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Printed Pages : 4 **TCS – 405**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 1071 Roll No.

B. Tech.

(SEM. IV) EXAMINATION, 2006-07

THEORY OF AUTOMATA & FORMAL LANGUAGES

Time : 3 Hours] *[Total Marks : **100***

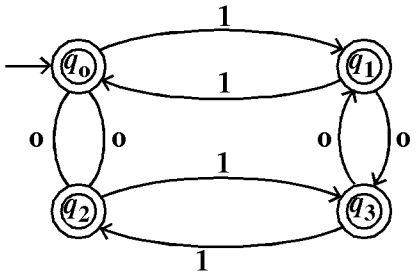
Note : *(1) Attempt **all** questions.*
*(2) All questions carry **equal** marks.*

1 Attempt any **two** parts of the following :

(a) (i) Find the transitive closure R^+ and reflexive and transitive closure R^* of the relation- **4**

$$R = \{(1, 2), (2, 3), (3, 4), (5, 4)\}$$

(ii) Consider the following transition diagram- **6**



Test whether the string 110101 is accepted by the finite automata represented by above transition diagram. Show the entire sequence of states traversed.

(b) Give DFA accepting the following languages over the alphabet $\{0, 1\}$ - **10**

(i) The set of all strings with three consecutive zeros.

(ii) The set of all strings such that every block of 05 consecutive symbols contains at least two zeros.

(c) Find the equivalence partition and corresponding reduced machine in standard form, for the following machine - **10**

PS	*NS, Z*	
	$X = 0$	$X = 1$
A	F, 0	B, 1
B	G, 0	A, 1
C	B, 0	C, 1
D	C, 0	B, 1
E	D, 0	A, 1
F	E, 1	F, 1
G	E, 1	G, 1

where, ***PS*** = Present State, ***NS*** = Next State
Z = Output, ***X*** = ***I/P***

2 Attempt any **two** questions :

(a) Construct DFA equivalent to the NFA- $(\{p, q, r, s\}, \{0, 1\}, \delta, p, \{s\})$, where δ is given by **10**

	0	**1**
p	*p,q*	*p*
q	*r*	*r*
r	*s*	–
s	*s*	*s*

(b) Construct NFA for $(a/b)^+$ and derive DFA through subset construction algorithm. **10**

(c) Prove or disprove the following for regular expressions r, s and t **10**

(i) $(r+s)^* = r^* + s^*$

(ii) $s(rs+s)^* r = rr^* s(rr^* s)^*$

3 Attempt any **four** questions :

(a) Construct finite automata equivalent to following regular expression - **5**

$10+(0+11)0^*1$

(b) Write regular expression for the following language over the alphabet $\{0, 1\}$ - **5**

"The set of all strings not containing 101 as a substring."

(c) Explain the procedure to convent a Moore machine into its corresponding Mealy machine, with the help of an example. **5**

(d) Find parse tree for the expression abbcde considering the productions - **5**

$S \rightarrow a\ Ac\ Be$

$A \rightarrow Ab$

$A \rightarrow b$

$B \rightarrow d$

(e) What is an ambiguous grammar ? Explain with example. **5**

(f) Consider the grammar $(\{S, A, B\}, \{a, b\}, P, S)$ **5**
that has the productions -
$S \rightarrow bA/aB$
$A \rightarrow bAA/aS/a$
$B \rightarrow aBB/bS/b$
Find an equivalent grammar in CNF.

4 Attempt any **two** questions :

(a) Define concept and working of a PDA. **10**

(b) Construct a PDA equivalent to the following grammar- **10**
$S \rightarrow aAA$
$A \rightarrow aS/bS/a$

(c) Construct a PDA accepting the language- **10**
$\{a^i\ b^j\ c^k / i \neq j \ \ or \ \ j \neq k\}$

5 Attempt any **four** questions :

(a) Define the basic model of a Turing machine. **5**

(b) Explain the techniques for Turing machines construction. **5**

(c) Explain Church's thesis. **5**

(d) Design Turing machine to compute the function **5**
$f(n) = n^2$

(e) Design Turing machine to recognize the language- **5**
"The set of strings with an equal no. of 0's and 1's."

(f) Give recursive definitions for : $n + m$. **5**

Printed Pages : 3 **Roll No.** | | | | | | | | | | | **NCS402**

B.TECH.

