(1+2+3) + 6 = 12

9. Consider the matrix multiplication program

```
for(i=0; i<r1; ++i)
    for(j=0; j<c2; ++j)
    {
       result[i][j] = 0;
    }
for(i=0; i<r1; ++i)
    for(j=0; j<c2; ++j)
       for(k=0; k<c1; ++k)
       {
          result[i][j]= result[i][j]+a[i][k]*b[k][j];
       }
```

(i) Translate the above program into three-address statements

(ii) Construct a flow graph from the three-address statements

(iii) Eliminate the common sub-expression.

(3× 4)= 12

COMPILER DESIGN
(INFO 3132)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) Maximum number of states of a DFA converted from a NFA with n states is
(a) n (b) n^2 (c) 2^n (d) none of these.

(ii) Given the language L = {ab, aa, baa}, which of the following strings are in L*?
(1) abaabaaabaa (2) aaaabaaaa (3) baaaaabaaaab (4) baaaabaa
(a) 1, 2 and 3 (b) 2, 3 and 4 (c) 1, 2 and 4 (d) 1, 3 and 4.

(iii) Compiler can diagnose
(a) grammatical errors only (b) logical errors only
(c) grammatical and logical errors (d) none of the mentioned.

(iv) When expression sum=3+2 is tokenized then what is the token category of 3?
(a) Identifier (b) Assignment operator
(c) Integer Literal (d) Addition Operator.

(v) The graph that shows basic blocks and their successor relationship is called
(a) Dag (b) Flow Graph (c) Control Graph (d) Hamilton Graph.

(vi) A grammar that produces more than one parse tree for some sentence is called
(a) ambiguous (b) unambiguous
(c) regular (d) none of the mentioned.

(vii) Which of these is true about LR parsing?
(a) It is most general non-backtracking shift-reduce parsing
(b) It is still efficient
(c) Both (a) and (b)

(d) None of the mentioned.

(viii) The graph that shows basic blocks and their successor relationship is called
(a)Dag (b) Flow Graph (c) Control Graph (d) Hamilton Graph.

(ix) Type checking is normally done during?
(a) Lexical Analysis (b) Syntax Analysis
(c) Syntax Directed Translation (d) Code generation.

(x) Which of the following derivations does a top-down parser use while parsing an input string?
(a) Leftmost derivation
(b) Leftmost derivation in reverse
(c) Rightmost derivation
(d) Rightmost derivation in reverse.

Group – B

2. (a) What is mean by input buffering? Explain the use of sentinels to recognize tokens.

(b) Construct the transition diagram to recognize tokens given below:
(i) Identifier (ii) Unsigned number

(c) Explain different functions perform by Pre-processors.

(d) What are Lexemes and Tokens?

(1 + 3) + (2 × 2) + 2+ 2 = 12

3. Using Thompson's construction rule convert regular expression ((ab|ba)b*)*ab to NFA and then convert the NFA of ((ab|ba)b*)*ab to DFA.

(4 + 8) = 12

Group – C

4. (a) Define operator grammar with example. Draw block diagram of LR parser with stack and briefly describe the components.

(b) Consider the following grammar and test whether the grammar is LL(1) or not. State the reason.
S→1AB│ ϵ
A→1AC│0C
B→0S
C→1

(2 + 4) + (2 + 4) = 12

5. (a) Define augmented grammar with example. Draw parse tree for the following code fragment:

```
if(basic> 10,000)
salary =basic*1.8;
else
salary= basic*1.9 + PF;
```

(b) Compute FRIST() and FOLLOW() of the following grammar:
S→ACB│CbB│Ba
A→da│BC
B→g│ϵ
C→h│ϵ

(2 + 4) + (3 + 3) = 12

Group – D

6. (a) What are the different ways to represent intermediate code? Consider the following statements to construct 3-address code with quadruples:

```
x= y+z+k;
if  x>10 then
x=y*z*k;
else x=y+z-k;
```

(b) Define annoted parse tree. Given the Syntax-Directed Definition below with the synthesized attribute val, draw the annoted parse tree for the expression (3+4) * (5+6).

L →E	L.val = E.val
E →T	E.val =T.val
E →E1 + T	E.val = E1.val + T.val
T →F	T.val = F.val
T →T1* F	T.val = T1.val * F.val
F →(E)	F.val = E.val
F →digit	F.val = digit.lexval

(1 + 5) + (1 + 5) = 12

7. (a) Explain code motion with an example.

(b) Write short note on static and dynamic storage allocation strategies.

4 + (4 + 4) =12

Group – E

8. (a) What is DAG? Write the steps for DAG construction. Draw DAG for the following expressions:
a = b + c
b = b - d
c = c + d
e = b + c

(b) What is Loop optimization? Explain with example.