$$

a) Build the Automata for this grammar.

b) Build the Parsing tables for this grammar.

c) Is it an LR(0) grammar? Why or why not?

d) Build the Parsing Stack for the input **id.id.id#**

5.4) Is the following grammar: (6points)

$$S \rightarrow aS \mid aSbS \mid c$$

a) Left Recursive?

b) suitable for predictive parsing?

c) Ambiguous?

Justify your answer

Good Luck ☺

Cairo University	Cairo University – Institute Of Statistical Studies And Researches	
	Department: COMPUTER SCIENCES	
	Academic Year: 2015-2016 Semester:2	
	Date: 24-05-2016 Level: Diploma	

Course Title:	Course code:	Time:	Exam marks:	# Exam. Sheets:
Compiler Construction	CS510	3 Hours	70	2

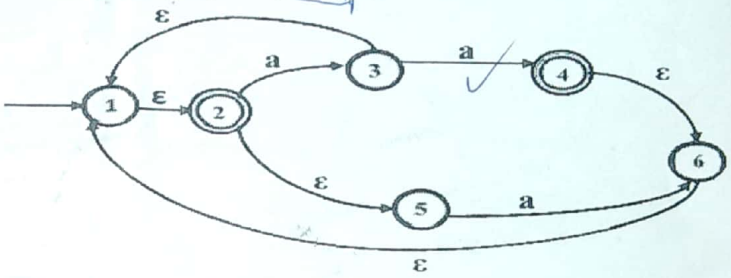
ANSWER THE FOLLOWING QUESTIONS

Scanning Questions (20 Marks)

Q1: Write regular expressions to specify the following patterns: (4 Marks)

1. ∑= {a, b, c}. All strings over this alphabet that are in a sorted order.
2. All strings of digits such that all the 2's occur before all the 9's.
3. ∑= ASCII. All strings that contain only letters.
4. All strings of digits that represent decimal numbers e.g, 5.33,-1.223, 22.

Q 2: Build an equivalent DFA for the following NFA using subset construction (4 Marks)



Q3: Given RE below, construct an NFA using Thompson's construction (4 Marks)

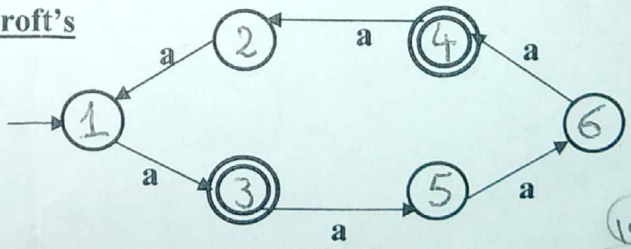
a|bc*

Q4: Write FLEX scanner (4Marks)

Print the total number of Grammar Production Rule in a file.

e.g. "X:=XYZ"

Q5: Minimize the following DFA using Hopcroft's Algorithm: (4Marks)



Code Generation Questions (10 Marks)

a) Q=a + b + c + d + e + f

b) x = z*y*w/2

1. Give the sequence of three address code instructions corresponding to the given Expressions.
2. Write the data structure appropriate for triples and quadruples implementation of three addresses code for the expression **Q=a + b + c + d + e + f**
3. Write the three address code instructions for the following code fragment:

```
for(int i=100;i>=1;i--)
{
        Sum+=i;
}
x=sum+100;
```

Parsing Questions (30 Marks)

Q1: Remove Left Recursion and Left Factoring. (6 Marks)

$E \rightarrow E + T \mid E - T \mid T$

$T \rightarrow T*F \mid T/F \mid F$

$F \rightarrow (E) \mid X \mid id \mid cn$

$X \rightarrow id\ (Y?)$

$Y \rightarrow E\ (,E)^*$

Q2: Is the following grammar is LL(1)? (4 Marks)

$S \rightarrow AB$

$A \rightarrow aaA \mid \epsilon$

$B \rightarrow bbB \mid \epsilon$

Justify your answer?

Q3: Show the steps of a LL(1) Parser (the parsing stack, input, and actions)(5 Marks)

$M \rightarrow (E)M \mid \epsilon$

$E \rightarrow QF$

$F \rightarrow ;E \mid \epsilon$

$Q \rightarrow a \mid b \mid M$

in the recognition of the input string **(a;(b))**

Q4 Find First and Follow sets and construct Parsing table (10 Marks)

$S \rightarrow TS \mid [S]S \mid)S \mid \epsilon$

$T \rightarrow (X)$

$X \rightarrow TX \mid [X]X \mid \epsilon$

Q 5: Context-Free Grammars (5 Marks)

Consider the following context-free grammar:

$E \rightarrow E+E \mid E-E \mid num$

using the string: **2-3+4**

(a) Give a leftmost derivation for the string. Show the derivation rules applied

(b) Give a rightmost derivation for the string. Show the derivation rules applied.

(c) Give a parse tree for the string.

(d) Rewrite the above grammar to remove ambiguity.

Semantic Analysis Questions (10 Marks)

$N \rightarrow SND \mid D$

$Sign \rightarrow + \mid -$

$D \rightarrow 0 \mid 1 \mid 2$

(a) Write an attribute grammar for **value** of an integer number.

(b) Draw a parse tree for the binary number -120 and show the attribute calculation performed at each node.

Best Wishes