Final Assessment Test – November 2019

VIT
Vellore Institute of Technology

Course: CSE2002 - Theory of Computation and Compiler Design

Class NBR(s): 0663/0664/0677/0678/0914/0926/0930/ 0938/5369/6665

Slot: A2+TA2+TAA2

Time: Three Hours

Max. Marks: 100

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION, IS EXAM MALPRACTICE

General Instructions: Assume code is error free

Answer ALL Questions

(10 X 10 = 100 Marks)

1. Give a translation of statement for the expression given below by tracing down the output of each phase of compiler.

   $a / b \wedge (c - d + e) / f \wedge g - h$

2. Convert DFA directly from the given augmented regular expression.

   $(a\, a^* / b^*\, b)\, a\, b\, \#$

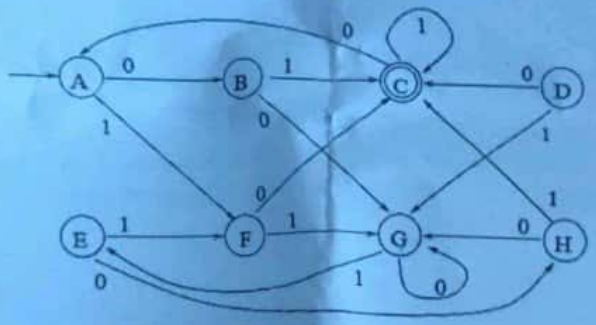
3. a) Minimize the DFA given below where [5]

   States are A to H.

   Initial state is A.

   The final state is C.

   The alphabets are {0, 1}.



   b) Prove that the language $L = \{ 0^n \mid n \text{ is not a power of } 2 \}$ is not regular. [5]

4. a) Find the equivalent three address code for given assignment statement. [5]

   $A[i,j] = B[i,j] + C[A[k,i]] + D[i+j]$

   b) How will find cost of instruction for the code given below [5]

   i) ADD b, a

   ii) DIV c, d

   iii) MUL d, e

   iv) ADD c, Ro

   v) MOV a, b

   vi) MOV *R1, R2

   vii) ADD *R2, R3

5. Explain your logic by constructing a pushdown automata for the language.
$D = \{a^{2n} b^m c^n / n, m \geq 1\}$

Given the input string a a b b c, discuss how the constructed PDA will process it.

6. Consider the following grammar:

$S \rightarrow A$,

$A \rightarrow xA \mid yA \mid y$

(i) Is the grammar LL(1) or not? Explain your answer. If not, transform the grammar into one that is LL(1), and give the LL(1) parse table for the transformed grammar.

(ii) Is the grammar LR(0)?.Why or why not?

(iii) Construct the SLR(1) parse table for the original grammar. Is the grammar SLR(1)? Why or why not?

(iv) Is the grammar LR(1)? Why or why not?

7. Construct a Turing machine that accepts exactly those strings of 0's, 1's, and 2's that have the same number of each character (so 010201221 would be accepted but 01122 would be rejected).

8. Consider the following basic block, in which all variables are integers and ** denotes exponentiation:

```
a := b + c
z := a ** 2
x := 0 * b
y := b + c
w := y * y
u := x + 3
v := u + w
```

Assume that the only variables that are live at the exit of this block are v and z. In order, apply the following optimizations to this basic block. Show the result of each transformation.

1. Algebraic simplification
2. Common sub-expression elimination
3. Copy propagation
4. Constant folding
5. Dead code elimination

When you have completed part 5, the resulting program will still not be optimal. What optimizations, in what order, can you apply to optimize the result of 5 further?

9.
```
01 func: a = 1
02 b = 2
03 L0: c = a + b
04 d = c - a
05 if c < d goto L2
06 d = b + d
07 if d < 1 goto L3
08 L2: b = a + b
09 e = c – a
```

10 if e == 0 goto L0

11 a = b + d

12 b = a – d

13 goto L1

14 L3: d = a + b

15 e = e + 1

16 goto L2

17 L1: return

For the code shown above, determine the following:

a) The basic blocks of instructions identifying the instructions that Constitutes each basic block. Clearly identify the leader instruction of each basic block.

b) The control-flow graph (CFG) and the corresponding dominator tree.

10. a) Construct the syntax tree, Directed Acyclic Graph and Quadruples for the given expression [6]

$$((x+y)-((x+y)\times(x-y)))+((x+y))$$

b) Eliminate all useless productions from the below grammar. [4]

Give all the steps.

G={

$S \rightarrow a \mid aA \mid B \mid C$

$A \rightarrow aB \mid \varepsilon$

$B \rightarrow Aa$

$C \rightarrow cCD$

$D \rightarrow ddd$

}

What language does this grammar generate?