Reg. No.															

Question Paper Code	13240

B.E. / B.Tech. / M.Tech - DEGREE EXAMINATIONS, NOV / DEC 2024

Fifth Semester

Computer Science and Engineering

(Common to Computer Science and Engineering (IoT) & M.Tech. Computer Science and Engineering (5 years Integrated))

20CSPC502 - THEORY OF COMPUTATION

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

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

		Marks	K–Level	CO
1.	How an empty string is denoted?	1	K1	CO1
	(a) 0　　　　　(b) E　　　　　(c) $ 　　　　　(d) ε			
2.	In which type of finite automata, the machine only goes to one state for each input character.	1	K1	CO1
	(a) DFA　　　　　(b) NFA			
3.	How the DFA transition function is represented?	1	K1	CO1
	(a) $\delta: Q \times \sum \to Q$			
	(b) $W: Q \times \sum \to Q$			
	(c) $\delta: Q \times \sum \to W$			
	(d) $\delta: Q \times \sum \to F$			
4.	Write the regular expression for all strings Starts With a defined over {a,b}.	1	K1	CO2
	(a) a(a+b)　　　(b) a(a+b)*　　　(c) a*　　　(d) a*(a+b)*			
5.	Given the language L = {ab, aa, baa}, which of the following strings are in L*?	1	K1	CO2
	(a) abaabaaabaa　　(b) aaaabaaaa　　(c) baaaaabaa　　(d) All of these			
6.	Which type of expression can be used easily to represent the language accepted by finite automata?	1	K1	CO2
	(a) Constant expression　　　　　(b) Frequent expression			
	(c) Regular expression　　　　　(d) Conventional expression			
7.	In the PDA transition $\delta(q, a, X) = (p, \gamma)$, what does X represent?	1	K1	CO3
	(a) The current input symbol　　　(b) The top symbol of the stack			
	(c) The next state　　　(d) The symbol to be pushed onto the stack			
8.	The CFG $S \to aSb \mid SS \mid \epsilon$ generates which type of language?	1	K1	CO3
	(a) Strings with equal numbers of a's and b's in any order　(b) Palindromes			
	(c) Strings of the form $a^n b^n$　　　(d) Non-deterministic languages			
9.	What is the CFG that generates the language any number of a followed by b?	1	K1	CO3
	(a) $S \to aS \mid a \mid {}^\wedge$			
	(b) $S \to aS \mid b$			
	(c) $S \to aS \mid a$			
	(d) None of the above			
10.	Which of the following does not belong to the context free grammar?	1	K1	CO3
	(a) Terminal symbol　(b) Non-terminal symbol　(c) Start symbol　(d) End Symbol			
11.	What does it mean when we say that CFLs are closed under union?	1	K1	CO4
	(a) The union of a CFL with any regular language is regular.			
	(b) The union of two context-free languages is always context-free.			
	(c) The union of two context-free languages may not be context-free.			
	(d) The union of a context-free language with its complement is context-free.			
12.	Which of the following operations is CFLs closed under?	1	K1	CO4
	(a) Union　　　(b) Intersection　　　(c) Complement　　　(d) Subtraction			

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create　　　**13240**

13. What is the primary feature of a grammar in Greibach Normal Form? *1 K1 CO4*
    (a) Every production is of the form A→aB or A→a, where A andB are variables and a is a terminal.
    (b) Every production has exactly two variables.
    (c) The grammar allows epsilon (ε) productions.
    (d) Productions can start with a terminal or a variable.
14. Which among the following options are correct? *1 K1 CO5*
    Statement 1: TMs can accept languages that are not accepted by any PDA with one stack.
    Statement 2: But PDA with two stacks can accept any language that a TM can accept.
    (a) Statement 1 and 2, both are correct
    (b) Statement 1 is correct but Statement 2 is false
    (c) Statement 2 is correct while Statement 1 is false
    (d) Statement 1 and 2, both are false
15. In a n-track turing machine, how many head/heads read and write on all tracks simultaneously. *1 K1 CO5*
    (a) one   (b) two   (c) n   (d) infinite
16. Which of the following can be used to simulate any turing machine? *1 K1 CO5*
    (a) Finite State Automaton   (b) Universal Turing Machine
    (c) Counter machines   (d) All of the mentioned
17. Which among the following are undecidable theories? *1 K1 CO6*
    (a) The first order theory of boolean algebra
    (b) The first order theory of Euclidean geomentry
    (c) The first order theory of hyperbolic geometry
    (d) The first order theory of the natural number with addition, multiplication, and equality
18. What language L is said to be? if there is a turing machine M such that L(M)=L and M halts at every point. *1 K1 CO6*
    (a) Turing acceptable   (b) decidable   (c) undecidable   (d) none of the mentioned
19. Which of the following problems are decidable? *1 K1 CO6*
    1) Does a given program ever produce an output?
    2) If L is a context-free language, then, is L also context-free?
    3) If L is a regular language, then, is L also regular?
    4) If L is a recursive language, then, is L also recursive?
    (a) 1,2,3,4   (b) 1,2   (c) 2,3,4   (d) 3,4   (e) None of the mentioned
20. Assume lists A and B each contains 3 strings numbering 1,2,3. *1 K1 CO6*
    A=[aa, bb, abb] and B=[aab, ba, b] So the solution to this PCP is
    (a) 1,2,1,3   (b) 1,2,2,3   (c) 2,2,1,3   (d) 1,2,1,1

