

B.E. Computer Science & Engineering (MODEL CURRICULUM) Sem-V  
**TEE103CS : Formal Language and Automata Theory**

P. Pages : 3

Time : Three Hours

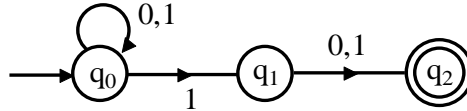


**GUG/W/22/13813**

Max. Marks : 80

- Notes :
1. All questions carry equal marks.
  2. Assume suitable data wherever necessary.
  3. Illustrate your answers wherever necessary with the help of neat sketches.

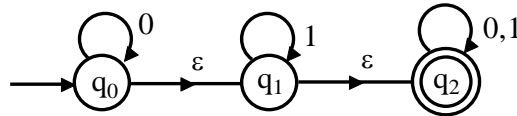
1. a) Convert the NFA to its equivalent DFA. 8



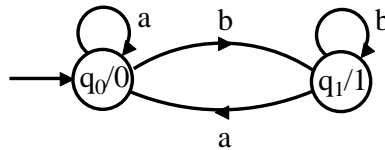
- b) What is finite automata? Construct DFA for the language over  $\Sigma = \{a, b\}$  for the set of all strings which ends with "bab". 8

**OR**

2. a) Convert the following NFA with  $\epsilon$ -transition into equivalent NFA without  $\epsilon$ -transition. 8



- b) Convert the following MOORE machine to mealy machine. 8



3. a) Define and design PDA (Push Down Automata) for  $L = \{a^m b^m c^n / n, m \geq 1\}$ . 8

- b) Convert PDA M, which accepts  $L = \{0^n 1^n\}$  into context free grammar. 8

$M = (\{q, r\}, \{0, 1\}, \{z, x\}, \delta, z, F)$

Where  $\delta$  is defined as.

- 1)  $\delta(q, 0, z) = (q, xz)$ ,
- 2)  $\delta(q, 0, x) = (q, xx)$ ,
- 3)  $\delta(q, 1, x) = (r, \epsilon)$ ,
- 4)  $\delta(r, 1, x) = (r, \epsilon)$
- 5)  $\delta(r, \epsilon, z) = (r, \epsilon)$

**OR**

4. a) Give formal definition of push down automata and explain the model of push down automata. 5
- b) Bring the following grammar in GNF. 6  
 $S \rightarrow SS$   
 $S \rightarrow 0S1 / 01$
- c) Show that the grammar- 5  
 $S \rightarrow aB / ab$   
 $A \rightarrow aAB / a$   
 $B \rightarrow ABb / b$  is ambiguous
5. a) Explain in detail context sensitive grammar? Consider the following grammar. 8  
 $s \rightarrow uvx$   
 $uv \rightarrow aux$   
 $uv \rightarrow buz$   
 $yx \rightarrow vax$   
 $zx \rightarrow vbx$   
 $ya \rightarrow ay$   
 $yb \rightarrow by$   
 $za \rightarrow az$   
 $zb \rightarrow bz$   
 $uv \rightarrow \epsilon$   
 $x \rightarrow \epsilon$   
 $av \rightarrow va$   
 $bv \rightarrow vb$   
Derive the following words from this grammar.  
1)  $\epsilon$   
2)  $aa$   
3)  $bb$   
4)  $ab ab$
- b) Show that every context sensitive language is recursive? Explain in detail linear bounded automata. 8

**OR**

6. a) Let  $M$  be an Linear bounded automata. Show that there exists an LBA  $M_1$ , accepting the same language as  $M$ , which always halts. Check whether its input is accepted or not. 8
- b) Consider the following grammar. 8  
 $S \rightarrow ABS / \epsilon$   
 $AB \rightarrow BA$   
 $BA \rightarrow AB$   
 $A \rightarrow a$   
 $B \rightarrow b$

- 1) Derive the abba and babaabbbbaa from above grammar.
- 2) Prove that all words with an equal no of a's and b's can be generated by this grammar.

7. a) Design Turing machine for language  $L = \{w \in \{a,b,c\}^* \mid w \text{ has equal number of a's, b's and c's}\}$ . 8
- b) Convert the following context free grammar into (CNF) Chomsky Normal Form. 8  
 $G = (\{S, A\}, \{a\}, p, s)$ , where p as,  
 $S \rightarrow AS / AAS$   
 $A \rightarrow SA / aa$

**OR**

8. a) Define Turing machine construct TM for 2's complement. 8
- b) Discuss briefly Chomsky Hierarchy of language with suitable example of each? 8
9. a) What is halting problem. Show that halting problem is undecidable. 8
- b) Define P and NP class? Explain the P and NP class with example. 8

**OR**

10. Write short note on:
- i) Recursive and Recursively enumerable language. 8
  - ii) Universal Turing Machine. 4
  - iii) Bounded minimalization. 4

\*\*\*\*\*

