# COMPILER DESIGN
## (MCAP 3182)

**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) A compiler for a high-level language that runs on one machine and produces code for a different machine is called
(a) Optimizing compiler (b) One pass compiler
(c) Cross compiler (d) Multipass compiler.

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

(iii) An attribute in syntax directed translation is said to be synthesized if it is determined by attribute value of the
(a) child node (b) parent node
(c) sibling node (d) root node.

(iv) Conventionally, lower case Greek alphabets like α, β, γ etc. are members of
(a) $V_N$ (Set of non-terminals) (b) $\sum$ (Set of terminals)
(c) Strings of terminals (d) None of these.

(v) The symbol table implementation is based on the property of locality of reference is
(a) Linear list (b) Search tree
(c) Hash Table (d) Self Organization.

(vi) Which Type of Grammar is it?
$S \rightarrow Aa, A \rightarrow Aab \mid \varepsilon$
(a) Right Recursive (b) Left Recursive
(c) Regular (d) Right & Left Linear

(vii) The optimization which avoids test at every iteration is
(a) Loop unrolling (b) Loop jamming
(c) Constant folding (d) Loop Invariant Removal.

(viii) The process of removing sentences that do not get affected within the loop is known as
(a) Induction variable removal (b) Invariant removal
(c) Jamming (d) Peephole Optimization.

(ix) A dangling reference is a
(a) reference pointing to storage which is freed
(b) reference to an object that no longer exists
(c) reference pointing to storage which is still in use
(d) reference pointing to uninitialized storage.

(x) Given two DFA's M1 and M2. They are equivalent if
(a) M1 and M2 has the same number of states
(b) M1 and M2 has the same number of final states
(c) M1 and M2 accepts the same language i.e. L(M1) = L(M2)
(d) They have identical start state.

## Group - B

2. (a) Describe the role of Lexical Analyzer in the design of a Compiler.

(b) Convert the following Regular Expressions to NFA: (Any Two)
i. $(0|1)^*(01)^*0101$,
ii. $a^*(a|b)^*$
iii. $ab^*|ba^*$.

(c) What are the differences between NFA and DFA?

**3 + 6 + 3 = 12**

3. (a) Write Regular Expressions for the following:
i. Identifiers of C language.
ii. All strings of letters that contain the five vowels in order.
iii. All strings of digits that contain a valid IP address.

(b) Write a LEX script that will mimic the wc command of Unix.

**(3 × 2) + 6 = 12**

## Group - C

4. (a) Define formal grammar and classify according to the Chomsky Hierarchy.





(b) What is ambiguity in a grammar? Consider the grammar: S→ aSbS|bSaS|ε . Show that this grammar is ambiguous.

**8 + 4 = 12**

5. (a) When a Reduce-Reduce conflict can occur in LALR parsing?

(b) Compute FIRST and FOLLOW for each non-terminals of the following grammar:
$E \rightarrow ME'$, $E' \rightarrow +ME' \mid \varepsilon$, $M \rightarrow AM'$, $M' \rightarrow *AM' \mid \varepsilon$, $A \rightarrow num \mid (E)$

**4 + 8 =12**

## Group - D

6. (a) How is backpatching achieved? Justify or contradict the Statement, "backpatching is essential for constructs with forward branch tagets".

(b) Generate the translation scheme for the array reference and intermediate code along with parse tree for the following grammar: B[ I, J, K] = A, Where B is the array of size 10*20*30? Assume 4 bytes word.

**(3 + 3) + 6 = 12**

7. (a) What is a display? How does it help in accelerating the program execution?

(b) Differentiate synthesized and inherited attributes with example.

**(2 + 4) + 6 = 12**

## Group - E

8. (a) Generate 3 address code for the following program segment
```
sum = 0;
for (j = 1; j <= 10; j++)
sum = sum + a[j] + b[j];
```

(b) Explain back edge and non-reducible flow graph.

**6 + (3 + 3) = 12**

9. (a) Consider the following source language statement
If x+3>3*(y-1) +4 then z=0.
Convert it into (i) Quadruple, (ii) Triple.

(b) What is a Peephole in the context of Code Optimization? Discuss the scheme for Global Common Subexpression Elimination.

**5 + (2 + 5) = 12**