

## U.G. 5th Semester Examination - 2021

### BCA

Course Code : BBCACCHT501

Course Title : Theory of Computation

Full Marks : 40

Time : 2 Hours

*The figures in the right-hand margin indicate marks.*

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

1. Answer any **ten** questions: 1×10=10
- a) What is ambiguous grammar?
  - b) What is  $\epsilon$ -production in grammar?
  - c) Find all words 'w' having the properties  $|w| \leq 3$  from the language  $L = \{a^n \mid n \geq 0\}$ .
  - d) What is Backus-Naur Form (BNF)?
  - e) Which of the following is FALSE in respect to possible outcomes of executing a Turing Machine over a given input?
    - i) It may halt and accept the input.
    - ii) It may halt by changing the input.
    - iii) It may halt and reject the input.
    - iv) It may never halt.

- f) Draw the DFA for  $L = \{(ab)^n \mid n \geq 0\}$ .
- g) What is Arden's theorem?
- h) Find the regular expression 'r' over  $\Sigma = \{a, b\}$  such that  $L(r) = \{a^{2n}b^{2m+1} : n \geq 0, m \geq 0\}$ .
- i) Give the English description for the regular expression  $r = aa^*bb^*b$ .
- j) What is Chomsky hierarchy?
- k) What is main application of pumping lemma for regular expression?
- l) What is the relationship between CFG and PDA?
- m) Define Greibach normal form.
- n) Differentiate between  $L^*$  and  $L^+$ .
- o) What are the ways to simplify a Context Free Grammar?

2. Answer any **five** questions: 2×5=10
- a) What is Determinism and Non-Determinism in FA?
  - b) What is  $\epsilon$ -closure of a state  $q_0$ ?
  - c) Generate the Context Sensitive grammar for  $L = \{a^n b^n c^n \mid n > 0\}$ .
  - d) Write down the Regular expression denoting a language over  $\Sigma = \{1\}$  having

- i) even length of string
- ii) odd length of a string

e) Draw the transition diagram from the following table:

State	A	B
->q0	q1	q2
q1	q3	q2
q2	q1	q3
*q3	q3	q3

f) Differentiate between moore and melay machine.

g) Consider the following :

CFGG = ( $\{S,X,Y\}, \{a,b\}, P, S$ ) where P consist of

$S \rightarrow aXb/aYa$

$X \rightarrow Y/\lambda$

$Y \rightarrow b/X$

Remove  $\lambda$  productions.

h) Define Turing Machine.

3. Answer any **two** questions: 5×2=10

a) Define Type-3 grammar. Construct the regular grammar for the following expression :

$a^*b(a+b)^*$  2+3=5

b) i) Write down the algorithm to convert NFA to DFA.

ii) Define NFA with  $\lambda$ . 4+1

c) i) Convert the following grammar in to CNF:

$S \rightarrow bA/aB$  3+2

$A \rightarrow bAA/aS/a$

$B \rightarrow aBB/bS/b$

ii) State Pigeon whole principle.

4. Answer any **one** question : 10×1=10

a) i) Use induction to show that  $|un|=n|u|$  for all string u and all n.

ii) Construct a Moore machine that takes binary numbers as input and produces residue modulo 3 as output. 4+6=10

b) i) Draw the DFA for the following languages over  $\Sigma = \{a, b\}$ :

i) Set of all strings having at least one 'a' and exactly two b's.

ii) Set all strings that contain aba as substring.

iii) Set of all strings have even number of a .

ii) Obtain a NFA which should accept a language

$L = \{x \in \{a, b\}^* : |x| \geq 3 \text{ and third symbol of } x \text{ from right side is 'a'}\}$ .

iii) Minimize the following DFA:

States	$\Sigma$	
	0	1
$q_0$	$q_1$	$q_3$
$q_1$	$q_4$	$q_2$
$q_2$	$q_1$	$q_5$
$q_3$	$q_0$	$q_4$
$q_4$	$q_4$	$q_4$
$q_5$	$q_2$	$q_4$

$$3+2+5=10$$

c) i) Design a turing machine that accept  $\{0^n 1^n | n \geq 1\}$

ii) Show that  $L = \{a^i b^i | n \geq 1\}$  is not a regular language.

$$6+4=10$$

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