Faculty of Engineering & Technology
Fourth Semester B.E. (Computer Science Engineering)
(C.B.S.) Examination
THEORETICAL FOUNDATION COMPUTER SCIENCE
Paper—IV

Time—Three Hours] [Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.

(2) Assume suitable data wherever necessary.

(3) Illustrate your answers wherever necessary with the help of neat sketches.

1. (a) Define the following terms with the help of examples :

(i) Transitive Closure

(ii) Reflexive Transitive Closure

(iii) Equivalence Relation. 6

(b) Prove the following by Mathematical Induction :

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

(c) Write a short note on Pigeonhole principle. 4

OR

2. (a) Explain the following with suitable examples :

(i) Alphabet set

(ii) Proper prefix

(iii) Proper suffix

(iv) Power set. 8

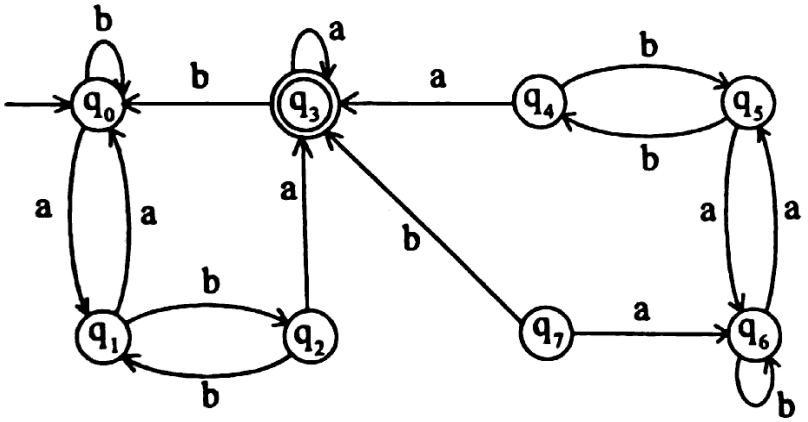
(b) Write short notes on :

(i) Countability

(ii) Diagonalization. 6

3. (a) Design a finite state machine which determines the residue mod 3 for any binary string. Design Moore and Mealy machine for the same. 6

(b) Minimize the DFA :



4

(c) Differentiate between NFA and DFA. 3

OR

4. (a) Desing a DFA accepting following language :

$$L = \left\{ w \;\middle|\; \begin{array}{l} w \in (a \mid b)^* \\ n(a)\, w \text{ MOD } 3 > nb(w) \text{ MOD } 3 \end{array} \right.$$

where $na(w) \rightarrow$ Number of a's in w

$nb(w) \rightarrow$ Number of b's in w. 8

(b) Desing a Moore and Melay Machine that generates output EVEN if the number of a's are Even and generates output ODD if the number of a's are odd for $\Sigma = \{a, b\}$. 5

5. (a) Convert the following Grammar from Right Linear to Left Linear form.

$S \rightarrow 01A \mid 10$

$A \rightarrow 10A \mid 10$ 5

(b) Reduce the following Grammar :

$S \rightarrow AB \mid CA$

$B \rightarrow BC \mid AB$

$A \rightarrow a$

$C \rightarrow aB \mid b$ 4

(c) Write a short note on Ambiguity of Grammar. Prove that the following Grammar is ambiguous :

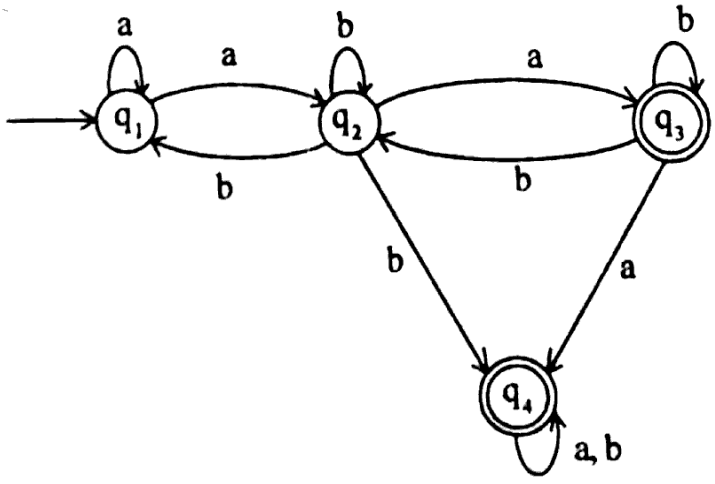
$S \rightarrow aSbS \mid bSaS \mid \in$. 4

OR

6. (a) Desing a NFA with $\in$-moves for the following regular expression then find equivalent DFA ;

$(a + b)^*\ aba'\ (a + ba)^*\ b$ 8

(b) Find Regular Expression for following finite Automata :



5

7. (a) Design PDA to check for a well formed parenthesis, write an algorithm for the same. Explain it with transition diagram. 6

(b) Convert the PDA accepting following language $L = \{a^n b^{2n} \mid n \geq 1\}$ into equivalent CFG. 8

OR

8. (a) Construct a PDA for the CFG and show the acceptance/rejection of string

$w = ababab$

$S \rightarrow aSa|bSb|a|b$ 7

(b) Construct PDA for the language :

$L = \{a^n b^n c^m d^m / m, n \geq 1\}$. 7

9. (a) Explain various types of Turing Machine. 6

(b) Design a Turing Machne to perform 2's complement of binary number. [Explain with Transition diagram and algorithm]. 5

(c) Explain Unrestricted Grammar. 2

OR

10. (a) Design a Turing machine for :

$L = \{W \subset W^R \mid W = (a, b)^*\}$. 7

(b) What are the closure properties of Recursive Enumerable Language. 6

11. (a) Show that Halting problem is unsolvable. 4

(b) Explain PCP problem and give solution for following :

$X = \{babbb, ba, b\}$, $Y = \{ba, a, bbb\}$. 5

(c) Define μ-recursive function. 4

OR

12. (a) Find Ackermann's function $A(1, 1) = ?$ and $A(2, 3) = ?$ 4

(b) Explain PRF and prove that the function is PRF :

(i) $f(x, y) = x + y$

(ii) $f(x, y) = x^y$. 6

(c) Explain Church's Hypothesis. 3