DUBLIN CITY UNIVERSITY

SEMESTER ONE REPEAT EXAMINATIONS 2006

MODULE: ***(Title & Code)***	Compiler Construction 1 CA448/CA423
COURSE:	B.Sc. in Computer Applications (SE) B.Sc. in Computer Applications (CSSE) B.Sc. in Computer Applications (IS) B.Sc. in Computer Applications (Evening) B.Sc. in Computional Linguistics
YEAR:	4
EXAMINERS:	Mr. D. Dolan Dr. P. Gibson Dr. G. Hamilton (ext. 5017)
TIME ALLOWED:	2 Hours
INSTRUCTIONS:	Please answer ALL questions. All questions carry equal marks

Requirements for this paper
Please tick (X) as appropriate

- ☐ ***Log Table***
- ☐ ***Graph Paper***
- ☐ ***Attached Answer Sheet***
- ☐ ***Statistical Tables***
- ☐ ***Floppy Disk***
- ☐ ***Actuarial Tables***

THE USE OF PROGRAMMABLE OR TEXT STORING CALCULATORS IS EXPRESSLY FORBIDDEN

PLEASE DO NOT TURN OVER THIS PAGE UNTIL YOU ARE INSTRUCTED TO DO SO

1. Write a regular expression which describes the language of all strings from the alphabet {a,b} which either have an even number of a's or an odd number of b's (or both). [10 marks]

2. Construct a deterministic finite state automaton that recognises the same language as defined by the regular expression in question 1. [10 marks]

3. Consider the following grammar for Boolean expressions: [10 marks]

   $E \rightarrow E$ **or** $E \mid E$ **and** $E \mid$ **not** $E \mid (E) \mid$ id

   Show that the grammar is ambiguous by giving two different parse trees for the following expression:

   id **and** (**not** id **or** id)

4. Construct an unambiguous grammar which describes the same language as the grammar given in question 3, and which deals with the precedence of the Boolean operators (**not** has the highest precedence, followed by **and**, followed by **or**). [10 marks]

5. Verify whether or not the following grammar is LL(1): [10 marks]

   $S \rightarrow aAa$
   $S \rightarrow b$
   $A \rightarrow ab$
   $A \rightarrow \varepsilon$

6. Verify whether or not the following grammar is SLR(1): [10 marks]

   $S \rightarrow AaAb$
   $S \rightarrow BbBa$
   $A \rightarrow \varepsilon$
   $B \rightarrow \varepsilon$

7. Verify whether or not the following grammar is LR(0): [10 marks]

   $S \rightarrow Xb$
   $S \rightarrow Y$
   $X \rightarrow aY$
   $Y \rightarrow a$
   $Y \rightarrow aX$

8. Verify whether or not the grammar in question 7 is LR(1). [10 marks]

9. Consider the following attribute grammar for numbers in a given base:

Production	Semantic Rules
$S \rightarrow \text{digit} : D$	D.bas := digit.val D.pos := 0 S.val := D.val
$D \rightarrow D' \text{digit}$	D′.bas := D.bas D′.pos := D.pos + 1 D.val := D′.val + digit.val * $D.bas^{D.pos}$
$D \rightarrow \text{digit}$	D.val := digit.val * $D.bas^{D.pos}$

You can assume that `digit` is a digit in the range 0-9, and that `digit.val` gives the value of this digit.

Use this attribute grammar to calculate the attributes for the string 8:123 (note: this denotes the octal or base 8 number 123).

10. Construct a control-flow graph for the following piece of code: [10 marks]

```
if (x < y)
        if (x < z)
                smallest = x;
        else
                smallest = z;
else
        if (y < z)
                smallest  = y;
        else
                smallest = z;
return smallest;
```

[Total marks: 100]