KUMARAGURU
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B.E DEGREE EXAMINATIONS: MAY 2018
(Regulation 2015)
Fourth Semester
COMPUTER SCIENCE AND ENGINEERING
U15CST403 : Theory of Computation

COURSE OUTCOMES

CO1: Explain automata theory as the basis of all computer science languages design
CO2: Construct automata for regular expression and perform minimization of automata
CO3: Perform simplification in grammars and build normalized grammars
CO4: Construct Push Down Automata for simple Applications
CO5: Construct Turing machine for simple applications
CO6: Explain undecidable problems and measure complexity

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 1 = 10 Marks)

1.   CO1 [K_2]

List I	List II
A. Push down automata	i. Deterministic Finite State Automata
B. Halting Problem	ii. Recursive
C. Regular Grammar	iii. Context Free Grammar
D. Union of two recursively enumerable is	iv. Recursively Enumerable

	A	B	C	D
a)	ii	I	iii	iv
b)	iii	Iv	ii	i
c)	iii	Iv	i	ii
d)	iii	I	ii	iv

2. Select one CFG that can't be simulated by an Finite State Machine?   CO3   [K_3]
    a)   S $\rightarrow$ Sa | b   b)   S $\rightarrow$ abX, X $\rightarrow$ cY, Y $\rightarrow$ d | aX
    c)   S $\rightarrow$ aSb | ab   d)   S $\rightarrow$ abc

3. Write the regular expression for the language L={ W/ no pair of consecutive zeros in W,   CO2 [K_3]
    W $\in$ 0,1}
    1. $(1 + 01)^* (0 + \square)$
    2. $(1 + 010)^* (0 + \square)$
    3. $(101)^*$
    4. $(1 + 010)^*$
    a)   1,3   b)   1,4
    c)   1,2   d)   2,3

4. Recursively enumerable languages are not closed under_____   CO6 [K₁]

   a) Union   b) Concatenation

   c) Complementation   d) Intersection

5. Assertion (A): Let n be the positive integer constant and L be the language with alphabet {a}   CO2 [K₂]

   Reason (R): To recognize L the minimum number of states required in a DFA will be 2n+1

   a) Both A and R are Individually true and R is the correct explanation of A   b) Both A and R are Individually true but R is not the correct explanation of A

   c) A is true but R is false   d) A is false but R is true

6. The DFA shown below accepts the set of all strings over {0, 1} that_____   CO2 [K₃]
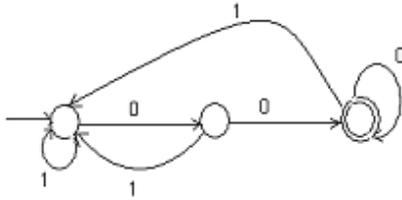
   a) End with 0   b) End with 00

   c) Begin either with 0 or 1   d) Contain the substring 00

7.   CO1 [K₃]
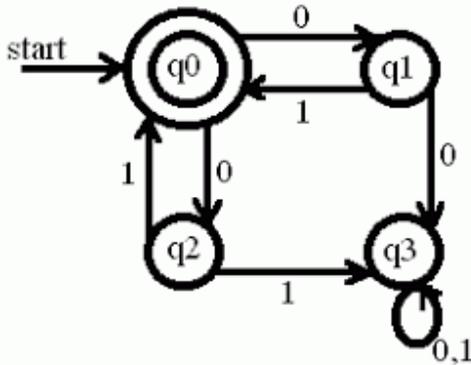
   Write the sequence of moves to trace the String 0101100 in above NFA

   a) q0-q1-q0-q2-q3-q3-q3-q3s   b) q0-q2-q1-q3-q3-q3-q3-q3

   c) q1-q0-q2-q3-q1-q3-q3-q3   d) q0-q2-q0-q1-q3-q3-q3-q3

8. The language accepted by a Push down Automata is_____   CO4 [K₂]

   a) Type 2   b) Type 0

   c) Type 1   d) Type 3

9. Assertion (A): P1 is decidable and P2 is undecidable   CO6 [K₁]

   Reason (R): P3 is undecidable if P2 is reducible to P3

   a) Both A and R are Individually true and R is the correct explanation of A   b) Both A and R are Individually true but R is not the correct explanation of A

   c) A is true but R is false   d) A is false but R is true

10. Next move function δ of a Turing machine M = (Q, Σ , Γ, δ, q0, B, F) is a _____   CO5 [K₂]

   a) $\delta : Q \times \Gamma \longrightarrow Q \times \Gamma \times \{L, R\}$ b) $\delta : Q \times \Gamma \longrightarrow Q \times \Sigma \times \{L, R\}$

   c) $\delta : Q \times \Sigma \longrightarrow Q \times \Gamma$ d) $\delta : Q \times \Sigma \longrightarrow Q \times \Gamma \times \{L, R\}$

