Faculty of Engineering & Technology

Fourth Semester B.E. (Computer Science Engineering) (C.B.S) Examination

THEORETICAL FOUNDATIONS OF COMPUTER SCIENCE

Time—Three Hours] [Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.

(2) Solve Question No. **1 OR** Question No.**2**

(3) Solve Question No. **3 OR** Question No.**4**

(4) Solve Question No. **5 OR** Question No.**6**

(5) Solve Question No. **7 OR** Question No.**8**

(6) Solve Question No. **9 OR** Question No.**10**

(7) Solve Question No. **11 OR** Question No.**12**

(8) Due credit will be given to neatness and adequate dimensions.

(9) Assume suitable data whenever necessary.

(10) Illustrate your answers whenever necessary with the help of neat sketches.

1. (a) Explain Chomsky hierarchy of language in detail. 7

(b) Explain Pigeon-hole principle. 6

OR

2. (a) Explain the following terms :

(i) String

(ii) Prefix of string

(iii) Suffix of string

(iv) Star closure of string

(v) Plus (+) closure of string

(vi) Power set. 6

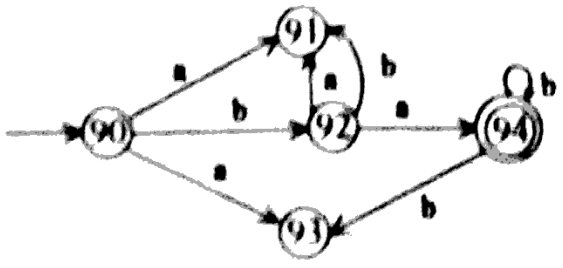
(b) Prove the given relation using principle of Induction.

$$1 \cdot 2 \cdot 3 + 2 \cdot 3 \cdot 4 + \ldots\ldots + n(n+1)(n+2) = \frac{n(n+1)(n+2)(n+3)}{4}.$$ 5

(c) Define countability and diagonalization. 2

3. (a) What is finite Automata ? Also, explain its applications. 6

(b) Convert the following NFA into equivalent DFA.



7

OR

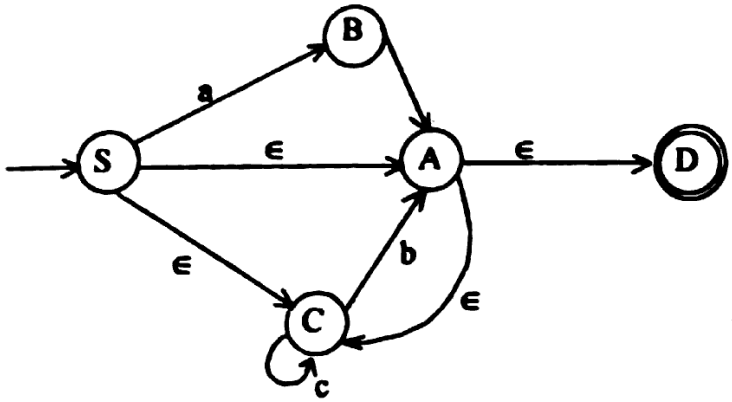
4. (a) Differentiate between Mealy and Moore M/C. 4

(b) Minimize the following DFA :

Σ / Q	a	b
q_0	q_1	q_0
q_1	q_0	q_2
q_2	q_3	q_1
(q_3)	q_3	q_0
q_4	q_3	q_5
q_5	q_6	q_4
q_6	q_5	q_6
q_7	q_6	q_3

6

(c) Calculate ∈-closure of all state of following NFA.



3

5. Write a regular expression for following language on {0, 1} :

(i) All strings not ending with "01"

(ii) All strings which should not contain "101" as substring. 14

OR

6. (a) Convert the following left linear grammar into right linear grammar :

$S \rightarrow A0 \mid A1$

$A \rightarrow B00$

$B \rightarrow B0 \mid B1 \mid 0 \mid 1.$ 5

(b) Reduce the following grammar :

$S \rightarrow aA \mid aBB$

$A \rightarrow aaA \mid \in$

$B \rightarrow bB \mid bbC$

$C \rightarrow B.$ 5

(c) Convert the grammar into CNF :

$S \rightarrow ABa$

$A \rightarrow aab$

$B \rightarrow AC.$ 4

7. Design a PDA for following. Also, construct CFG from designed PDA :

$L \{a^n b^m c^n d^m \ \ m, n \geq 1\}.$ 14

OR

8. (a) Explain closure property of CFL. 5

(b) Construct a NPDA that accepts the language generated by the grammar

$S \rightarrow aSbb \mid aab.$ 5

(c) Explain the model of PDA. 4

9. (a) Explain Linear bounded Automata. 6

(b) Design a Turing Machine for following language.

$L = \{a^n b^n c^n \; n \geq 1\}$. 7

OR

10. (a) Explain types of Turing Machine. 6

(b) Design a Turing Machine to multiply two unary numbers. 7

11. (a) Explain the properties of recursively enumerable set. 7

(b) Compute A(1, 1) A(1, 2) A(2, 1) using Ackerman function. 6

OR

12. (a) What is post correspondence problem and solve the following :

Sr. No.	List A	List B
1	01	011
2	1	10
3	1	11

6

(b) Show that the following functions are primitive recursive :

$$f(x) = \begin{cases} x/2 & \text{when x is even} \\ (x-1)/2 & \text{when x is odd} \end{cases}$$

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