NEW SCHEME

CS664

USN

Sixth Semester B.E. Degree Examination, July/August 2005

Computer Science / Information Science and Engineering

Compiler Design

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*
2. All questions carry equal marks.

1. (a) What is the need for a multipass compiler? Explain.

(b) Briefly explain a strategy to reduce the number of passes. **(6 Marks)**

(c) Construct a transition diagram to recognize the tokens given below : **(4 Marks)**

i) Keywords : BEGIN END
ii) Integer constant
iii) Identifier

Show the program segment for the start state and one final state.

2. (a) Define : **(10 Marks)**

i) left most derivation
ii) right most derivation and
iii) Parsetree

(b) Your are given the grammar : **(6 Marks)**

$$S \rightarrow a|b|(L)$$
$$L \rightarrow L, S|S$$

Give left most derivation for the sentence ((a, b), a)

(c) Define ambiguity and show that the grammar below is ambiguous **(4 Marks)**

$$E \rightarrow E + E|E * E|(E)|id.$$

(d) Give an unambiguous grammar for the above language such that **(6 Marks)**

i) + has higher priority
ii) $*$ has less priority
iii) Both are right associative.

3. (a) Briefly explain the problems associated with top-down parsing. **(4 Marks)**

(b) Given the grammar **(6 Marks)**

$$E \rightarrow T + E|T$$
$$T \rightarrow T * F|F$$
$$F \rightarrow (E)|id$$

i) Make the necessary changes to make it suitable for u(1) parsing.
ii) For the resulting grammar, construct FIRST and FOLLOW sets and LL(1) parsing table.

(c) Briefly explain the rules for building operator precedence relations from priority and associativity. **(10 Marks)**

(4 Marks)

Contd.... 2

4. (a) Given the grammar

$$E \rightarrow E + T | T$$
$$T \rightarrow T * id | id$$

i) Construct sets of LR (1) items
ii) Construct canonical LR (1) parsing table
iii) Is the grammar LALR (1)? Justify your answer (8+4+2=14 Marks)

(b) Write a note on error recovery in LR parsers. (6 Marks)

5. (a) Briefly explain the concept of syntax directed definition. (4 Marks)

(b) Define synthesized and inherited attributes. (2 Marks)

(c) Define S-attributed and L-attributed SPD's (4 Marks)

(d) Give the syntax directed definition to process a simple variable declaration in C and construct annotated parse tree for the input (10 Marks)

int a, b, c;

6. (a) Briefly explain the run time storage scheme for C-language. Give the structure of the activation record. Briefly explain the actions required during.

i) function call
ii) function beginning
iii) return
iv) after the return (2+4+2×4=14 Marks)

(b) Briefly explain the difference between static scope and dynamic scope. (6 Marks)

7. (a) Briefly explain any five kinds of source level optimization. (10 Marks)

(b) Given the program segment :

```
a = b + c + d;
b = c+ a;
c = c+ d;
```

i) Give the 3 - address code
ii) Construct 'next use' information. Assume that temporaries are 'dead' and other variables are 'live' at the end. (10 Marks)

8. Write short notes on :

a) Panic modes
b) Peep hole optimization
c) Call-by-name
d) Register allocation by graph colouring (5×4=20 Marks)

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NEW SCHEME

CS664

Reg. No.

Sixth Semester B.E. Degree Examination, January/February 2006

Computer Science and Engineering

Complier Design

Time: 3 hrs.) (Max.Marks : 100

Note: ***Answer any FIVE full questions.***

1. **(a)** Explain with diagram the phases of a compiler. **(8 Marks)**

   (b) Show the translation made by each of these phases for the statement $a := b + c * 10$ where a,b and c are reals. **(4 Marks)**

   (c) Write a Lex program that recognises the following :

   i) if, then, else, begin, end

   ii) relational operators $<, >, <=, >=$

   iii) numbers in integer and reals separately

   iv) identifier (letter followed by digit)

   Also find the number of occurences of the above mentioned in the input file. **(8 Marks)**

2. **(a)** Construct the operator precedence relation table for the grammar given that

   $E \rightarrow E + E \mid E - E \mid E * E \mid E \uparrow E \mid (E) \mid id \mid E div E$

   i) $\uparrow$ has highest precedence and right associative

   ii) * and div operators are of next higher precedence and are left associative

   iii) $+$ & $-$ are lowest precedence and are left associative.

