2021/TDC/CBCS/ODD/
CSCHCC–501T/090

TDC (CBCS) Odd Semester Exam., 2021
held in March, 2022

COMPUTER SCIENCE

(5th Semester)

Course No. : CSCHCC–501T

(Theory of Computation)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

Answer any *ten* questions : 2×10=20

1. What is the importance of studying theory of computation?
2. Define Kleene star with example.
3. What do you mean by the positive closure of a language?
4. Define regular expression with example.

5. What do you mean by finite automata?

6. State pumping lemma for regular language.

7. Write down the applications of CFG.

8. What do you mean by the leftmost derivation tree?

9. What is the objective of designing a parse tree?

10. What is CFL? Give example.

11. Give the formal definition of PDA.

12. Distinguish between PDA and FA.

13. Define Turing machine.

14. Write down the properties of recursive enumerable languages.

15. How is TM more powerful than any other machine?

SECTION—B

Answer any *five* questions : 10×5=50

16. *(a)* What are the three branches of TOC? Explain them. 5

(b) Discuss the basic operations performed on languages. 5

(Continued)

17. *(a)* Given $\Sigma = \{a, b\}$.

(i) Obtain Σ^*.

(ii) Give an example of finite language in Σ. 2+2=4

(b) Given $L = \{a^n b^n : n \geq 0\}$. Check if the strings *aabb*, *aaaabbbb*, *abb* are in L. 2

(c) Given $L = \{a^n b^n : n \geq 0\}$. Obtain

(i) L^2

(ii) L^R 2+2=4

18. *(a)* Design DFA for the following languages : 2½+2½=5

(i) $L = \{(ab)^n : n \geq 0\}$ over $\Sigma = \{a, b\}$

(ii) $L = \{w \in \{a, b\}^* : w$ starts with a and ends with $b\}$

(b) Show that the language

$$L = \{0^i 1^i \mid i \geq 1\}$$

is not regular. 5

19. *(a)* Write the regular expressions for the following languages : 1+2+2=5

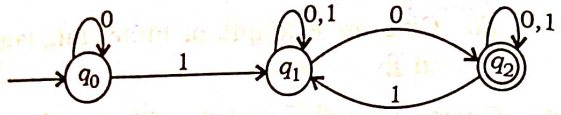
(i) $L = \{e, 11, 1111, 111111, \cdots\cdots\}$

(ii) $L = \{w \in \{a, b\}^* : w$ contains exactly two a's$\}$

(iii) $L = \{a^{2n} \mid n \geq 1\}$

(Turn Over)

(b) Convert the following NFA to its equivalent DFA :



20. (a) Give the formal definition of CFG. Also design CFG for the language $L = \{a^n b^n : n \geq 0\}$. 2+3=5

(b) Derive the string '*abb*' for leftmost and rightmost derivations using the following CFG : 5

$$S \rightarrow AB \mid e$$
$$A \rightarrow aB$$
$$B \rightarrow Sb$$

21. (a) Consider a CFG with the following production rule :

$$S \rightarrow aSa$$
$$S \rightarrow bSb$$
$$S \rightarrow c$$

Obtain the derivation tree and the language generated by the given grammar. 5

(b) What do you mean by ambiguity in grammar? Show that the grammar

$$S \rightarrow SbS$$
$$S \rightarrow a$$

is ambiguous grammar. 5

(Continued)

22. (a) Design PDA for the following languages : 4+4=8

(i) $L = \{a^n b^{2n} : n \geq 1\}$

(ii) $L = \{wcw^R : w \in \{a, b\}^*\}$

(b) Write two closure properties of CFL. 2

23. (a) Explain two normal forms of CFG with examples. 6

(b) Design PDA for the language

$L = \{w \in \{a, b\} : n_a(w) = n_b(w)\}$ 4

24. (a) Write short notes on the following : 3½+3½=7

(i) Recursive language

(ii) Recursive enumerable language

(b) Why is Turing halting problem undecidable? 3

25. (a) Design TM that accepts the set of all even palindromes over {0, 1}. 6

(b) What are undecidable problems in TOC? Explain. 4

★★★