

Reg. No.

B.Tech. DEGREE EXAMINATION, DECEMBER 2018
1st to 6th Semester

15CS301 – THEORY OF COMPUTATION

(For the candidates admitted during the academic year 2015-2016 to 2017-2018)

Note:

- (i) **Part - A** should be answered in OMR sheet within first 45 minutes and OMR sheet should be handed over to hall invigilator at the end of 45th minute.
- (ii) **Part - B and Part - C** should be answered in answer booklet.

Max. Marks: 100

Time: Three Hours

PART – A (20 × 1 = 20 Marks)
Answer ALL Questions

- Which of the following is not a part of 5-tuple finite automata?
(A) Input alphabet (B) Transition function
(C) Initial state (D) Output alphabet
- When are 2-finite states equivalent?
(A) Same number of transitions (B) Same number of states
(C) Same number of states as well as transitions (D) Both are final states
- The maximum number of transition which can be performed over a state in a DFA $\Sigma = \{a, b, c\}$
(A) 1 (B) 2
(C) 3 (D) 4
- A regular language over an alphabet 'a' is one that can be obtained from
(A) Union (B) Intersection
(C) Segmentation (D) Partition
- Regular expression ϕ^* is equivalent to
(A) ϵ (B) ϕ
(C) 0 (D) 1
- A push down automaton employs _____ data structure
(A) Queue (B) Linked list
(C) Hash table (D) Stack
- Push down automata accepts _____ language
(A) Type 3 (B) Type 2
(C) Type 1 (D) Type 0
- A string is accepted by a PDA when
(A) Stack is empty (B) Acceptance state
(C) Both (A) and (B) (D) Rejected state

9. Given grammar: $S \rightarrow A$, $A \rightarrow Aa$, $A \rightarrow e$, $B \rightarrow bA$ which among the following productions are useless productions?
 (A) $S \rightarrow A$ (B) $A \rightarrow aA$
 (C) $A \rightarrow e$ (D) $B \rightarrow bA$
10. Give grammar: $A \rightarrow aS|A$, $A \rightarrow a$, $B \rightarrow aa$ find the number of variables reaching from the starting variable
 (A) 0 (B) 1
 (C) 2 (D) 3
11. Which of the following strings is not generated by the given grammar: $S \rightarrow SaSb|e$?
 (A) aabb (B) abab
 (C) abaabb (D) baaa
12. Which of the following does not have left recursions?
 (A) Chomsky normal form (B) Greibach normal form
 (C) Backus naur form (D) Regular normal form
13. The context free languages are closed under
 (A) Intersection (B) Complement
 (C) Kleene (D) Segment
14. A turing machine that is able to simulate other turing machines?
 (A) Nested turing machines (B) Universal turing machine
 (C) Counter machine (D) Multitape turing machine
15. While applying pumping lemma over a language we consider a string 'W' that belong to 'L' and fragment it into _____ parts?
 (A) 2 (B) 5
 (C) 3 (D) 6
16. A grammar with more than one parse tree is called?
 (A) Unambiguous (B) Ambiguous
 (C) Regular (D) Irregular
17. Recursive languages are also known as
 (A) Decidable (B) Undecidable
 (C) Sometimes decidable (D) Sometimes undecidable
18. The language accepted by a Turing machine is called
 (A) Recursive enumerable (B) Recursive
 (C) Non recursive (D) Both (A) and (B)
19. A problem is called _____ if it has an efficient algorithm for itself.
 (A) Tractable (B) Intractable
 (C) Computational (D) Complex
20. Which of the following problem is not NP-hard?
 (A) Hamiltonian circuit (B) 0/1 knapsack problem
 (C) Finding bi-connected component of (D) Graph coloring

PART - B (5 × 4 = 20 Marks)
 Answer ANY FIVE Questions

21. Design an automata for the language over the alphabet $\Sigma = \{a, b\}$ which contains set of all string that not ends with "aba".
22. Explain context free grammar (CFG) with example and explain ambiguity with that grammar.
23. Design a PDA for accepting a language $\{L = a^n b^{2n} \mid n > 1\}$.
24. Show that the language $\{0^n 1^n 2^n\}$ is not a context free language.
25. Define multitape Turing machine and multiple track Turing machines.
26. Is it possible that a Turing machine could be considered as a computer of functions from integer to integer? If yes justify.
27. When a problem is said to be decidable and give an example of undecidable problem.

PART - C (5 × 12 = 60 Marks)
 Answer ALL Questions

28. a. Describe pumping lemma and prove that the language $L = a^n b^n$ is not regular when $n \geq 1$?
 (OR)
 b. Convert regular expression to ϵ -NFA and from ϵ -NFA to DFA for the expression $(a/b)^* ab$.
29. a. Convert the grammar
 $S \rightarrow ABB|Ba$
 $A \rightarrow Ba|e|ca$
 $B \rightarrow Bb|b|A$
 $C \rightarrow Ca|C|Ca$
 $D \rightarrow Da|a$
 into Chomsky normal form.
 (OR)
 b. Convert the grammar
 $S \rightarrow AB$
 $A \rightarrow BS|a$
 $B \rightarrow SA|b$
 into Greibach normal form.
30. a. Construct push down automata for $L = \{a^n b^n \mid n \geq 1\}$. Acceptance by emptying the stack.
 (OR)

b. Convert the PDA $P = (\{p, q\}, \{0, 1\}, \{x, z_0\}, \delta, q, z_0)$ to a CFG if δ is given by

- (i) $\delta(q, 1, z_0) = \{(q, xz_0)\}$
- (ii) $\delta(q, 1, x) = \{(q, xx)\}$
- (iii) $\delta(q, 0, x) = \{(p, x)\}$
- (iv) $\delta(q, \epsilon, x) = \{(q, \epsilon)\}$
- (v) $\delta(p, 1, x) = \{(p, \epsilon)\}$
- (vi) $\delta(p, 0, z_0) = \{(q, z_0)\}$

31. a. Describe the Turing machine that will recognize the language $L = \{w / w \in [a+b]^*\}$ and input string starts with 'a'.

(OR)

b. Construct a Turing machine that will accept multiplication of two integers.

32. a. Explain the following in detail

- (i) NP-hard problem
- (ii) NP-complete problem

(OR)

b. Explain about

- (i) Recursively enumerable language (4 Marks)
- (ii) Prove that universal Turing machine is recursively enumerable but not recursive. (8 Marks)

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