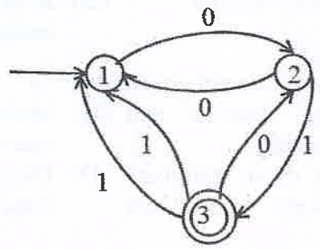
b. Find the regular expression for the following DFA.



29. a.i. Prove that $S \rightarrow aS \mid aSbS \mid \in$ is ambiguous. (8 Marks)

ii. Find left most derivation and right most derivation for the string 00101 for the grammar

$S \rightarrow A1B$

$A \rightarrow 0A \mid \in$ (4 Marks)

$B \rightarrow 0B \mid 1B \mid \in$

(OR)

b. Covert the following grammar into Chomsky normal form

$S \rightarrow ASB \mid \in$

$A \rightarrow aAS \mid a$

$B \rightarrow SbS \mid A \mid bb$

30. a. Construct a PDA for the language $L = \{a^n b^{2n} \mid n \geq 0\}$. Show that the string aabbbb is accepted by the PDA.

(OR)

b. Construct CFG for the following PDA $P = (\{p,q\},\{0,1\},\{x,z_0\},\delta,q,z_0)$ where δ is defined 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) $\delta(q,\in,x) = \{(q,\in)\}$

(v) $\delta(p,1,x) = \{(p,\in)\}$

(vi) $\delta(p,0,z_0) = \{(q,z_0)\}$

31. a. Design a Turing Machine to accept the language $L = \{0^n 1^n \mid n \geq 1\}$. Draw the transition diagram. Specify the instantaneous description to trace the string 0011.

(OR)

b. Explain the programming techniques for Turing Machine construction.

32. a. State and explain RICE theorem.

(OR)

b.i. Show that union of recursive languages is recursive.

ii. Show that intersection of recursive languages is recursive.

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Reg. No.															

B.Tech. DEGREE EXAMINATION, NOVEMBER 2019

Third to Seventh 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.

Time: Three Hours Max. Marks: 100

PART – A (20 × 1 = 20 Marks)

Answer **ALL** Questions

1. A language is regular if and only if it is accepted by
   (A) DFA (B) PDA
   (C) LBA (D) Turing machine

2. Regular expression for the language $L = \{w \in \{0,1\}^* \mid w$ has no pair of consecutive zero$\}$ is
   (A) $(1+010)^*$ (B) $(01+10)^*$
   (C) $(1+010)^*(0+\in)$ (D) $(1+01)^*(0+\in)$

3. Which of the following languages is not accepted by any DFA?
   (A) $L = \{x \mid x = 0^{2m}1^{4m}$ where m ∈ N$\}$ (B) $L = \{x \mid x = 0^{4m}$ where m ≥ 0$\}$
   (C) $L = \{x \mid x$ is name of some city in India$\}$ (D) $L = \{x \mid x$ is binary representation of form 5m+2$\}$

4. Which of the following is true?
   (A) NFA is a 6 tuple (B) A language accepted by a DFA is also accepted by some NFA but not vice versa
   (C) A language accepted by a DFA is also accepted by some NFA and vice versa (D) DFA is 5-tuple but not NFA

5. Let L_1, L_2 and L_3 are three languages out of which L_1 and L_2 are regular. Which of the following implies that L_3 is regular?
   (A) $L_1 = L_2 \cup L_3$ (B) $L_3 = L_1 \cdot (L_2 \cup L_1)^* \cdot L_2$
   (C) $L_1 = L_3^*$ (D) $L_2 = L_3 \cdot (L_1 \cup L_3)^*$

6. Consider the following grammar

   $S \rightarrow 0A \mid 1B$

   $A \rightarrow 0AA \mid 1S \mid 1$

   $B \rightarrow 1BB \mid 0S \mid 0$

   Which of the following is true?
   (A) Grammar is not ambiguous (B) Grammar is ambiguous
   (C) Grammar generates 0001000 (D) Grammar does not generate 001110

7. The following context grammar
$S \to aB \mid bA$
$A \to b \mid aS \mid bAA$
$B \to b \mid bS \mid aBB$
Generates strings of terminals that have
(A) Equal number of a's and b's
(B) Odd number of a's and odd number of b's
(C) Even number of a's and even number of b's
(D) Odd number of a's and even number of a's of b's