THEORY EXAMINATION (SEM–IV) 2016-17

THEORY OF AUTOMATA AND FORMAL LANGUAGES

Time : 3 Hours ***Max. Marks : 100***

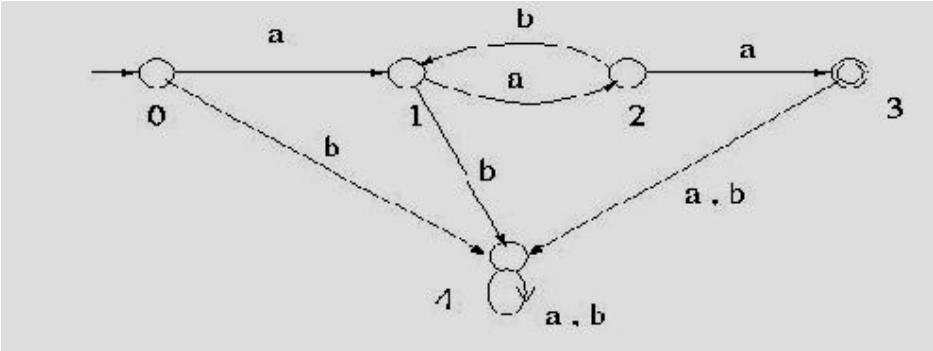
Note : *Be precise in your answer. In case of numerical problem assume data wherever not provided.*

SECTION – A

1. Explain the following: **10 x 2 = 20**

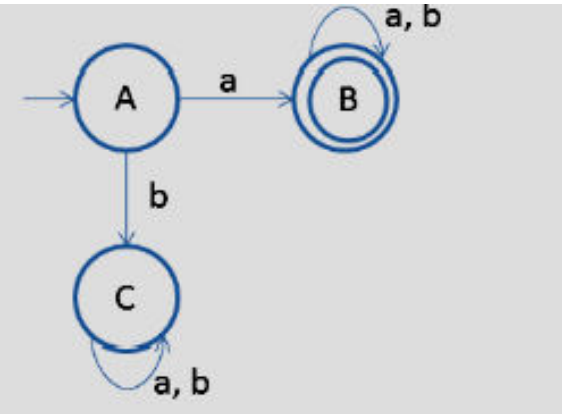
(a) Design the DFA that accepts an even number of a's and even number of b's.

(b) Consider the DFA given below and identify the L accepted by the machine.



(c) State the pumping lemma theorem for regular languages.

(d) Convert the FA given below to left linear grammar.



(e) Check whether the grammar is ambiguous or not.
R-> R+R/ RR/ R*/ a / b / c. Obtain the string w = a+b*c

(f) S->aB/bA A->a/aS/bAA B-> b/bS/aBB. Identify the strings obtained from this grammar.

(g) Define PDA. Draw the graphical representation for PDA.

(h) Design a PDA which accepts set of balanced paranthesis ({ { } }).

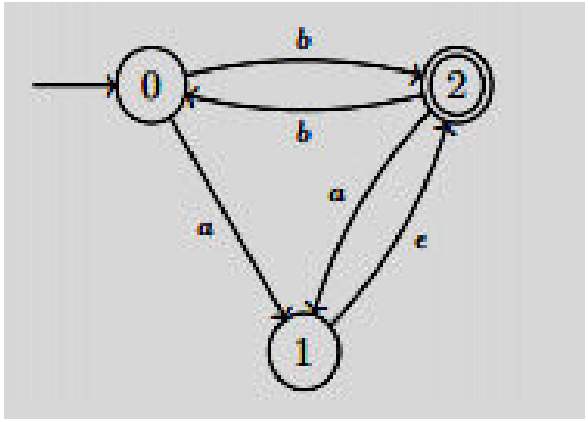
(i) Eliminate unit productions in the grammar. S->A/bb A->B/b B->S/a

(j) What are checking off symbols?

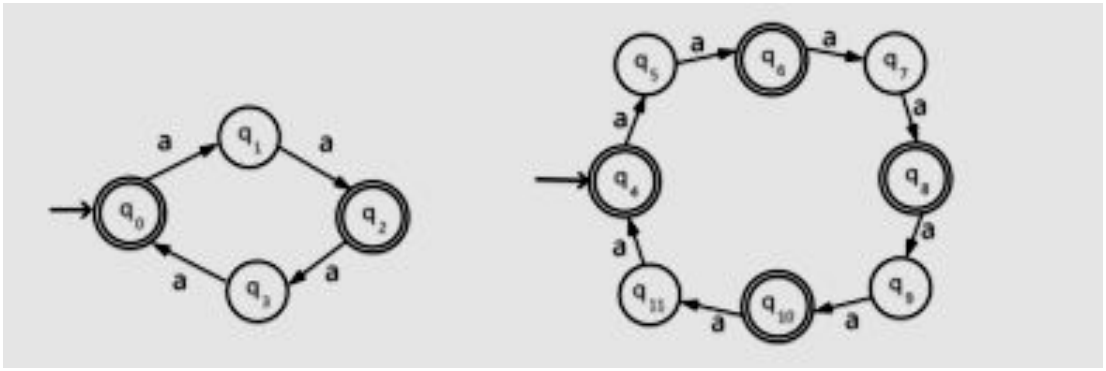
SECTION – B

2. Attempt any five of the following questions: **5 x 10 = 50**

(a) (i) Convert the NFA- ε to DFA.



(ii) Check with the comparison method for testing equivalence of two FA given below.



(b) Prove that the compliment, homomorphism and inverse homomorphism, closure of a regular language is regular.

(c) State and prove kleene's theorem with an example.

(d) Consider the grammar with the production S->aSS A->b. Compute the string aababbb with the left most and right most derivation. Draw the derivation tree.