PART - B (10 × 2 = 20 Marks)
Answer ALL Questions

21. Define ε-closure (q) with an example. *2 K1 CO1*
22. Show the DFA for the set of all strings with equal number of 0's and 1's starting with '0'. *2 K1 CO1*
23. Illustrate a regular expression for the language accepting the strings which are starting with 1 and ending with 0, over the set = {0, 1}. *2 K2 CO2*
24. Define Homomorphism. *2 K1 CO2*
25. Define the instantaneous Description of PDA. *2 K1 CO3*
26. List the steps for Pumping Lemma for CFL. *2 K1 CO4*
27. State the steps to find the Reachable Symbols. *2 K1 CO4*
28. Classify some techniques for Turing machine construction. *2 K1 CO5*
29. Summarize the checking off symbols. *2 K2 CO5*
30. What is a universal language Lu? *2 K1 CO6*

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **13240**

PART - C (6 × 10 = 60 Marks)
Answer ALL Questions

31. a) Convert the following NFA with epsilon to its equivalent DFA directly.   *10 K2 CO1*
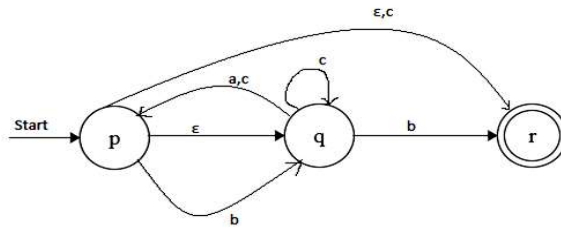
OR

  b) Describe and prove "LetS be a Finite subset of some Infinite set U. T be the   *10 K2 CO1*
  component of S with respect to U then T is Infinite".

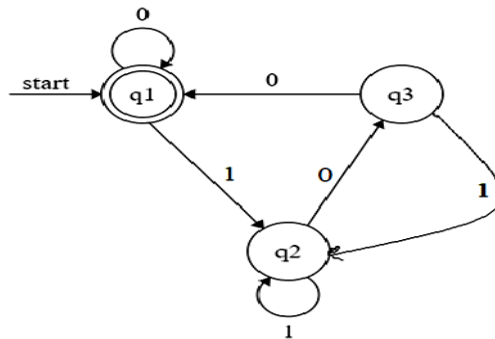32. a) Convert the DFA to minimize it using the Equivalence partition algorithm.   *10 K2 CO2*

	0	1
Start → A	B	A
B	A	C
C	D	B
* D	D	A
E	D	F
F	G	E
G	F	G
H	G	D

OR

  b) Convert the Finite Automata to regular expression using the State elimination   *10 K2 CO2*
  Method.

33. a) Consider the grammar   *10 K3 CO3*
      S→iCtS
      S→iCtSeS
      S→a
      C→b
      wherei, t, and e stand for if, then, and else, and C and S for "conditional" and
      "statement" respectively.
       (i) Construct a leftmost derivation for the sentence w=ibtibtaea.
      (ii) Show the corresponding parse tree for the above sentence.
      (iii) Is the above grammar ambiguous? If so, prove it.
      (iv) Remove ambiguity if any and prove that both the grammar produces the same
      language.

OR

  b) Construct PDA to accept the language L=$\{0^n1^n \ / \ n>=1\}$ accepting by final   *10 K3 CO3*
  state.Also check the string "0011" and "011" by instantaneous description.

34. a) Construct a turing machine for the language $L = \{w \, c \, w^R / w = \{0, 1\}\}$.　　10　K3　CO4

OR

b) Identify Greibach Normal Form (GNF) for the following grammar.　　10　K3　CO4

$S \rightarrow AB$
$A \rightarrow BS \, / \, b$
$B \rightarrow SA \, / \, a$

35. a) Explain the storage technique in the Turing machine.　　10　K2　CO5

OR

b) Explain Multi-tape and Multi-head Turing machine with suitable example.　　10　K2　CO5

36. a) Construct the given turing machine to MPCP.　　10　K3　CO6
   $M = (\{q1,q2,q3\},\{0,1\},\{0,1,B\},q1,B,\{q3\})$ with input string w=01

	0	1	B
q0	(q1,0,R)	(q1,0,R)	-
q1	(q1,0,R)	-	(q2,B,L)
q2	(q3,B,R)	-	-
q3	-	-	-

OR

b) Identify that "MPCP reduce to PCP".Does PCP with two lists below have a solution.　　10　K3　CO6

i	List A (Wi)	List B (Xi)
1	1	111
2	10111	10
3	10	0