8. The set $\{a^n b^n / n = 1,2,3,.....\}$ can be generated by the CFG
(A) $S \to ab \mid aSb$
(B) $S \to aaSbb \mid abS$
(C) $S \to ab \mid aSb \mid \in$
(D) $S \to aaSbb \mid aabb$

9. Which of the following is not true?
(A) Power of deterministic automata is equivalent to the power of non-deterministic automata
(B) Power of deterministic pushdown automata is equivalent to power of non-deterministic pushdown automata
(C) Power of deterministic Turing machine is equivalent to power of non-deterministic Turing machine
(D) For every CFG there exists a non-deterministic pushdown automata

10. Consider the languages
$L_1 = \{0^i 1^j \mid i = j\}$ $L_2 = \{0^i 1^j \mid i = j\}$
$L_3 = \{0^i 1^j \mid 2j+1\}$ $L_4 = \{0^i 1^j \mid i! = 2\}$
(A) Only L_2 is context free
(B) Only L_2 and L_3 are context free
(C) Only L_1 and L_3 are context free
(D) L_1, L_2 and L_3 are context free

11. Identify the language which is not context free
(A) $L = \{ww^R \mid w \in (0,1)^*\}$
(B) $L = \{ww \mid w \in (0,1)^*\}$
(C) $L = \{a^i b^j c^k \mid i * j = k; i, j, k \geq 1\}$
(D) $L = \{0^i 1^j \mid i = j\}$

12. Context free grammar is not closed under
(A) Concatenation
(B) Complementation
(C) Kleene star
(D) Union

13. Given a Turing Machine $M = (\{q_0, q_1, q_2, q_3\}, \{a,b\}, \{a,b,B\}, \delta, B\{q_3\})$ where δ is a transition function defined as $\delta(q_0, a) = (q_1, a, R), \delta(q_1, b) = (q_2, b, R), \delta(q_2, a) = (q_2, a, R)$ $\delta(q_2, b) = (q_3, b, R)$. The language accepted by Turing machine is given as
(A) aa^*b
(B) $abab$
(C) aba^*b
(D) aba^*

14. Which of the following statement is false?
(A) For every non-deterministic Turing machine there exists a equivalent deterministic Turing machine
(B) Turing recognizable languages are closed under union and complementation
(C) Turing decidable languages are closed under intersection and complementation
(D) Turing recognizable languages are closed under union and intersection

15. Which of the following is true for the language $L = \{a^p \mid p$ is prime$\}$?
(A) It is not accepted by Turing machine
(B) It is regular but not context free
(C) It is context free but not regular
(D) It is neither regular not context free but accepted by a Turing machine

16. Which of the following pairs are not equivalent?
(A) Single tape Turing machine and multi tape Turing machine
(B) Multi tape and multi-dimensional Turing machine
(C) Deterministic push down automata and nondeterministic pushdown automata
(D) Deterministic finite automata and nondeterministic finite automata

17. Which of the following problem is undecidable?
(A) Membership problem of CFL
(B) Membership problem of regular sets
(C) Membership problem of CSL
(D) Membership problem of type 0 languages

18. Let L_1 and L_2 be two NP languages. Which of the following is not true?
(A) $L_1 \cup L_2 \in NP$
(B) $L_1 \cap L_2 \in NP$
(C) $L_1 \cdot L_2 \in NP$
(D) $\overline{L_1} \in NP$

19. Which of the following problem is solvable?
(A) Writing a universal Turing machine
(B) Determining of an arbitrary Turing machine is an universal Turing machine
(C) Determining of an universal Turing machine can be written for fewer than some k instructions for some k
(D) Determining a universal Turing machine and some inputs will halt

20. If L and L_1 are recursively enumerable, then L is
(A) Regular
(B) Context free
(C) Context sensitive
(D) Recursive

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

21. Prove by induction method $1+2+3+.....+n = \frac{n(n+1)}{2}$

22. Construct NFA, DFA and regular expression for the language accepting the set of strings with 011 as substring over $\sum = \{0, 1\}$.

23. Construct a context free grammar for the language $L = \{a^n \mid n$ is odd$\}$.

24. Show that $L = \{a^p \mid p$ is prime$\}$ is not context free.

25. Construct PDA for the language $a^n b^m a^{n+m}$.

26. List the seven tuple notation of a Turing machine.

27. Define recursively enumerable language.

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

28. a. Construct DFA for the following expression $(a+b)^* ab$.

(OR)