(e) (i) Find out whether the language L = $\{x^n y^n z^n \mid n \geq 1\}$ is context free or not.

(ii) Construct a PDA that accepts L = $\{ ww^R \mid w = (a+b)^* \}$

(f) (i) Convert the following CFG into CNF

$S \rightarrow XY \mid Xn \mid p$

$X \rightarrow mX \mid m$

$Y \rightarrow Xn \mid o$

(ii) Convert the following CFG into CNF $S \rightarrow ASA \mid aB$, $A \rightarrow B \mid S$, $B \rightarrow b \mid \varepsilon$

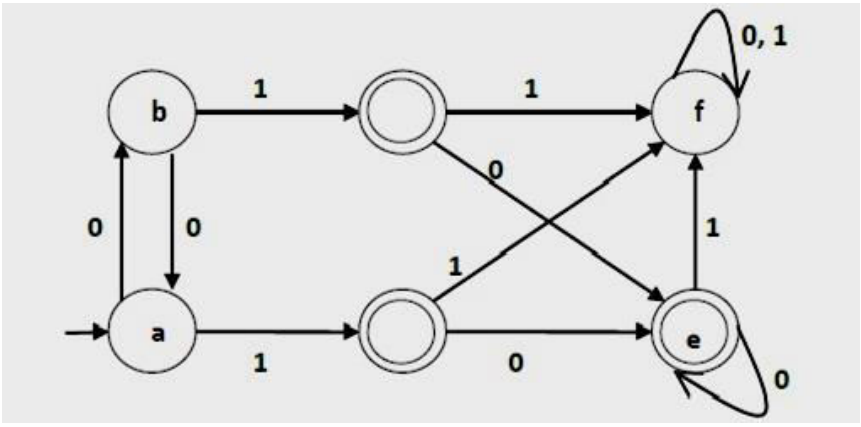
(g) Design a TM to recognize all strings consisting of an odd number of α's.

(h) Prove that the halting problem is undecidable.

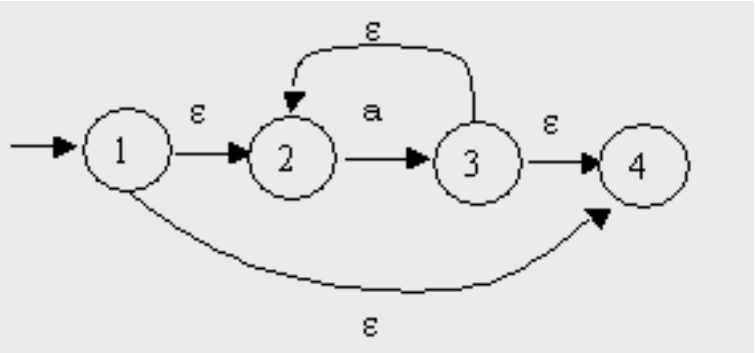
SECTION – C

Attempt any two of the following questions: **2 x 15 = 30**

3. (a) Minimize the automata given below



(b) Compute the epsilon- closure for the given NFA. Convert it into DFA.



4. **(a)** Construct PDA to accept $L = \{0^n 1^n \mid n \geq 0\}$

(b) Construct a PDA from the following CFG.

$G = (\{S, X\}, \{a, b\}, P, S)$ where the productions are −

$S \rightarrow XS \mid \varepsilon$, $A \rightarrow aXb \mid Ab \mid ab$

5. **(a)** Prove that single tape machines can simulate multi tape machines.

(b) Design a TM to recognize all strings consisting of an odd number of α's.

Printed Pages: 03 **Sub Code: RCS403**

Roll No. | | | | | | | | | | |

B. TECH
(SEM IV) THEORY EXAMINATION 2017-18
THEORY OF AUTOMATA AND FORMAL LANGUAGES

Time: 3 Hours ***Total Marks: 70***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a. Define alphabet, string and language.
b. Design a regular expression that accepts all the strings for input alphabet {a,b} containing exactly 2 a's.
c. Design a NFA that accepts all the strings for input alphabet {a,b} containing the substring abba.
d. Define Chomsky hierarchy.
e. Is context free language closed under union? If yes, give an example.
f. Convert NFA into equivalent DFA by taking any suitable example.
g. Remove useless productions from the given productions: S→AB|ab, A→aA|B|a, B→D|E

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a. Define Deterministic Finite Automata (DFA) and design a DFA that accepts the binary number whose equivalent is divisible by 5.
b. State recursive definition of regular expression and construct a regularexpression corresponding to the state transition diagram as shown in Fig.1

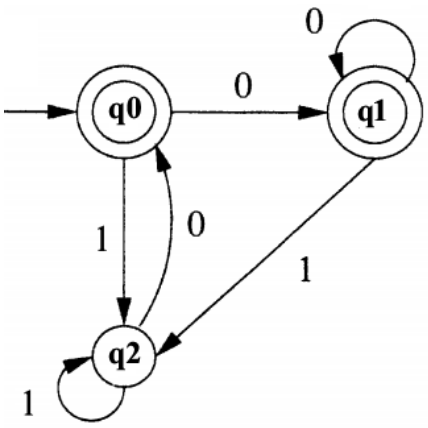


Fig.1

c. Reduce the given grammar G=({S,A,B},{a,b},P,S) to Chomsky Normal Form. Where P is defined as:

$S \rightarrow bA \mid aB$
$A \rightarrow bAA \mid aS \mid a$
$B \rightarrow aBB \mid bS \mid b$

d. What is Push Down Automata (PDA)? Design the PDA for the language $L = \{wcw^R \mid w \in \{a,b\}^*\}$
e. Define Turing Machine (TM). Construct the TM for the language $L = \{a^n b^n \mid n>0\}$.

