B.E. END SEMESTER EXAMINATIONS APR/MAY 2024

Computer Science and Engineering

CS6202 THEORY OF COMPUTATION

3 Hours | Semester IV, Regulation 2018 | 100 Marks

PART - A (10 x 2 = 20)

1. When a finite automaton is said to be deterministic? Draw the transition diagram of a deterministic finite automaton to recognize empty language.

2. What is the maximum and minimum number of states available in a DFA equivalent to a NFA with m states?

3. Write a regular expression from the alphabet { 0, 1 } to recognize the set of all strings without the substring 101.

4. Prove that Φ^* generates a non-empty language.

5. Show that the following grammar is ambiguous by identifying anyone ambiguous sentence from its language.

   $S \rightarrow i\,(E)\,t\,S \mid i\,(E)\,t\,S\,e\,S \mid a \qquad E \rightarrow E = E \mid c$

6. Which normal form of the context free grammar will produce a string of length m in m-step derivation? State the reason.

7. Give a context free language and its grammar that cannot be recognized by a deterministic push down automaton.

8. Differentiate k-track Turing machine from k-tape Turing machine. What kinds of problems are benefitted from both types of Turing machines?

9. Is the complement of a recursive language decidable? Justify.

10. What is a diagonal language? Is it Turing recognizable?

PART - B (8 x 8 = 64)

(Answer any EIGHT questions)

11. Define a Nondeterministic Finite Automaton and prove that there exists an equivalent DFA for every NFA.

12. Convert the $\in$-NFA given here into its equivalent DFA. In the transition table, state p is the start state, state r is the final state, and Φ denotes no transition.

State	Transitions			
	$\in$	a	b	c
p	{q, r}	Φ	{q}	{r}
q	Φ	{p}	{r}	{p, q}
r	Φ	Φ	Φ	Φ

13. Find the regular expression denoted by the DFA given in figure 1.

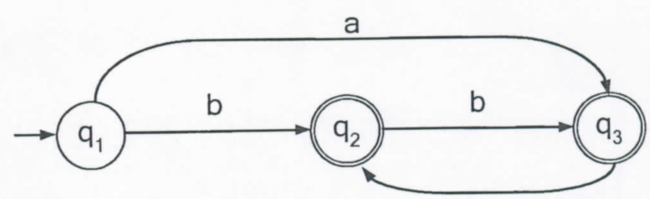

figure 1

14. What is the criterion to say the language of a finite automaton is infinite? Prove that the languages L_1 and L_2, described below, are not regular.

$$L_1 = \{ uu \mid u \in \{0, 1\}^* \}$$

$$L_2 = \{ 0^m 1^n 2^p,\ n,\ m,\ p > 0 \text{ and } m = p \}$$

15. Show that the regular languages are closed under union, reversal, intersection, and complement.

16. Simplify the following CFG whose language is L and find its equivalent CFG in CNF for L- {∈}.

$$S \rightarrow ASB \mid \epsilon \qquad A \rightarrow aAS \mid a \qquad B \rightarrow SbS \mid A \mid bb$$

17. Find the CFG in GNF for the language L denoted by the following grammar.

$$S \rightarrow ASc \mid Ab \quad A \rightarrow SA \mid c$$

18. Design PDAs for the languages.

$L_1 = \{ u\#u^R \mid u \in \{0, 1\}^* \text{ and } u^R \text{ is the reverse of } u \}$

$L_2 = \{ 0^m 1^n 2^p, n, m, p \geq 0 \text{ and } m = n + p \}$

19. How the given context free grammar is converted into its equivalent PDA? Find the PDA equivalent for the following grammar.

$$E \rightarrow E + E \mid E * E \mid (E) \mid V \qquad V \rightarrow Va \mid V0 \mid a$$

20. Prove that a Turing machine with two-way infinite tape can be simulated using one-way infinite tape.

21. Design a Turing Machine to compute 8*X+1, where X in in binary form in the Turing machine tape.

22. Define universal language L_u and prove that L_u is recursively enumerable but not recursive.

PART - C (2 x 8 = 16)

23. Prove that Post's correspondence problem is undecidable.

24. Find the context free grammar equivalent for the PDA P given below.

$P = (\{p, q\}, \{0, 1\}, \{Z, X\}, \delta, p, Z, \Phi)$

$\delta(p, 1, Z) = \{(p, XZ)\}$, $\delta(p, \epsilon, Z) = \{(p, \epsilon)\}$, $\delta(p, 1, X) = \{(p, XX)\}$,

$\delta(q, 1, X) = \{(q, \epsilon)\}$, $\delta(p, 0, X) = \{(q, X)\}$, $\delta(q, 0, Z) = \{(p, Z)\}$

QNo	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
CO	1	1	2	2	2	3	3	4	5	5	1	1	1	2	3	3	3	3	3	4	4	5	5	5
BT	2	2	2	3	2	1	1	2	1	2	2	3	3	2	2	3	3	2	3	2	3	2	2	4