CENTRAL INSTITUTE OF TECHNOLOGY KOKRAJHAR
(Deemed to be University)
KOKRAJHAR :: BTR :: ASSAM :: 783370

**END – SEMESTER EXAMINATION**
**UG**

Session: **Janu-June, 2023** Semester: **VI** Time: **3Hrs.** Full Marks: **100**
Course Code: **UCSE601** Course Title: **Compiler Design**

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**Answer question no 1 and any *four* from the rest**

1. Answer all the questions:
a) Lexical analyser is related to (regular expression, context free grammar, type checking, left-most derivation) .....
b) The number of token in the C-statement ***printf("Hello World");*** is .....
c) The grammar $S \rightarrow a/ab/abc$ is [LL (1), LL (2), LL (3)] .....
d) The regular expression for the language L = { w ∈ (0, 1) *: |w| is even} .....
e) The most powerful parser is (CLR, SLR, LALR) .....
f) The bottom-up parsing is also known as (Shift-reduce, Predictive, Recursive descent) .....
g) Write the three address code for $x = a[i][j]$
h) Give an example of semantic error.
i) In order to calculate $x^n$, the minimum number of multiplication is .....
j) What are the different ways to express three address codes?

2 x 10

2. (a) Remove left recursion from the following grammar:

$$A \rightarrow ABd|Aa|a,\ B \rightarrow Bc|b$$

(b) Calculate the First and Follow for the given grammar:

$$S \rightarrow ACB|CbB|Ba,\ A \rightarrow da|BC,\ B \rightarrow g|\epsilon,\ C \rightarrow h|\epsilon$$

c) Write quadruples for the expression:

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

6 + 10 + 4

3. a) Consider the following grammar:

$$S \rightarrow S,\ S \rightarrow SS|a|\epsilon$$

i) Construct the collection of sets of LR(0) items for this grammar and draw its go to graph.
ii) Indicate the shift-reduce and reduce-reduce conflict (if any) in the various state of the LR(0) parser.
b) Define ambiguous grammar. Check whether the grammar is ambiguous or not? Justify your answer.

$$S \rightarrow aBC,\ A \rightarrow bC|cd,\ C \rightarrow cd, B \rightarrow c|d$$

15 + 5



4. (a) Find the basic blocks and construct the Flow Graph of the following piece of Three Address Code:

| | |
|---|---|
| 1. location = -1 | 8. goto 10 |
| 2. i = 0 | 9. location = i |
| 3. if i<100 goto 5 | 10. t3 = i+1 |
| 4. goto 13 | 11. i = t3 |
| 5. t1 = 4*i | 12. goto 3 |
| 6. t2 = A[t1] | 13. return |
| 7. if t2 == x goto 9 | |

b) construct the LL(1) parsing table of the following grammar

$$S \rightarrow iEtSS'|a,\ S' \rightarrow eS|\epsilon,\ E \rightarrow b$$

10 + 10

5. (a) Consider the following grammar productions and the corresponding semantic rules:

| Production | Semantic Rule |
|---|---|
| E $\rightarrow$ TR | E.val = R.val , R.inh = T.val |
| R $\rightarrow \epsilon$ | R.val = R.inh |
| R $\rightarrow$ +E | R.val = R.inh + E.val |
| T $\rightarrow$ FS | T.val = S.val, S.inh = F.val |
| S $\rightarrow \epsilon$ | S.val = S.inh |
| S $\rightarrow$ *T | S.val = S.inh * T.val |
| F $\rightarrow$ n | F.val = n.val |
| F $\rightarrow$ (E) | F.val = E.val |

Use this to evaluate the expression 3*5. Display the annotated parse tree and order of evaluation of the variable attributes.

(b) The lexical analyzer uses the given patterns for recognizing three tokens, $T_1$, $T_2$, and $T_3$, over the alphabets $\{a, b, c\}$.

$$T_1 : a?(b|c)^*a$$
$$T_2 : b?(a|c)^*b$$
$$T_3 : c?(b|a)^*c.$$

Note: 'x?' means 1 or 0 occurrences of the symbol x. Also, the analyzer outputs the token matching the longest possible prefix. If the analyzer processes the string *bbaacabc*, find the sequence of tokens it outputs.

10 + 10

6. Write the short note on (any two)
a) Peephole optimization
b) Lex and Yacc
c) Target Code Generation

10 + 10

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