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

(a) Describe Mealy and Moore machines with example. Convert the given Mealy machine as shown in Fig. 2 into Moore Machine.

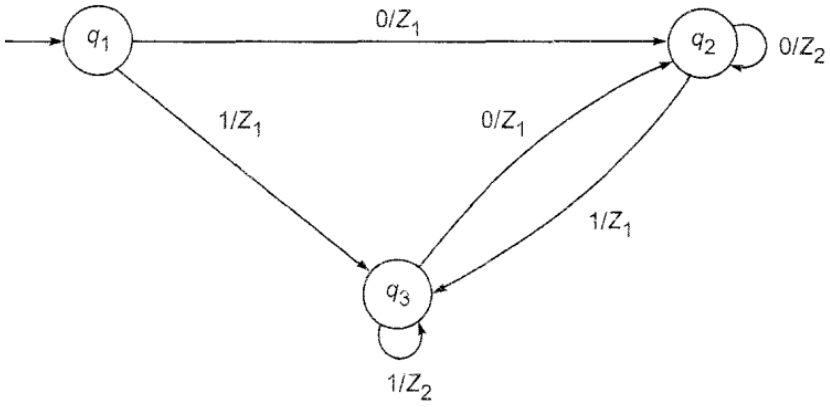


Fig. 2

(b) Construct the minimum state automata equivalent to DFA described by Fig. 3

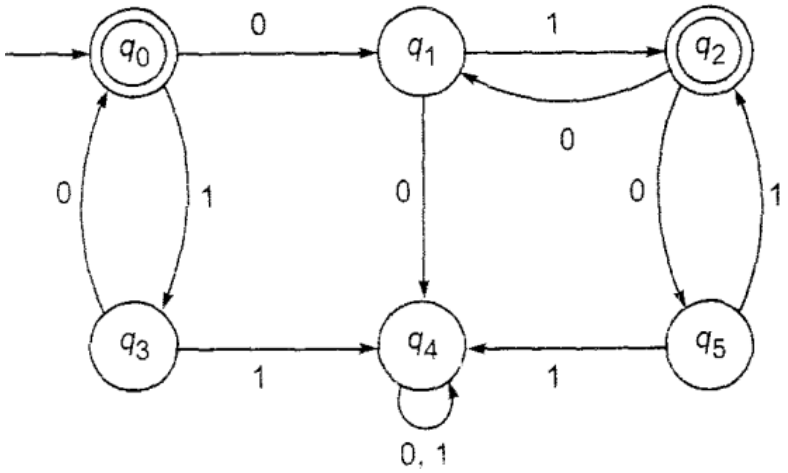


Fig. 3

4. Attempt any *one* part of the following: 7 x 1 = 7

(a) State Pumping Lemma for regular sets. Show that the set $L=\{a^p | \text{ p is a prime}\}$ is not regular.

(b) Discuss closure properties i.e. concatenation, union, intersection, complement of regular languages.

5. Attempt any *one* part of the following: 7 x 1 = 7

(a) Discuss inherent ambiguity of context free languages with suitable example. Construct the context free grammar that accepts language $L=\{a^i b^j c^k | \text{ i = j or j = k; i, j, k are positive integers}\}$.

(b) Define parse tree. Find parse tree for the string *abbcde* considering the productions-

S→aAcBe

A→Ab

A→b

B→d

Is this ambiguous? Justify.

6. Attempt any *one* part of the following: 7 x 1 = 7

(a) Differentiate between deterministic PDA (DPDA) and non-deterministic PDA (NPDA) with suitable example. Also discuss two stack PDA with example.

(b) Construct a PDA equivalent to the following CFG productions:

$S \rightarrow aAA,\ A \rightarrow aS \mid bS \mid a$

7. Attempt any *one* part of the following: 7 x 1 = 7

(a) Write short notes on the following:
   (i) Halting problem of Turing machine
   (ii) Recursive Language
   (iii) Variants of Turing Machine

(b) Define Post's Correspondence Problem (PCP) and Modified PCP with its applications. Find any three PCP solutions of the lists $x=(b,bab^3,ba)$ and $y=(b^3,ba,a)$.

