Faculty of Engineering & Technology
Fourth Semester B.E. (Computer Science Engineering) (C.B.S.) Examination
THEORETICAL FOUNDATION OF 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) With the help of Mathematical Induction prove that :

$$1^2 + 2^2 + 3^2 + \ldots + n^2 = \frac{n \times (n+1)(2n+1)}{6}.$$ 4

(b) Explain the following terms :

(i) Null set

(ii) Singleton set

(iii) Power set

(iv) Subset

(v) Universal set

(vi) Family of sets. 6

(c) Describe the concept of Pigeon hole principle with suitable example. 4

OR

2. (a) What do you mean by the following terms :

(i) Prefix of a string

(ii) Star closure of a language

(iii) Positive closure of a language

(iv) Proper prefixes and suffixes of a string. 4

(b) Explain Chomsky hierarchy of formal languages. 6

(c) Explain the following terms with suitable examples :

(i) Closure of Relation

(ii) Reflexive Closure

(iii) Symmetric Closure

(iv) Transitive Closure. 4

3. (a) Construct a DFA which is equivalent to NFA $m = (\{q_0, q_1, q_2, q_3\}, \{0,1\}, \delta, q_0, \{q_3\})$ and transition δ is given in table

Σ / Q	0	1
q_0	q_0q_1	q_0
q_1	q_2	q_1
q_2	q_3	q_3
q_3	—	q_2

6

(b) Design a DFA for accepting

$$L = \{W \mid \begin{array}{l} W \in (a \mid b) \\ n(a)W \text{ MOD3} > n(b)\text{MOD3} \end{array}$$

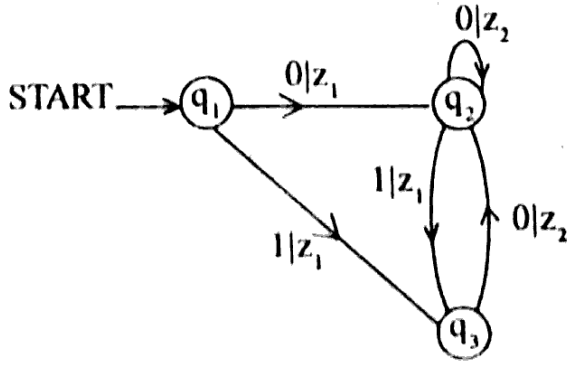
where $n(a) \rightarrow$ No. of a's

and $n(b) \rightarrow$ No. of b's. 7

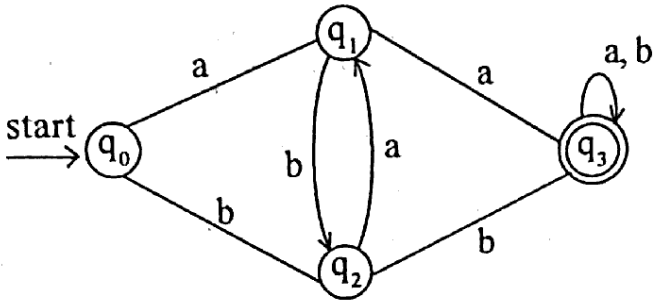
OR

4. (a) Design a Moore and Melay Machine that will generate OUTPUT EVEN if the no. of a's are even and generate OUTPUT ODD if the no. of a's are ODD over $\Sigma = \{a, b\}$. 6

(b) Convert the given Melay to Equivalent Moore Machine : 7



5. (a) Find the Regular Expression for the given transition diagram using Arden's theorem. 5



(b) Explain Pumping Lemma for Regular sets. Show that $L = \{0^i 1^i \mid i \geq 1\}$ is not Regular. 5

(c) Convert the Grammar with Productions :

$S \rightarrow ABa$

$A \rightarrow aab$

$B \rightarrow Ac$

to Chomsky Normal form. 4

OR

6. (a) Convert the following Grammar into GNF :

$S \rightarrow aAS$

$S \rightarrow a$

$A \rightarrow SbA$

Contd.

$A \rightarrow SS$

$A \rightarrow ba$ 5

(b) Obtain Left Linear Grammar Equivalent to the following Right Linear Grammar.

$S \rightarrow 01A \mid 10$

$A \rightarrow 10A \mid 10$ 5

(c) What is an Ambiguous Grammar ? Check the ambiguity of the following Grammar :

$S \rightarrow aSSb \mid bSSa \mid \in$ 4

7. (a) Design PDA for the given language. Design the algorithm and transition diagram for the same :

$L = \{a^n b^{2n} \mid n \geq 1\}$ 8

(b) Design a PDA for the following LPG :

$S \rightarrow XY$

$X \rightarrow AX \mid BX \mid a$

$Y \rightarrow YA \mid YB \mid ap$

$A \rightarrow a$

$B \rightarrow b$ 5

OR

8. (a) Construct a PDA accepting the

$\alpha = \{a^n b^m a^n \mid m, n \geq 1\}$

by null store. Construct a corresponding context free grammar accepting the same set. 8

(b) Construct a CFG which generate the following language :

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

and also design a PDA for above CFG. 5

9. (a) Describe the concept of Chruch's Hypothesis. 3

(b) Design a Turing Machine for (n+1)/2 where n is a uninary number. 6

(c) Explain the concept of Linear Bounded Automata. 4

OR

10. (a) Design a TM that has

INPUT :– # W # & generate O/P as

OUTPUT :– # W # W 8

(b) Explain the following terms :

(i) Multitape Turing Machine

(ii) Universal Turing Machine. 5

11. (a) Define Ackermann's Function. Compute A (1, 1), A (2, 1) and A (2, 2). 5

(b) Explain Post Correspondence problem. Prove that PCP with two list :

$X = (01, 1, 1)$

$Y = (01^2, 10, 1^2)$

has no solution. 5

(c) What is meant by Undecidability ? 3

OR

12. (a) "Every function in Primitive Recursive class is Turing Computable." Comment on the statement. 3

(b) Explain the properties of Recursive and Recursively Enumerable language. 6

(c) Describe the concept of Halting Problem. 4