INDIAN INSTITUTE OF INFORMATION TECHNOLOGY SRI CITY

END SEMESTER EXAMINATION – APRIL, 2021 (ONLINE MODE)

THEORY OF COMPUTING

DATE: 19-04-2021

1 a. Find whether string aabba is generated by the following grammar using CYK algorithm. Show the entire calculation table.

S -> AB

A -> BB | a

B -> AB | b

(4 marks)

1 b. Show that the following language is inherently ambiguous by identifying a string for which there will be two parse trees for any grammar generating L. Give the reason behind the inherent ambiguity of this language.

$$L = \{ a^i b^i c^j \mid i, j \geq 0 \} \cup \{ c^j b^i a^i \mid i, j \geq 0 \}$$

(1 mark)

2. a. Convert the following grammar to Chomsky Normal Form. Show the step-by-step procedure.

$S \rightarrow abAB$
$A \rightarrow bAB \mid \varepsilon$
$B \rightarrow BAa \mid A \mid \varepsilon$

(4 marks)

2b. State the advantages of converting a grammar to Chomsky Normal Form

(1 mark)

3. Consider the following Turing Machine M with input alphabet {a,b}, blank symbol B. Rest of the components of the TM can be inferred from the following transition table.

	B	X	a	b
→ q0	(q2,B,L)	(q0,X,R)	(q0,a,R)	(q1,X,L)
q1		(q1,X,L)	(q0,X,R)	
q2	(q3,B,R)	(q2,X,L)		
*q3				

(i) By giving trace (sequence of IDs) find whether **aababb** is in the L(M) or not.

(ii) By giving trace (sequence of IDs) find whether **aababbb** is in the L(M) or not.

(5 marks)

4. Find out whether each of the following language is a decidable language or not (Your answer should be a mathematically valid one).

(a) Let $ALL_{\mathsf{DFA}} = \{\langle A \rangle | \ A \text{ is a DFA and } L(A) = \Sigma^*\}$.

(b) Let $A\varepsilon_{\mathsf{CFG}} = \{\langle G \rangle | \ G \text{ is a CFG that generates } \varepsilon\}$.

(5 marks)