Printed Pages: 02 **Sub Code: RCS403**

Roll No. | | | | | | | | | | |

B TECH
(SEM-IV) THEORY EXAMINATION 2018-19
THEORY OF AUTOMATA AND FORMAL LANGUAGES

Time: 3 Hours ***Total Marks: 70***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a. For the given language $L_1 = \varepsilon$, $L_2 = \{a\}$, $L_3 = \emptyset$. Compute $L_1 L_2^* \cup L_3^*$.
b. Design a FA to accept the string that always ends with 101.
c. Write regular expression for set of all strings such that number of a's divisible by 3 over $\Sigma = \{a,b\}$
d. Construct the CFG for the Language $L = \{a^{2n}b^n \mid n>=3\}$.
e. What do you mean by ε-Closure in FA?
f. Explain Universal TM.
g. Explain Two Stack PDA.

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a. Construct a minimum state DFA from given FA

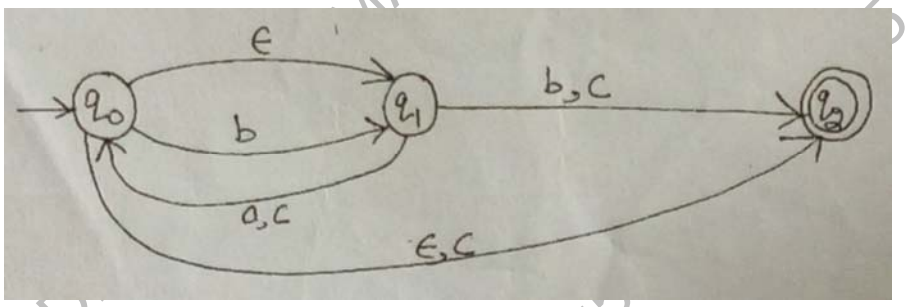


Fig. 1

b. Find the regular expression corresponding to the finite automata given bellow:

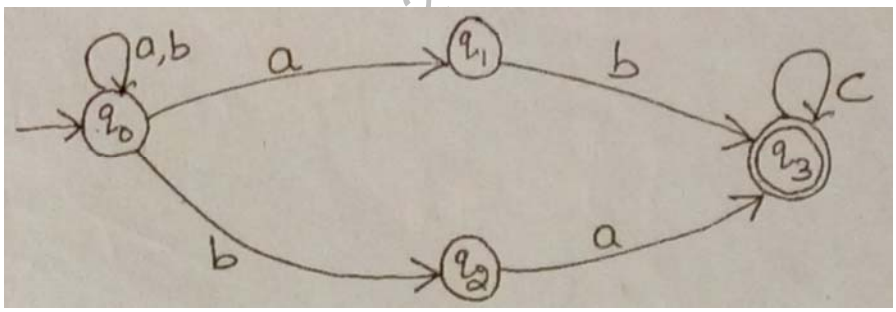


Fig. 2

P.T.O

c. Convert the following CFG to its equivalent GNF:
$S \rightarrow AA \mid a$, $A \rightarrow SS \mid b$.

d. Design a PDA for the following language:
$L = \{a^i b^j c^k \mid i = j \text{ or } j = k\}$

e. Design a TM for the following language:
$L = \{ a^{n+2} b^n \mid n > 0 \}$

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

(a) Design FA for ternary number divisible by 5.

(b) Explain Myhill-Nerode Theorem using suitable example.

4. Attempt any *one* part of the following: 7 x 1 = 7

(a) Prove that the following Language $L = \{a^n b^n\}$ is not regular

(b) Explain the Closure properties of regular expression.

5. Attempt any *one* part of the following: 7 x 1 = 7

(a) Design the CFG for the following language:
i) $L = \{0^m 1^n \mid m \neq n \ \& \ m,n \geq 1\}$
ii) $L = \{a^l b^m c^n \mid l + m = n \ \& \ l,m \geq 1\}$

(b) Prove that the following Language $L = \{a^n b^n c^n\}$ is not Context Free.

6. Attempt any *one* part of the following: 7 x 1 = 7

(a) Design a PDA for the Language $L = \{WW^R \mid W = \{a,b\}^*\}$

(b) Generate CFG for the given PDA M is defined as
$M = (\{q_0, q_1\}, \{0,1\} \{x, z_0\}, \delta, q_0, z_0, q_1)$ where δ is given as follows:
$\delta (q_0,1, z_0) = (q_0, xz_0)$
$\delta (q_0,1, x) = (q_0, xx)$
$\delta (q_0,0, x) = (q_0, x)$
$\delta (q_0, \varepsilon, x) = (q_1, \varepsilon)$
$\delta (q_1, \varepsilon, x) = (q_1, \varepsilon)$
$\delta (q_1,0, x) = (q_1, xx)$
$\delta (q_1,0, z_0) = (q_1, \varepsilon)$

7. Attempt any *one* part of the following: 7 x 1 = 7

(a) Design a TM for the following language:
$L = \{ a^n b^n c^n \mid n \geq 1\}$

(b) Write short note on:
i) Recursive Language and Recursively Enumerable Language.
ii) PCP problem and Modified PCP Problem