   Also find the precedence functions f and g. **(10 Marks)**

   (b) Explain left recursion and show how it is eliminated. Eliminate left recursion from the following grammar

   $E \rightarrow E + T \mid T$
   $T \rightarrow T * F \mid F$
   $F \rightarrow (E) \mid id$

   Also describe the algorithm used for eliminating left recursion. **(10 Marks)**

3. **(a)** What is left factoring? Show how we can left factor the grammar.

   $S \rightarrow iEtSeS \mid iEtS \mid a$
   $E \rightarrow b$

   (5 Marks)

   (b) Define LL(1) grammar. Give conditions for a grammar to be LL(1) based on first and follow. **(5 Marks)**

   (c) Obtain SLR parsing table for the grammar given in question 2(b). **(10 Marks)**

Contd.... 2

4. (a) Given the grammar

$E \rightarrow E + T \mid T$
$T \rightarrow id + T \mid id$

Construct LL(1) parsing table after making necessary modification. Is the grammar LL(1)? **(8 Marks)**

(b) Obtain the syntax directed definition for a simple desk calculator. Obtain an annotated parse tree for the expression 4*8+6n. **(8 Marks)**

(c) Describe S attributed and L attributed definition. **(4 Marks)**

5. (a) What is an activation record? Explain the purpose of each item in the activation record with example. **(8 Marks)**

(b) Explain briefly different storage allocation strategies. **(8 Marks)**

(c) Explain with examples quadruples, triples and indirect triples. **(4 Marks)**

6. (a) Explain the issues involved in code generation. **(10 Marks)**

(b) Write the code generation algorithm and generate code for the following expression.

$W = (X - Y) + (X - Z) + (X - Z)$. **(10 Marks)**

7. (a) Explain any five kinds of code optimisation techniques. **(10 Marks)**

(b) What are basic blocks and how do you partition a 3 address code into the basic blocks? **(5 Marks)**

(c) Translate the following into 3 address code

While $(A < B)$ do
if $(C < D)$ then $X = Y + Z$ **(5 Marks)**

8. Write short notes on any FOUR :

(a) Handle pruning

(b) Yacc

(c) Global register allocation

(d) DAG's

(e) Next use information for register allocation. **(5×4=20 Marks)**

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CS664

USN

NEW SCHEME

Sixth Semester B.E. Degree Examination, July 2006
Computer Science and Engineering
Compiler Design

Time: 3 hrs.] [Max. Marks:100

Note: *1. Answer any FIVE full questions.*

1 a. With the help of a neat diagram explain the various phases of a compiler and explain its functioning.

b. Why are look ahead operators required? With reference to this, give Lex Specification to recognize the DO and IF statement keywords in Fortran 77. **(10 Marks)**

2 a. Consider the grammar, **(10 Marks)**

$R \rightarrow R + R | R.R | R* | (R) | a | b | c$

i) Show that the grammar is ambiguous.
ii) Convert the above to equivalent unambiguous grammar.
iii) Write the parse structure in both grammar for the string a+b*.c

c. Give an algorithm for constructing predictive parsing table. Apply this algorithm for the following grammar to obtain parsing table. **(10 Marks)**

$E \rightarrow TE^{|}, \quad T \rightarrow FT^{|}, \quad T^{|} \rightarrow *FT^{|} | \in, \quad F \rightarrow (E) | id$.

