National University of Computer and Emerging Sciences, Lahore Campus

	Course:	**Theory of Programming Languages**	**Course Code:**	**CS507**
	Program:	**MS**	**Semester:**	**Fall 2020**
	Duration:	**1 HOUR 45 Minutes**	**Total Marks:**	**50**
	Paper Date:	**November 1, 2020**	**Weight**	
	Section:	**MS**	**Page(s):**	**6**
	Exam:	**Midterm I**		

Instruction/Notes: Attempt all questions on the question paper.

Name: _____ Roll Number: _____

Question 1 [10] Short Q/As

a. [1] Name a function in LISP (discussed in class) that is no longer widely used due to readability issues:
cdr

b. [1] Function in LISP is in notation.
a. Postfix b. Infix c. **Prefix** d. None of the above

c. [1] A particular CNF grammar defines rules to form a "word" is as follows:

```
<word>        →    <letter> | <letter><letter pair> | <letter><digit pair>
<letter pair> →    <letter><letter> | <letter pair><letter><letter>
<digit pair>  →    <digit><digit> | <digit pair><digit><digit>
<letter>      →    a|b|c|d|…|x|y|z
<digit>       →    0|1|2|3|…|8|9
```

Which of the following strings can be derived from the above grammar?

I. word
II. words
III. c22

a. None of them
b. I and II only
c. II and III only
d. All of them.

d. [1] If the program written in a particular language is less _____ than the cost of failure of the system may be significant.
a. Writable b. **Reliable** c. General **d**. Readable

e. [1] Which of the following is not an imperative language?
a. **LISP** b. C++ c. SNOBOL d. All of them are imperative

f. [1] In SNOBOL, binary operators must have at least __**2**__ spaces

g. [2] In SNOBOL, spaces can be used as an operator for different purposes. List two of those:
a. Concatenation
b. Pattern Matching

h. [1]
Consider the following grammar:

S → AB
A → 0 | B1B
B → bbA

Which of the following statements is **FALSE**?

a. The length of every string produced by this grammar is even.
b. Every string produced by this grammar has at least as many 1's as 0's.
c. No string produced by this grammar has three consecutive 0's.
d. No string produced by this grammar has four consecutive 1's.

i. [1] Consider the following grammar:

S → (S) | 0

Which of the following statements is (are) **TRUE**?

I. The grammar is ambiguous.
II. The grammar is suitable for top-down parsing.
III. The grammar is suitable for bottom-up parsing.

a. II only b. I and II only c. **II and III only** **d.** All of them

Question 2 [10]
Let = {void, int, double, name, (,), ,, ;}

Define a CFG for C++ function prototype
For example:

- void name (int name, double name);
- int name ();
- int name (int, double name, int);
- void name(int, int);

Note that there can be more than three parameters sent in the function prototype.

S → Ret name (Args);

Ret → | void | int | double

Args → ε | ArgList

ArgList → OneArg | ArgList, OneArg

OneArg → Ret | Ret name

Question 3 [20 = 5 + 5 + 10]
Part a) and b) has no partial credit.

a. Consider the following function:

```
(defun mystery (list))
        (cond
                ((null list             NIL)
                ((null (rest list)      (list (first list)))
                (t                      (cons (first list)
                                        (mystery (rest (rest list))))))))
```

Assuming that the list L is (4 3 2 1), what will be the result returned by the following:
(mystery L)
Show your work to get credit.

(4 2)

b. Assuming that the following definitions are executed in this order:

```
(define x '(3 28 400))
(define y (cons (cdr x) '(6 15 77)))
```

What is the result of typing the following into the LISP compiler?

i) y => ??? **((28 400) 6 15 77)**

ii) (cons 'x (cdr (cdr x))) => ??? **(x 400)**

c. Define a Scheme function, odds, that takes a list and returns every other one, starting with the first. See the example to the right below.

> (odds '())
()
> (odds '(a))
(a)
> (odds '(a b))
(a)
> (odds '(a b c))
(a c)
> (odds '(a b c d e f g h))
(a c e g)

Question 4 [10 = 5 + 3 + 2]
Part a) does not have partial credit.

a.

i) Explain the following SNOBOL code with respect to replacement through Pattern Matching. Explain what is happening in each line

VERB = 'MASH'

Verb 'm' = 'B'

OUTPUT = VERB

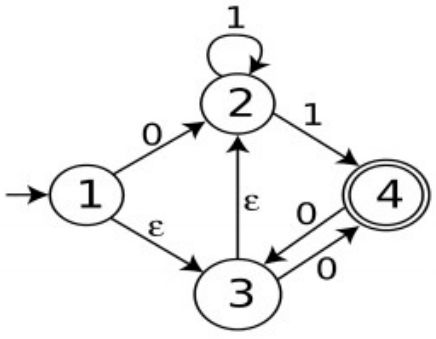
ii) What will be the final result?

BASH

b. A class of assignment statements in C/C++ has the following form: a **op**= b where **op** is an arithmetic or logic operator. Discuss the pros and cons of these statements from the perspective of readability and writability.

Will cause readability issues for a new user as s/he does not know the feature.
Writability becomes better as the size of instruction becomes shorter.

c. Determine whether the following strings are accepted or not be the NFA given below. Show complete path to get credit for both acceptance and rejection:



a) 10001

Rejected

b) 0111101

Accepted