Subject Code: KCS402

Roll No: | | | | | | | | | | | | | |

BTECH

(SEM IV) THEORY EXAMINATION 2021-22

THEORY OF AUTOMATA AND FORMAL LANGUAGES

Time: 3 Hours ***Total Marks: 100***

Note: Attempt all Sections. If you require any missing data, then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2x10 = 20

Q.no	Questions	Marks	CO
(a)	Define Alphabet and String in Automata Theory.	2	2
(b)	Give the definition of Deterministic Finite Automaton (DFA).	2	1
(c)	Explain in brief about the Kleen's Theorem.	2	2
(d)	Define Context Free Grammar (CFG).	2	1
(e)	Write the Context Free Grammar (CFG) for regular expression (0+1)*	2	3
(f)	What are Right Linear grammar and Left Linear grammars?	2	3
(g)	Discuss briefly about the Push Down Automata (PDA).	2	4
(h)	What do you mean by Two stack Pushdown Automata?	2	4
(i)	What do you mean by basic Turing Machine Model?	2	5
(j)	What do you understand by the Halting Problem?	2	5

SECTION B

2. Attempt any *three* of the following: 10x3 = 30

Q.no	Questions	Marks	CO
(a)	Explain in detail about the Turing Church's Thesis and Recursively Enumerable languages.	10	5
(b)	Prove that the Compliment, Homomorphism, Inverse Homomorphism, and Closure of a Regular Language is also Regular.	10	2
(c)	Give the Complete description about the Chomsky Hierarchy.	10	3
(d)	Convert the grammar S → aAA, A → a |aS| bS to a PDA that accepts the same language by Empty stack.	10	4
(e)	Grammar G is given with the production S->aSS A->b. Compute the string w= aababbb with the Left most and Right most derivation Tree.	10	1

SECTION C

3. Attempt any *one* part of the following: 10x1 = 10

Q.no	Questions	Marks	CO
(a)	Write short notes on following. i) Turing Machine as Computer of Integer Functions ii) Universal Turing machine	10	5
(b)	Explain in detail about the Pumping Lemma and application of Pumping Lemma for Regular Languages.	10	2

4. Attempt any *one* part of the following: 10x1 = 10

Q.no	Questions	Marks	CO
(a)	Construct a Non Deterministic Finite Automation (NFA) for the language L which accepts all the strings in which the third symbol from right end is always 'a' over Σ = {a, b}.	10	1
(b)	Explain in detail about the Myhill-Nerode theorem using suitable example.	10	3

PAPER ID-421621

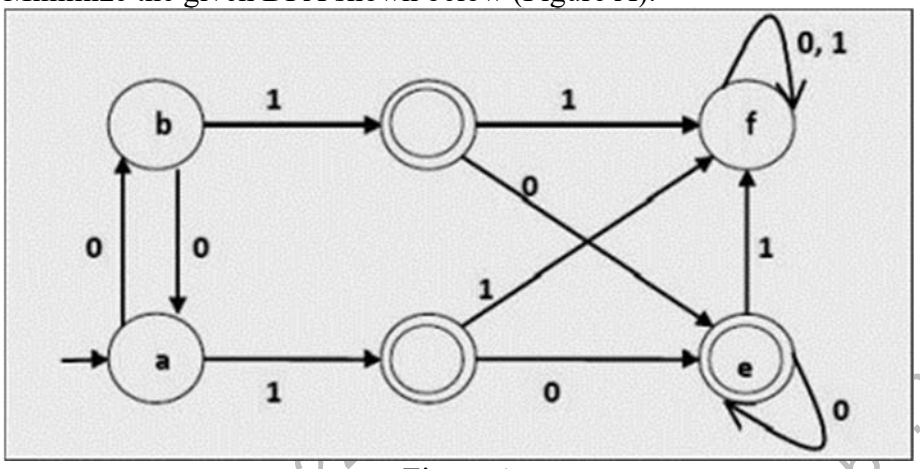
Roll No: | | | | | | | | | | | | | |

BTECH
(SEM IV) THEORY EXAMINATION 2021-22
THEORY OF AUTOMATA AND FORMAL LANGUAGES

5. Attempt any *one* part of the following: 10x1 = 10

Q.no	Questions	Marks	CO
(a)	Prove that the following Language L = {$a^n b^n$: n>=0} is not a regular language.	10	4
(b)	Design a Turing Machine for the language L. Where, L={$a^n b^n c^n$| n≥1}	10	5

6. Attempt any *one* part of the following: 10x1 = 10

Q.no	Questions	Marks	CO
(a)	Prove that the Compliment, Homomorphism, Closure and Inverse Homomorphism of a Regular language is also Regular.	10	2
(b)	Minimize the given DFA shown below (Figure A).  Figure A	10	1

7. Attempt any *one* part of the following: 10x1 = 10

Q.no	Questions	Marks	CO
(a)	Explain in detail about the following. i) Closure properties of Regular Languages ii) Decidability- Decision properties of Regular Languages	10	4
(b)	Check whether the grammar is ambiguous or not. R-> R+R/ RR/ R*/ a / b / c. Obtain the string w = a+b*c	10	3

Printed Pages:02 **Sub Code:KCS-402**

Paper Id: 238248 **Roll No.** | | | | | | | | | | |

B.TECH
(SEM IV) THEORY EXAMINATION 2022-23
THEORY OF AUTOMATA AND FORMAL LANGUAGES

Time: 3 Hours ***Total Marks: 100***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 10 = 20**

(a) What do you understand by grammar?
(b) What do you mean by ε-Closure in FA?
(c) State Arden's Theorem.
(d) State Kleen's Theorem.
(e) Derive the CFG for (a+b)*.
(f) Explain Chomsky Hierarchy.
(g) Explain pumping lemma for context free language.
(h) Draw the graphical representation for PDA.
(i) Explain Halting Problem of Turing Machine.
(j) Explain Linear bounded Automata.