3 a. Write an operator precedence parsing algorithm. **(10 Marks)**

b. Obtain set of canonical LR(0) items for the grammar $E^{|} \rightarrow E, \quad E \rightarrow E + T | T,$ $T \rightarrow T * F | F, \quad F \rightarrow (E) | id$ **(08 Marks)**

c. Write a note on Yale – Parser generator. **(08 Marks)**

4 a. Obtain directed acyclic graph for the expression $a + a * (b - c) + (b - c) * d$. Also give sequence of instructions for constructing above dag. **(04 Marks)**

b. Give Syntax Directed Definition with inherited attribute L.in. Show annotated parse tree for the sentence real id_1, id_2, id_3. **(06 Marks)**

c. Construct syntax tree for expression $a - 4 * C$ and give the sequence of functions calls. **(08 Marks)**

5 a. Write a note on activation tree in source language issues. **(06 Marks)**

b. Explain Stack and Heap allocation strategies with the help of necessary diagrams. Also highlight their differences. **(04 Marks)**

c. Explain different dynamic storage allocation techniques. **(06 Marks)**

6 a. Explain implementation of 3 – address code with an example. **(10 Marks)**

b. Give annotated parse tree for the string $x_i \; A[y, z]$ **(06 Marks)**

c. Explain methods of transformation of Boolean expressions. Generate 3 address code for the Boolean expression a<b or c<d and e<f. **(06 Marks)**

7 a. Explain the different issues involved in the design of code – generator. **(08 Marks)**

b. Explain different types of transformation on basic blocks. **(10 Marks)**

c. Obtain code sequence generated for pointer assignment $a := *P$ and $*P := a$. **(06 Marks)**

8 a. Explain graph colouring technique for allocation register. **(04 Marks)**

b. Explain any five kinds of code optimization techniques. **(04 Marks)**

c. Explain how the following code can be optimized and give its dag. **(10 Marks)**

a: = b + c
b: = a – d
c: = b + c
d: = a – d.

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CS664

USN

NEW SCHEME

Sixth Semester B.E. Degree Examination, Dec. 06 / Jan. 07
CS / IS
Compiler Design

Time: 3 hrs.] [Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. What is compiler? Explain the different phases of compiler by considering the following statement as input.
position := initial + rate * 60 **(10 Marks)**

b. Briefly explain the need for multipass in compiler. **(06 Marks)**

c. Briefly explain a strategy to reduce the number of passes. **(04 Marks)**

2 a. Write a transition diagram to recognize the following set of tokens. Write program segments for start state, any one of the intermediate states and any one final state.
BEGIN
END
ELSE
Identifier **(10 Marks)**

b. What is look ahead operator? With examples show how this operator may be used to solve lexical analysis problems. **(10 Marks)**

3 a. With a schematic, explain the role of Parser. List and explain various error recovery strategies. **(10 Marks)**

b. Define left-recursion. Eliminate left recursion from the following grammar :
$E \rightarrow E + T / T$
$T \rightarrow T * F / F$
$F \rightarrow (E) / id$
Also obtain FIRST and FOLLOW symbols for the above resulting grammar. **(10 Marks)**

4 a. Construct SLR(1) parsing table for the following grammar
$E \rightarrow T * E / T$
$T \rightarrow T + F / F$
$F \rightarrow id$ **(10 Marks)**

b. Compare the relative merits and demerits of LL (1), SLR (1), LALR (1) and canonical LR (1) parsing methods. **(10 Marks)**

5 a. Briefly explain the concept of syntax directed definition with example. **(06 Marks)**

b. Write a note on L-attributed definition. **(04 Marks)**

c. Give SDTS for an arithmetic expression with +, * and -. Show annotated parse tree for the input 3 + 4 * 5. **(10 Marks)**

Contd.... 2

6 a. Explain in detail, different storage allocation strategies. **(10 Marks)**
b. With example explain different parameter passing methods. **(10 Marks)**

7 a. Briefly explain the main issues in code generation. **(10 Marks)**
b. Briefly explain any five kinds of code-optimization. **(10 Marks)**