PART B (10 x 2 = 20 Marks)
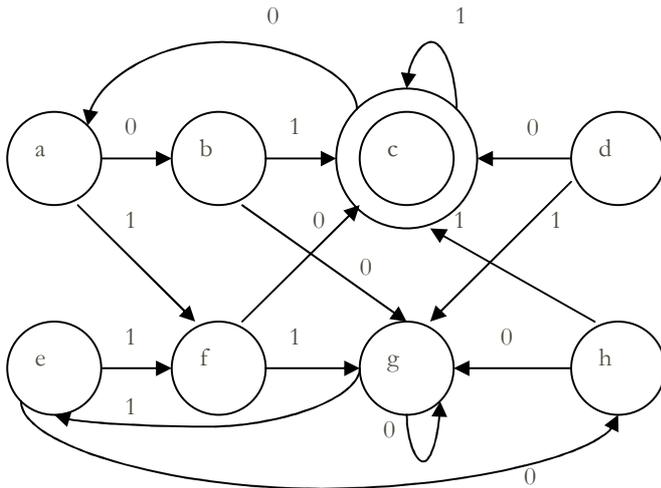### (Answer not more than 40 words)

11.	Define Deterministic finite state Automata.	CO1 [K_2]
12.	Design a DFA for L (M) = {$a^n b$ / n>=0}	CO2 [K_3]
13.	Is the language L = { a^{2n} / n > 1 is regular? Justify.	CO2 [K_2]
14.	Give the reason for minimization of Automata.	CO2 [K_1]
15.	Design a CFG for the language L={ WCW^R/ w is formed over the string {a,b}}	CO3 [K_6]
16.	Draw the Push down automata for the language L={ $a^n b^n$/n>0}	CO4 [K_3]
17.	Define Instantaneous Description of Turing machine.	CO5 [K_1]
18.	Draw the Turing machine to recognize all strings consisting of an even number of 1's over $\sum$ = {1}	CO5 [K_6]
19.	Mention the advantage of multi tape turning machine.	CO5 [K_1]
20.	What is Post Correspondence Problem?	CO6 [K_1]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

21. Convert the given productions into CNF.   CO3 [K_3]

S→bA/aB

A→bAA/aS/a

B→aBB/bS/b

22. Minimize the given DFA   CO2 [K_3]

23. Suppose the PDA P= ({q,p},{0,1},{Z_0,X}, δ,q, Z_0,{p}) has the following transition function :

        1. $\delta(q,0, Z_0) = \{(q, XZ_0)\}$
        2. $\delta(q,0, X) = \{(q,XX)\}$
        3. $\delta(q,1, X) = \{(q,X)\}$
        4. $\delta(q,\varepsilon, X) = \{(p,\varepsilon)\}$
        5. $\delta(p,\varepsilon, X) = \{(p,\varepsilon)\}$
        6. $\delta(p,1, X) = \{(p,XX)\}$
        7. $\delta(p,1, Z_0) = \{(p,\varepsilon)\}$ starting from the initial ID (q,w, Z_0), show all the reach
ID's when the input w is a) 01 b) 0011 c) 010

            CO4   [K_2]

24. Design a Turing Machine to accept the language L={$a^n b^{2n} a^n / n>0$} and simulate its action on the input abba.

            CO5   [K_6]

25. i. Prove that the language 'L' is recursive if the language 'L' and the complement of L (7) are recursively enumerable.
ii. Show that L_u is recursively enumerable.   (7)

            CO6   [K_2]

26. Construct a DFA that accepts all the string on {0,1} except those containing the substring 101

            CO2   [K_3]

27. Construct the following NFA into DFA

            COL   [K_3]

	0	1
p	{p,q}	{p}
q	{r,p}	{t}
r	{p,r}	{t}
t	Φ	Φ

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