SECTION B

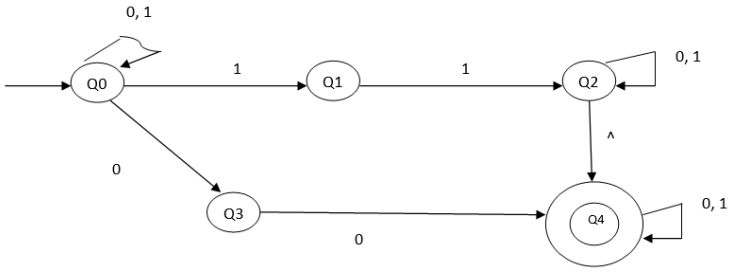
2. Attempt any *three* of the following: **10x3=30**

(a) Construct a DFA for ternary number divisible by 4.
(b) Determine the FA accepted by the language described by the regular expression: (0+1)*0(0+1)*0(0+1)* over the alphabet {0,1} and also mention the accepted language ?
(c) Consider the grammar with following production rules:
S→ABD | AC
A→aA | bAa |a
B→bbA | aB | AB
C→aCa |aD
D→aD | bC
Convert the above grammar into Chomsky Normal Form.
(d) Design a PDA for the language L= {WW^T | W= $(a+b)^*$ }
(e) Write short notes on:
i) Church's Thesis
ii) Recursive and Recursive Enumerable Language

SECTION C

3. Attempt any *one* part of the following: **10x1=10**

(a) Construct a DFA equivalent to the NFA

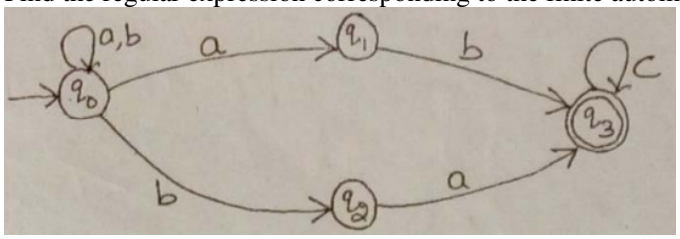


(b) Construct a minimum state automata equivalent to a DFA whose transition table is as follows where q3 and q4 are final state.

State/∑	Input	
	A	b
→ Q0	Q1	Q2
Q1	Q4	Q3
Q2	Q4	Q3
Q3	Q5	Q6
Q4	Q7	Q6
Q5	Q3	Q6
Q6	Q6	Q6
Q7	Q4	Q6

4. Attempt any *one* part of the following: 10x1=10

(a) Find the regular expression corresponding to the finite automata given below:



(b) State pumping lemma for regular language. Prove that the language L= $\{a^p \mid p$ is prime$\}$ is not regular.

5. Attempt any *one* part of the following: 10x1=10

(a) A context free grammar G is given by the following productions:

E→E+E|E-E|E∗E|E^E|N

N→0|1|2|3|4|5|6|7|8|9

Determine whether the grammar G is ambiguous or not.If ambiguous then construct an unambiguous grammar equivalent to G.

(b) Explain Closure properties of regular language.

6. Attempt any *one* part of the following: 10x1=10

(a) Design a two stack PDA for the language L=$\{a^n b^n c^n \mid n>=1\}$

(b) Generate CFG for the given PDA M is defined as

M = ({q0, q1}, {0,1} {x, z0}, δ, q0, z0, q1) where δ is given as follows: δ (q0,1, z0) = (q0, xz0)

δ (q0,1, x) = (q0, xx)

δ (q0,0, x) = (q0, x)

δ (q0, ε, x) = (q1, ε)

δ (q1, ε, x) = (q1, ε)

δ (q1,0, x) = (q1, xx)

δ (q1,0, z0) = (q1, ε)

7. Attempt any *one* part of the following: 10x1=10

(a) Design a Turing Machine for the language:
L=$\{a^n b^n c^n \mid n>=1\}$

(b) Write short notes on:

(i) Variants of Turing Machine

(ii) Post Correspondence problem

(iii) Universal Turing Machine

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BTECH
(SEM IV) THEORY EXAMINATION 2023-24
THEORY OF AUTOMATA AND FORMAL LANGUAGES