8 Write short notes on :
a. LEX
b. Recursive descent parser.
c. Dead code elimination.
d. L-attributed SDD. **(20 Marks)**

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CS664

USN | | | | | | | | | | |

NEW SCHEME

Sixth Semester B.E. Degree Examination, Dec. 06 / Jan. 07
CS / IS
Compiler Design

Time: 3 hrs.] [Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. What is compiler? Explain the different phases of compiler by considering the following statement as input.
position := initial + rate * 60 **(10 Marks)**

b. Briefly explain the need for multipass in compiler. **(06 Marks)**

c. Briefly explain a strategy to reduce the number of passes. **(04 Marks)**

2 a. Write a transition diagram to recognize the following set of tokens. Write program segments for start state, any one of the intermediate states and any one final state.
BEGIN
END
ELSE
Identifier **(10 Marks)**

b. What is look ahead operator? With examples show how this operator may be used to solve lexical analysis problems. **(10 Marks)**

3 a. With a schematic, explain the role of Parser. List and explain various error recovery strategies. **(10 Marks)**

b. Define left-recursion. Eliminate left recursion from the following grammar :
$E \rightarrow E + T / T$
$T \rightarrow T * F / F$
$F \rightarrow (E) / id$
Also obtain FIRST and FOLLOW symbols for the above resulting grammar. **(10 Marks)**

4 a. Construct SLR(1) parsing table for the following grammar
$E \rightarrow T * E / T$
$T \rightarrow T + F / F$
$F \rightarrow id$ **(10 Marks)**

b. Compare the relative merits and demerits of LL (1), SLR (1), LALR (1) and canonical LR (1) parsing methods. **(10 Marks)**

5 a. Briefly explain the concept of syntax directed definition with example. **(06 Marks)**

b. Write a note on L-attributed definition. **(04 Marks)**

c. Give SDTS for an arithmetic expression with +, * and -. Show annotated parse tree for the input 3 + 4 * 5. **(10 Marks)**

Contd.... 2

6 a. Explain in detail, different storage allocation strategies. **(10 Marks)**
b. With example explain different parameter passing methods. **(10 Marks)**

7 a. Briefly explain the main issues in code generation. **(10 Marks)**
b. Briefly explain any five kinds of code-optimization. **(10 Marks)**

8 Write short notes on :
a. LEX
b. Recursive descent parser.
c. Dead code elimination.
d. L-attributed SDD. **(20 Marks)**

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CS664

Sixth Semester B.E. Degree Examination, June / July 08
Complier Design

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. Explain the different phases of compiler with a block diagram. **(10 Marks)**

b. Construct a transition diagram for the following :
i) Relational operators ii) Identifiers iii) Unsigned numbers. **(06 Marks)**

c. Distinguish between phases and passes. **(04 Marks)**

2 a. Define ambiguity. Show that the grammar

$S \rightarrow ictses|icts|a$

is ambiguous and eliminate ambiguity from the expression. **(06 Marks)**

b. What do you mean by left recursion? Given the grammar,

$E \rightarrow E + T|T$

$T \rightarrow T * F|F$

$F \rightarrow (E)|id$

i) Remove left recursion and do left factoring if needed.
ii) For the resulting grammar construct LL(1) parsing table. **(14 Marks)**

3 a. Construct LALR parsing table for the grammar.

$S' \rightarrow S$

$S \rightarrow CC$. **(14 Marks)**

$C \rightarrow_C C|d$

b. What is handle pruning? Explain the same with the grammar.

$E \rightarrow E + E|E * E|(E)|id$

and the input string is id1 + id2 *id3 $. **(06 Marks)**

4 a. What are precedence functions? Give an algorithm for constructing precedence functions. From the table of precedence relations given below, construct precedence functions.

	id	+	*	$
id		:>	:>	:>
+	<:	:>	<:	:>
*	<:	:>	:>	:>
$	<:	<:	<:	

(10 Marks)

b. Briefly describe the concept of syntax directed definition. **(10 Marks)**

5 a. Explain the different storage allocation strategies. **(12 Marks)**

b. Give a scheme for runtime storage allocation for C – like languages along with the structure of activation record. **(08 Marks)**

6 a. Briefly explain the different types of intermediate codes, with the expression.

