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MCA-404(1)

(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 1475**

Roll No.

**M. C. A.**

**(SEM. IV) EXAMINATION, 2006-07**

**COMPILER DESIGN**

*Time : 3 Hours]*

*[Total Marks : 100*

*Note : Attempt all questions*

- 1 Attempt any **two** of the following parts :
- (a) What do you understand by single pass and multi pass compiler. Discuss their merits and demerits also. **10**
  - (b) Describe the languages denoted by the following regular expressions : **10**
    - (1)  $0(0|1)^*0$
    - (2)  $C(\in|0|^*)^*$
    - (3)  $(0|1)^*0(0|1)(0|1)$
    - (4)  $a^*|0^*|0^*|0^*$
  - (c) Following are the sequence of auxiliary definitions : **10**

$$A_0 = a / b$$

$$A_1 = A_0 A_0$$

$$A_2 = A_1 A_1$$

$$\vdots$$

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[Contd...

$$A_n = A_{n-1}A_{n-1}$$

followed by the pattern  $A_n$

- (1) Describe the set of strings denoted by the pattern (as a function of  $n$ )
- (2) If we substitute out all auxiliary definitions in the pattern, how long is the regular expression ?
- (3) If you convert the regular expression from (ii) into an NFA how many states are there ?

2 Attempt any **two** of the following :

(a) What do you understand by Boot strapping ? **10**  
Explain with the help of example.

(b) Formulate a context free grammar for the **10**  
language of parenthesized logical expressions consisting of the logical variable  $b$  and the logical operations  $\neg$  (not)  $\vee$ (or),  $\wedge$  (and)  $\rightarrow$  (if then) and  $\leftrightarrow$  (if and only if) the priority of the augmented set of logical operators is given from highest to lowest priority as :

$\neg$  **Highest**

$\wedge$

$\vee$

$\rightarrow$

$\leftrightarrow$  **Lowest**

Give a derivation and its associated syntax tree for each of the following sentences :

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[Contd...

(1)  $(b \vee b) \rightarrow b$

(2)  $\neg b \rightarrow b \vee b$

(3)  $(\neg(b \vee b)) \leftrightarrow \neg(b \wedge b)$

(c) Given the grammar :

$\langle \text{number} \rangle ::= \langle \text{integer} \rangle \mid \langle \text{real number} \rangle$

$\langle \text{integer} \rangle ::= \langle \text{digit} \rangle \mid \langle \text{integer} \rangle \langle \text{digit} \rangle$

$\langle \text{real number} \rangle ::= \langle \text{integer} \rangle \cdot \langle \text{integer} \rangle \mid$   
 $\langle \text{integer} \rangle \cdot \langle \text{integer} \rangle E \langle \text{scale} \rangle$   
 $\text{factor} \rangle \mid \langle \text{integer} \rangle E$   
 $\langle \text{scale factor} \rangle$

$\langle \text{scale factor} \rangle ::= \langle \text{integer} \rangle \mid \langle \text{sign} \rangle \langle \text{integer} \rangle$

$\langle \text{sign} \rangle ::= + \mid -$

$\langle \text{digit} \rangle ::= 0 \mid 1 \mid 2 \mid 3 \dots \dots \mid 9$

where  $\langle \text{number} \rangle$  is the starting symbol of the grammar, give left most and right most canonical derivation for the following sentences :

(1) 100

(2) 6E-3

(3) 87.25E+7

3 Attempt any **two** of the following parts :

(a) Discuss basic parsing techniques. **10**

(b) Consider the fragment of grammar as **10**

$\text{Stat} \rightarrow \text{if cond then sub stat else stat}$   
 $\mid \text{if cond then stat}$

$\text{Sub stat} \rightarrow \text{if cond then substat else stat}$  show that this grammar fragment is still ambiguous if stat, substat, and cond are given productions that allow them to derive terminal strings.

- (c) To generate a small NFA from a regular expression, it is useful to identify character strings in the syntax analysis of a regular expression. We might therefore wish to introduce the non terminal  $S$  (not the start symbol) standing for "string" as follows :

$$E \rightarrow E + E \mid EE \mid E^* \mid (E) \mid a \mid b \mid E \mid s$$

$$S \rightarrow a s \mid b s \mid E$$

- (1) Give ambiguity resolving rules that will cause all maximal length strings of two or more consecutive a's and b's to be parsed as an
- (2) Construct the LALR parser for the grammar with your ambiguity rules.

4 Attempt any **four** of the following :

- (a) Discuss the role of syntax directed translation scheme. **10**
- (b) Discuss the role of data flow analysis.
- (c) Discuss important data structures which are used in implementing symbol table. **10**
- (d) What do you understand by left recursion and left factoring ? How these are eliminated ? Explain with the help of example. **10**
- (e) Discuss the principal sources of optimization. **10**
- (f) Write down algorithm for code generation for three address code.