King Fahd University of Petroleum and Minerals

Department of Information and Computer Science

ICS 410: Programming Languages

Spring 2006-2007 (062)

Date: 14-March-2007 | **Major Exam I: Basics of Programming Languages & Imperative Programming and C** | **Time Slot:** 6:05 p.m. – 7:35 p.m.

Duration: 90 minutes | **Total Points:** 150

Name:	**Student ID #:**

Notes:

- Check that you have **five** (5) pages, including this one, containing **three** (3) questions.
- Please skim through all the questions, make sure that you understand them, and then attempt to answer them with a time-allocation in mind. If any question is not clear, get it clarified during the first fifteen minutes.
- If you need to make any assumptions, please state them clearly as part of your answers.
- There are **three** questions in this exam each focusing on one of the topics. You are expected to answer **all** of them.
- In some questions some parts may have some choices. Clearly identify which selection you decided to do.

Scores:

Question	**Points**	**Score**
Q.1: Preliminaries	**30**	
Q. 2: Syntax and Semantics	**75**	
Q. 3: Imperative Programming and C	**45**	
Total ➔	**150**	

<u>Question 1:</u> **(30 points)**

Briefly answer **only four** of the following:

1) One of the motivations for studying programming languages is to ***improve background for choosing appropriate languages***. Briefly discuss this motivation.
2) What are the main characteristics of ***scientific*** and ***system*** programming languages?
3) List ***two*** features that may increase the programming language's ***reliability*** and briefly explain ***one*** of them.
4) Briefly explain how ***reliability*** of a programming language can conflict with its ***execution speed***.
5) **Lexical analysis** and ***syntax analysis*** are two major steps in the compilation of a program. Briefly explain them.

Question 2: **(75 points)**

a. Briefly answer **each** of the following: **(30)**

1) What is the difference between ***syntax*** and ***semantics*** of a programming language?
2) What are the three main ***extension*** of BNF to EBNF?
3) What is an ***attribute grammar*** and what is used for? List two of its components?
4) Describe the basic concept of ***Operational Semantics*** approach.

b. Consider the following grammar. For your convenience rules are given labels. In your answer you can refer to those rule numbers and also use the abbreviations: *<p>* for *<prog>*, *<ss>* for *<statements>*, *<s>* for *<statement>*, *<v>* for *<variable>*, *<e>* for *<expression>*

```
R1:     <prog>         → begin <statements> end
R2:     <statements>   → <statements>; <statement>
R3:     <statements>   → <statement>
R4:     <statement>    → <var> = <exp>
R5:     <exp>          → <var>
R6:     <exp>          → <var> + <exp>
R7:     <exp>          → <exp> - <exp>
R8:     <var>          → A | B | C
```

Show the ***right-most derivation*** of `begin A = C - A + B end` **(30)**

c. Prove that the following grammar is ambiguous: **(15)**

```
<S>  →  <E>
<E>  →  <E> - <E> | <V>
<V>  →  a | b | c
```

Question 3: **(45 points)**

a. ***Two*** of the main differences between ***Object Oriented*** and ***imperative*** programming languages are their ***use of abstraction*** and their ***program design.*** Briefly explain them. **(10)**

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b. What will be printed by the following C program: **(15)**

```
#include <stdio.h>
   int main(){
   int i, j, s, *ip, *Ar;
   scanf("%d", &s);
   Ar = (int *) malloc (s*sizeof(int));
   for(i=0;i<s; i++){
      scanf("%d", Ar+i);
   }
   ip = &Ar[3];
   *(ip+1) = 34;
   *(ip-1) += -25;
   j  = *(ip-2);
   for(i=0; i<5; i++)
      printf("Ar[%d] = %d\n", i, *(Ar+i));
   printf("j = %d\n", j);
   return 0;
}
```

Program Input	**Program Output**
5 **30 37 65 54 63**	

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c. Write a C function *`change`* that takes the ***address of two integers*** *`num1`* and *`num2`*. If *`num2`* is less than *`num1`* it will swap them otherwise it will not. **(20)**