$a := b * -c + b * -c$. **(12 Marks)**

b. Explain in detail various issues involved in code generation phase. **(08 Marks)**

7 a. What are basic blocks? Explain in detail DAG representation of basic blocks. **(10 Marks)**

b. Briefly explain any five kinds of code optimization. **(10 Marks)**

8 Write short notes on :

a. Grouping of phases

b. LEX

c. Recursive descent parsing

d. Error recovery in LR parsers. **(20 Marks)**

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06CS63

Sixth Semester B.E. Degree Examination, June-July 2009
Compiler Design

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What is meant by input buffering? Explain the use of sentinels in recognizing tokens. **(04 Marks)**

b. With the help of a diagram, explain the various phases of a compiler. **(08 Marks)**

c. Construct the transition diagram to recognize the tokens given below:
i) Identifier ii) Relational operator iii) Unsigned number. **(08 Marks)**

2 a. Briefly explain the problems associated with top-down parser. **(04 Marks)**

b. Show that the grammar below is ambiguous.
$E \rightarrow E + E \mid E * E \mid id$
Give an unambiguous grammar for the above grammar such that + has higher priority, * has less priority and both are right associative. **(08 Marks)**

c. Given the grammar
$S \rightarrow a \mid (L)$
$L \rightarrow L, S \mid S$
i) Do the necessary changes to make it suitable for LL(1) parser.
ii) Check the resultant grammar is LL(1) or not. **(08 Marks)**

3 a. What is a shift reduce parser? Explain the conflicts that may occur during shift reduce parsing. **(04 Marks)**

b. Given the grammar
$A \rightarrow (A) \mid a$
i) Find LR(0) items ii) Construct SLR(1) parsing table. **(08 Marks)**

c. Write SLR(1) parsing algorithm. Using the table constructed in Q.3(b), show the parsing steps for the string ((a)). **(08 Marks)**

4 a. Write YACC specification to perform arithmetic operation. **(04 Marks)**

b. Write an algorithm for constructing the canonical LR(1) parsing table. Construct canonical LR(1) parsing table for $S \rightarrow CC$
$C \rightarrow eC \mid d$ **(16 Marks)**

PART – B

5 a. Give the syntax directed definition to process a sample variable declaration in C and construct dependency graph for the input float x, y, z. **(10 Marks)**

b. Assuming suitable syntax directed definition, construct a syntax tree for the expression $a - 4 + e$. **(10 Marks)**

6 a. Describe the method of generating intermediate code for the flow control statements. **(10 Marks)**

b. Explain the different types of representation of 3-address code. Generate 3-address code for $a < b$ or $c > d$ or $e < f$. **(10 Marks)**

7 a. Explain in detail different dynamic storage allocation strategies. **(10 Marks)**

b. Distinguish between static scope and dynamic scope. Briefly explain access to non-local names in static scope. **(10 Marks)**

8 a. Explain the code generation algorithm and generate code for the following expression
$X = (a - b) + (a + c)$ **(10 Marks)**

b. Briefly explain main issues in code generation. **(10 Marks)**

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06CS63

Sixth Semester B.E. Degree Examination, Dec.09/Jan.10
Compiler Design

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain a language processing system, with a block diagram. **(08 Marks)**

b. Explain the concept of input buffering in the lexical analysis. **(06 Marks)**

c. Write the transition diagram to recognize the token relop. (Corresponding to relational operators in a language). **(06 Marks)**

2 a. What is left-recursion? Eliminate left recursion from the following grammar:
$E \rightarrow E+T/T$; $T \rightarrow T*F/F$; $F \rightarrow (E)/id$ **(06 Marks)**

b. Obtain the predictive parsing table for the following grammar:
$S \rightarrow iEtSS'/a$; $S' \rightarrow eS/\in$; $E \rightarrow b$ **(14 Marks)**

