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 eej Kumar Birla Institute of Technology
 Gandhinagar
 GATEWAY

B. TECH.

SIXTH SEMESTER EXAMINATION, 2003-2004

COMPILER CONSTRUCTION

Time : 3 Hours

Total Marks : 100

Note : Attempt ALL questions.

1. Attempt any FOUR parts of the following :— (5×4=20)

(a) Differentiate between the following :—

(i) Compilers and Interpreters

(ii) Macro-processor and Pre-processor

(b) Discuss the action taken by every phase of the compiler on the following string :—

$$A = B * C + D/E$$

(c) Give Thompson's construction algorithm. Using this algorithm, convert the following regular expression into NFA (Non-deterministic Finite State Automaton) :—

$$(a|b)^*a(a|b)$$

(d) Find the DFA recognizing the language described by the regular expression :

$$a|abb|a^*b^+$$

(e) Discuss how YACC can be used to generate a parser. Also, explain the format of its input specification file.

(f) Construct all possible parse trees corresponding to the string $i + j * k$ for the following grammar. Also, comment on the precedence of operator $+$ and $*$ used in the grammar :—

$$E \rightarrow E + E$$

$$E \rightarrow E * E$$

$$E \rightarrow \text{id}$$

2. Attempt any TWO parts of the following :— (10×2=20)

- (a) Give algorithm for construction of predictive parsing table. Consider the following grammar and construct predictive parsing table :—

$$S \rightarrow iEtSS_1$$

$$S_1 \rightarrow eS | E$$

$$E \rightarrow b$$

- (b) Give the algorithm for computing precedence function. Consider the following operator precedence matrix and compute the precedence function :—

	a	()	;	\$
a			>	>	>
(<	<	=	<	
)			>	>	>
;	<	<	>	>	
\$	<	<			

- (c) Construct the LALR parsing table for the following grammar :—

$$S \rightarrow AA$$

$$A \rightarrow aA | b$$

3. Attempt any TWO parts of the following :— (10×2=20)

- (a) Describe various representations of three-address codes. Translate the expression :

$$-(a + b) * (c + d) + (a + b + c)$$

into Quadruples and Triples.

- (b) Consider the following SDTS (syntax directed translation scheme) :—

$$E \rightarrow E_1 * T \quad \{ E.val = E_1.val * T.val \}$$
$$E \rightarrow T \quad \{ E.val = T.val \}$$
$$T \rightarrow T_1 - F \quad \{ T.val = T_1.val - F.val \}$$
$$T \rightarrow F \quad \{ T.val = F.val \}$$
$$F \rightarrow 2 \quad \{ F.val = 2 \}$$
$$F \rightarrow 4 \quad \{ F.val = 4 \}$$

- (i) Using the above SDTS, construct a parse tree for the expression :

$$4 - 2 - 4 * 2$$

Also compute its E.val.

- (ii) Modify the given SDTS, without changing the grammar, by introducing E.red (synthesized attribute) to count the number of reductions performed while reducing an input to E.

- (c) Explain the backpatching. Also generate three-address code for the following program segment :—

```
while (a < c and b > d) do
  if a = 1 then c = c + 1;
else
  while a <= d do
    a = a + 3;
```

4. Attempt any TWO parts of the following :— (10×2=20)

- (a) Describe the representation of scope information in the symbol table. Consider the following program structure and give its symbol table organization :—

```
Program main
  Var x, y : integer
  Procedure P
    variable X, a : boolean
  Procedure Q
    Var x, y, z : real;
```

- 2.
- (b) Discuss the following parameter parsing techniques with suitable example :—
- (i) Call by value
 - (ii) Call by reference
 - (iii) Call by name
- (c) What do you understand by Lexical phase error and Syntactic phase error. Also suggest methods for recovery of errors.
5. Attempt any TWO parts of the following :— (10×2=20)
- (a) Discuss the algorithm for the elimination of induction variables with the help of example. Also, generalize this algorithm to the case where multiplicative constants can be negative.
- (b) Consider the following three-address code segment :—

```
PROD := 0
I := 1
T1 := 4 * I
T2 := addr (A) - 4
T3 := T2 [T1]
T4 := addr (B) - 4
T5 := T4 [T1]
T6 := T3 * T5
PROD := PROD + T6
I = I + 1
if I <= 20 goto (3)
```

- (i) Find the basic blocks and flow graph of above sequence.
 - (ii) Optimize the code sequence by applying function preserving transformation and loop optimization techniques.
- (c) Write short notes on any *two* of the following :—
- (i) Shift-reduce Parsing
 - (ii) Activation Record
 - (iii) Directed Acyclic Graph
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