P P SAVANI UNIVERSITY

Sixth Semester of B. Tech. Examination

May 2022

SECE3020 Theory of Computation

24.05.2022, Tuesday **Time: 09:00 a.m. To 11:30a.m.** **Maximum Marks: 60**

Instructions:

1. The question paper comprises of two sections.
2. Section I and II must be attempted in separate answer sheets.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculator is allowed.

SECTION – I

Q - 1 Answer the Following: **[05]**

(i) p→q is false when _____.
a)p=F and q=F
b)p=F and q=T
c) p=T and q=F
d)p=T and q=T

(ii) There are _____ tuples in finite state machine.
a) 4
b) 5
c) 6
d) unlimited

(iii) Number of states require to accept string ends with 10.
a) 3
b) 2
c) 1
d) can't be represented.

(iv) How many strings of length less than 4 contains the language described by the regular expression (x+y)*y(a+ab)*?
a) 7
b) 10
c) 12
d) 11

(v) Regular expressions are closed under
a) Union
b) Intersection
c) Kleen star
d) All of the mentioned

Q - 2 (a) (i)Write the regular expression for the language accepting all the string which are starting with 1 and ending with 0, over $\sum = \{0, 1\}$. **[01]**

(ii)Write the regular expression for the language starting and ending with a and having any combination of b's in between. **[01]**

(iii)Write the regular expression for the language starting with a but not having consecutive b's. **[02]**

(iv)Write the regular expression for the language accepting all the string in which any number of a's is followed by any number of b's is followed by any number of c's. **[01]**

Q - 2 (b) Construct DFA for the language [05]
L={x belongs to {a,b}*/ x contains the strings ending in b and not containing the substring aa}

OR

Q - 2 (a) Prove using mathematical induction that for every integer n ≥ 4, n! > 2n. [05]

Q - 2 (b) (i)State Pumping Lemma Theorem for Regular Languages. [03]
(ii) State Kleen's Theorem and its uses. [02]

Q - 3 (a) Prove using mathematical induction prove that for every nonnegative integer n, [05]

$$\sum_{i=1}^{n} \frac{1}{i(i+1)} = \frac{n}{n+1}$$

(If n = 0, the sum on the left is 0 by definition.)

Q - 3 (b) Define Non-Deterministic Finite Automata.Construct Nondeterministic Finite Automata which accepts Language L where [05]
L = {x belongs to {aa,aab}*{b} }

OR

Q - 3 (a) Let L1 and L2 be the languages [05]
L1 = {x ∈ {a, b}* | aa is not a substring of x}
L2 = {x ∈ {a, b}* | x ends with ab}
For these two languages, Finite automata is as shown in Fig. 1 and Fig. 2.

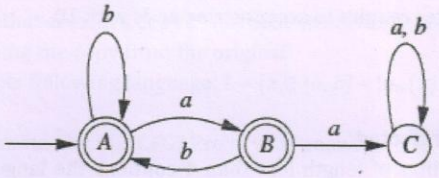

Fig.1

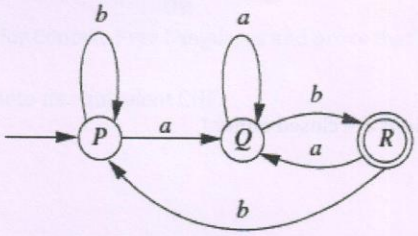

Fig. 2

Construct a Finite Automata which accepts L1∪ L2.

Q - 3 (b) For Finite Automata given in Fig. 3, find a minimum-state Finite Automata Recognizing the same language. **[05]**

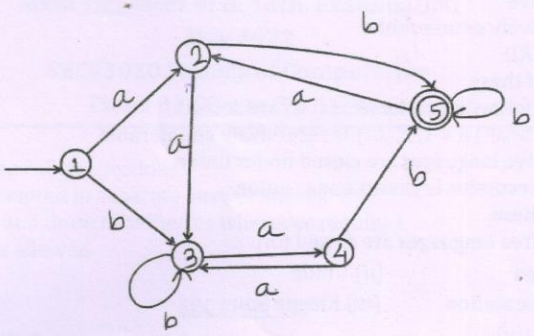

Fig. 3

Q - 4 **Attempt any one.** **[05]**

(i) Consider following Moore Machine. Convert it into a Mealy Machine.

Present State	Next State		Output
	input=0	input=1	
→a	D	b	1
B	A	d	0
C	C	c	0
D	B	a	1

(ii) Consider Nondeterministic finite automata given in below figure 4. write down the Language accepted by the given NFA. Apply string tracing and check that input string "aababa" is accepted or not.

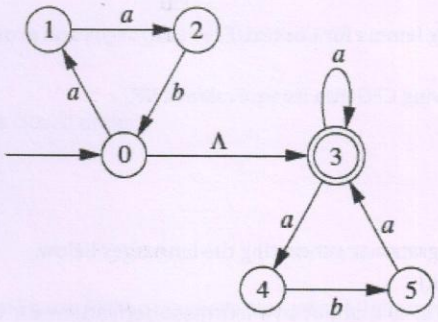

fig. 4

SECTION – II

Q - 1 Answer the Following: **[05]**

(i) Define a Turing Machine.

(ii) Explain LBA in brief.

(iii) If there exists a language L, for which there exists a TM, T, that accepts every word in L and either rejects or loops for every word that is not in L, is called
a) recursive
b) recursively enumerable
c) NP-HARD
d) none of these

(iv) Which of the following statement(s) is/are correct?
a) $L = \{a^n b^n a^n \mid n = 1, 2, 3...\}$ is recursively enumerable
b) Recursive languages are closed under union
c) Every recursive is closed under union
d) All of these

(v) The context-free languages are closed for:
(i) Intersection (ii) Union
(iii) Complementation (iv) Kleene Star
a) (i) and (iv)
b) (i) and (iii)
c) (ii) and (iv)
d) (ii) and (iii)

Q - 2 (a) Derive a CFG equivalent to following regular expression $(011 + 1)^* (01)^*$ and perform right most derivation with parse tree. **[07]**
Note: i/p string : 01101

Q - 2 (b) Explain Recursive Language and Recursive enumrable Language. **[03]**

OR

Q - 2 (a) Eliminate left recursion for following Grammar. **[03]**
S -> SAd | Sa | a
A -> Ae | b

Q - 2 (b) Develop a Turing Machine that creates a copy of its input string to the right of the input but with a blank space separating the copy from the original. **[07]**

Q - 3 (a) Develop a DPDA that accepts following language: $L = \{x \in \{a, b\} * | n_a(x) > n_b(x)\}$ **[05]**
Hint: No. of a > No. of b

Q - 3 (b) What language will be generated by this CFG? Prove your answer. **[05]**
$S \rightarrow aT \mid bT \mid \Lambda$
$T \rightarrow aS \mid bS$

OR

Q - 3 (a) Write the pumping lemma for Context-Free Languages and prove that $L = \{ a^i b^i c^i \mid i \geq 1\}$ is not a CFL. **[05]**

Q - 3 (b) Convert the following CFG into its equivalent CNF. **[05]**
$S \rightarrow aX \mid Y \mid bab$
$X \rightarrow \wedge \mid Y$
$Y \rightarrow bb \mid bXb$

Q - 4 Attempt any one. **[05]**

(i) Find context-free grammar generating the languages below.
$L = \{a^i b^j c^k \mid j \neq i + k\}$

(ii) For the following CFG, find out two left most derivations for the string "aaabb" and also draw the corresponding parse trees.
$S \rightarrow XY$
$X \rightarrow XX \mid a$
$Y \rightarrow YY \mid b$

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