3 a. Obtain LR(O) items for the following grammar:
$S \rightarrow L=R/R$; $L \rightarrow *R/id$; $R \rightarrow L$ **(08 Marks)**

b. Obtain first and follow symbols for the grammar shown in Q3 (a) and obtain SLR parsing table. Is the grammar SLR? **(12 Marks)**

4 a. Given the following grammar:
$S \rightarrow CC$; $C \rightarrow cC/d$
i) Construct sets of LR(1) items.
ii) Construct canonical LR(1) parsing table. **(12 Marks)**

b. Construct LALR parsing tables for the grammar shown in Q4 (a) using LR(1) items. **(08 Marks)**

PART – B

5 a. Explain the concept of syntax directed translation, with examples. **(06 Marks)**

b. Define inherited and synthesized attributes. **(04 Marks)**

c. Give SDD of a simple desk calculator. **(04 Marks)**

d. Write the annotated parse tree for $3*5+4n$. **(06 Marks)**

6 a. Draw the DAG for the arithmetic expression, $a+a*(b-c)+(b-c)*d$. Show the steps for constructing the DAG. **(10 Marks)**

b. What are three address codes? Explain different ways of representing three address codes, with examples. **(10 Marks)**

7 a. What is an activation record? Explain the purpose of each item in the activation record, with example. **(08 Marks)**

b. Distinguish between static scope and dynamic scope. **(04 Marks)**

c. What do you mean by calling sequence? Explain the actions performed during, i) function call ii) return. **(08 Marks)**

8 a. Explain the main issues in code generation. **(10 Marks)**

b. For the following program segment:

```
for i = 1 to 10 do
    for j = 1 to 10 do
        a[i, j] = 0.0
for i = 1 to 10 do
    a[i, i] = 1.0
```

generate intermediate code and identify basic blocks. **(10 Marks)**

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2002 SCHEME

USN | | | | | | | | | | |

CS664

Sixth Semester B.E. Degree Examination, Dec.09/Jan.10

Compiler Design

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. What are the different phases of a compiler? Explain each of the phases with examples. **(12 Marks)**

b. Give the regular expressions and transition diagram for the following tokens.
i) Identifier ii) Number iii) Relational operator **(08 Marks)**

2 a. What are the error recovery strategies used in parser? Explain. **(03 Marks)**

b. What is context free grammar? Give the notational convention used in it. **(07 Marks)**

c. Write the shift reduce parser on the input string : id * id + id **(10 Marks)**

3 a. Write the algorithm to eliminate left recursion from a grammar. **(05 Marks)**

b. Give the operator precedence relation table for the following grammar :

$$E \rightarrow E + E / E - E / E * E / E / E / id$$

(06 Marks)

c. Briefly explain LR parsing algorithm. **(09 Marks)**

4 a. What is syntax tree? Give syntax directed definition for construction of syntax tree for assignment statements. **(05 Marks)**

b. Write the annotated parse tree for 5 * 4 + 6n **(05 Marks)**

c. Write short note on the following :
i) Activation record ii) Activation trees **(10 Marks)**

5 a. What is three address code? Give the different types of three address statements. **(10 Marks)**

b. Write the quadruple and triple for the given statement :

$$a := b * c + d / e + f$$

(10 Marks)

6 a. What are the issues in the design of a code generator? Explain. **(10 Marks)**

b. What are the primary structure preserving transformations on basic block? Explain. **(10 Marks)**

7 a. What are the principal sources of code optimization? **(18 Marks)**

b. Write the DAG for the following given three address statements :

$a := b + c$
$b := a - d$
$c := b + c$
$d := a - d$

(02 Marks)

8 Write short notes on :

a. Role of lexical analyzer.
b. Code generation algorithm.
c. Algorithm of left factoring.
d. Translation scheme for Booleans. **(20 Marks)**

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