2023

AUTOMATA THEORY AND LANGUAGES

Paper : BCA–5·4·2

Full Marks : 80

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer ***all*** sections.

SECTION–A

Answer ***any ten*** questions : 2×10=20

1. Define finite automata.

2. Define state, transition, and state transition diagram with a suitable example.

3. Draw a DFA to accept all strings over $\sum=\{a,b\}$ starting and ending with same symbol.

4. What is context free grammar ?

5. Design a regular expression for the language containing even number of 0's followed by odd number of 1's.

6. State pumping lemma for context free languages.

7. Define CNF.

8. What is PDA ? Mention its types.

9. State Arden's theorem.

10. Regular languages are closed under what operations ?

11. Define ambiguous grammar with a suitable example.

12. State *any two* properties of CFL's.

SECTION–B

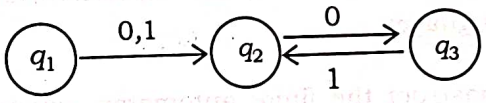
Answer ***any six*** questions : 5×6=30

13. What do you mean by regular grammar, right and left linear grammars ?

14. Obtain a CFG for the following language :

$$L = \{a^n b^n c^m / n >= 1, m >= 1\}$$

15. Convert the DFA to NFA :



16. Rewrite the following grammar after eliminating the useless symbols :

$$S \to AB \mid DS$$
$$A \to a$$
$$B \to c$$
$$C \to D$$
$$D \to Dd \mid \varepsilon$$
$$E \to a$$

17. Consider the grammar

$$G = (\{S\}, \{a, b, +, *\}, P, S)$$

where P consists of $S \to S+S \mid S*S \mid a \mid b$. Find the left-most and right-most derivations for the string "$a+b*a$".

18. What are the two normal forms in context free language ? State and explain with example.

19. Explain the Chomsky classification of languages.

20. Construct the finite automaton equivalent to the regular expression

$$a(a+b)^* ab$$

SECTION–C

Answer ***any three*** questions : 10×3=30

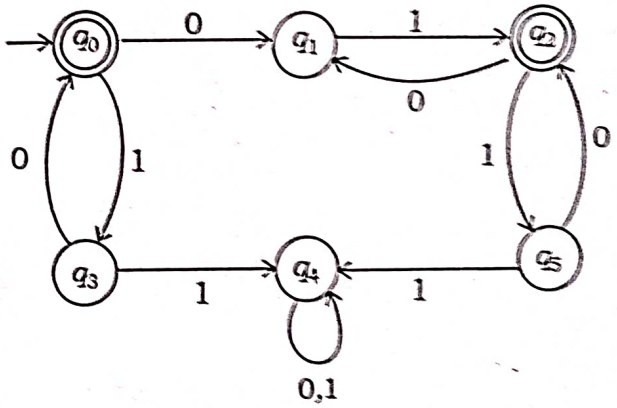
21. Construct a grammar in Greibach normal form (GNF) equivalent to the grammar $S \to AA \mid a,\ A \to SS \mid b$.

22. Design a PDA for the following language :

$$L = \{a^n c^m b^n / n \geq 0\}$$

What is instantaneous description ?

23. Construct a minimum state automaton equivalent to the DFA, described by fig.



24. State and proof pumping lemma for regular language. Give example.

25. *(a)* What is null production ? Eliminate the null production from the following grammar : 5

$$S \to aS/AB,\ A \to \wedge,\ B \to \wedge,\ D \to b$$

(b) Find a reduced grammar equivalent to the grammar G whose productions are 5

$$S \rightarrow AB/CA$$
$$B \rightarrow BC/AB$$
$$A \rightarrow a$$
$$C \rightarrow aB/b$$