TIME: 3 HRS **M.MARKS: 70**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

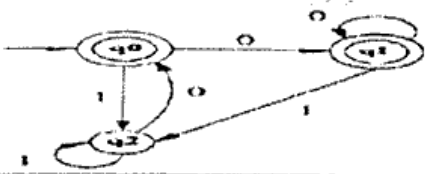
SECTION A

1. Attempt *all* questions in brief. **2 x 7 = 14**

a.	Give the mathematical definition of DFA. Differentiate between NFA and DFA.
b.	Construct Deterministic Finite Automata (DFA) to accept string that always ends with 101 over alphabet Σ ={0,1}
c.	Give regular expressions that represent the language (L), which has all binary strings having two consecutive 0s and two consecutive 1s over the alphabet Σ = {0, 1}.
d.	Compute the Language generated by the given CFG G = ({S}, {a, b}, P, S} where P is defined by: {S → SS, S → ab, S → ba, S → ε}
e.	Let G be the grammar S → 0B | 1A A → 0 | 0S | 1AA B → 1 | 1S | 0BB Determine the leftmost derivation for the string 00110101
f.	Explain the concept of two stack PDA. Give an example of a language that is accepted by two stack PDA but not accepted by normal one stack PDA.
g.	Explain Multi Tape Turing Machine.

SECTION B

2. Attempt any *three* of the following: **7 x 3 = 21**

a.	Construct a Finite automata (DFA) which accepts all binary numbers whose decimal equivalent is divisible by 4 over Σ = {0, 1}.
b.	Compute the regular expression using Arden's Theorem for the following DFA. 
c.	Write an equivalent left linear grammar from the given right linear grammar. S→0A |1B A→0C |1A |0 B→1B |1A |1 C→0 |0A
d.	Differentiate between DPDA and NPDA. Construct a PDA that accepts language L = $\{a^n b^n \mid n \geq 1\}$.
e	Differentiate between Deterministic Turing machine and Non-Deterministic Turing machine. Design a Turing machine for the language L={ww | w ε (a + b)*}

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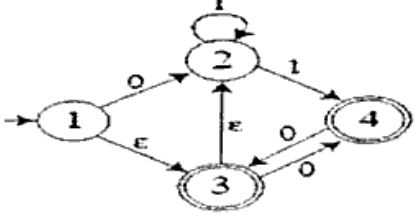
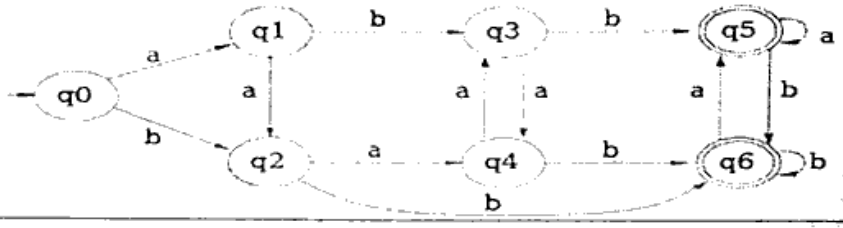
SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

a.	Construct a DFA corresponding to the following NFA with ϵ moves: 	
b.	Express in the minimum state automata equivalent to DFA described in below figure: 	

4. Attempt any *one* part of the following: 7 x 1 = 7

a.	State Pumping Lemma for Regular Language. Show that the given language $L=\{a^p \mid$ Where p is a prime$\}$ is not regular.	
b.	Discuss closure properties (i.e. union, concatenation, complement, intersection and differenee) of regular language. https://www.aktuonline.com	

5. Attempt any *one* part of the following: 7 x 1 = 7

a.	Reduce the given grammar G = ({S, A, B}, {a, b}, P, S) to Chomsky Normal form. Where P is defined by: $S \rightarrow bA \mid aB$ $A \rightarrow bAA \mid aS \mid a$ $B \rightarrow aBB \mid bS \mid b$	
b.	Design a CFG for the following language: (i) $L=\{0^m 1^n \mid m \neq n \ \& \ m, n>=1\}$ (ii) $L=\{a^p b^q c^r \mid p+q=r \ \& \ p, q>=1\}$	

6. Attempt any *one* part of the following: 7 x 1 = 7

a.	Construct PDA equivalent to the following CFG G = ({S, A}, {0,1}, P, S} where P is defined by: $S \rightarrow 0S1 \mid A$ $A \rightarrow 1A0 \mid S \mid \varepsilon$	

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b.	Find the equivalent CFG of the following PDA P = ({q0, q1,}, {a, b}, {a, z0}, δ, q0, z0) where δ is given by: δ (q0, a, z0) = (q0, az0) δ (q0, a, a) = (q1, aa) δ (q1, a, a) = (q1, ε) δ (q1, ε, z0) = (q1, ε)

7. **Attempt any *one* part of the following:** 7 x 1 = 7

a.	Construct Turing Machine that accepts language L=$\{a^{2n}b^n \mid n>=1\}$. Also show the instantaneous description for the string w = aaaabb.
b.	Explain the any two of the following: i. Universal Turing Machine. ii. Post Correspondence Problem. iii. Recursive and recursively Enumerable Languages