Roll No. | 7 | 8 | 6 | 3 | 8 | 1 | 4 | 5 |

KONGU ENGINEERING COLLEGE, PERUNDURAI 638 060
ODD SEMESTER 2017-2018
CONTINUOUS ASSESSMENT TEST 3 - OCTOBER 2017
(Regulations 2014)

Programme : BE Branch : CSE Semester : V	Date : 25.10.2017 Time : 9.15 am – 10.45 am
Course Code : 14CST52 Course Name : Theory of Computation	Duration : 1 ½ Hours Max. Marks : 50

PART - A (10 × 2 = 20 Marks)

ANSWER ALL THE QUESTIONS

1.	Mention the language accepted by PDA	C03	[K2]
2.	Write the formal definition of Turing machine.	C04	[K3]
3.	Design a turing machine that accepts string that contains exactly 2b's over {a,b}.	C04	[K3]
4.	Define ID for PDA.	C04	[K1]
5.	Consider a turning machine that computer the function $f(x,y) = y$	C04	[K3]
6.	When a language is said to be recursively enumerable?	C04	[K2]
7.	Show that the complement of recursive language is recursive.	C04	[K1]
8.	Define PCP with an example.	C04	[K1]
9.	What is DPDA? Write its properties	C04	[K1]
10.	State the rules for converting PDA to CFG.	C03	[K2]

Part – B (3× 10 = 30 Marks)

ANSWER ANY THREE QUESTIONS

11.		Find the CFG for the language whose PDA is given as $M=\{(q0,q1),\{a,b\},\delta, q0,z0,\phi\}$ and δ is defined as i) $\delta(q_0,a,z_0) = \{(q_0,, qz_0)\}$ ii) $\delta(q_0,a,a) = \{q_0,aa)\}$ iii) $\delta(q_0,b,a) = \{(q_0,a)\}$ iv) $\delta(q_0,a,a) = \{(q_1,\in)$ v) $\delta(q_1,\in,z0) = \{(q_1,\in)\}$	(10)	C03	[K3]
12	i)	Construct a PDA that accept the language $L= \{wcw^R / w\in \{a,b\}^+\}$	(5)	C03	[K3]
	ii)	Design a turing machine to perform addition of two integers.	(5)	C05	[K4]
13		Design a Turing machine that computes $f(m,n) = mxn$	(10)	C05	[K4]
14.		Write the code for the turing machine $M=\{(q1,q2,q3), (0,1), (01,B), \delta(q1,B, (q2\ 3\}$ when δ as $\delta(q1,1) = (q3,0,R)$ $\delta(q3,0) = (q1,1,R)$ $\delta(q3,1) = (q2,0,R)$ $\delta(q3,B) = (q3, 1,L)$	(10)	C04	[K2]

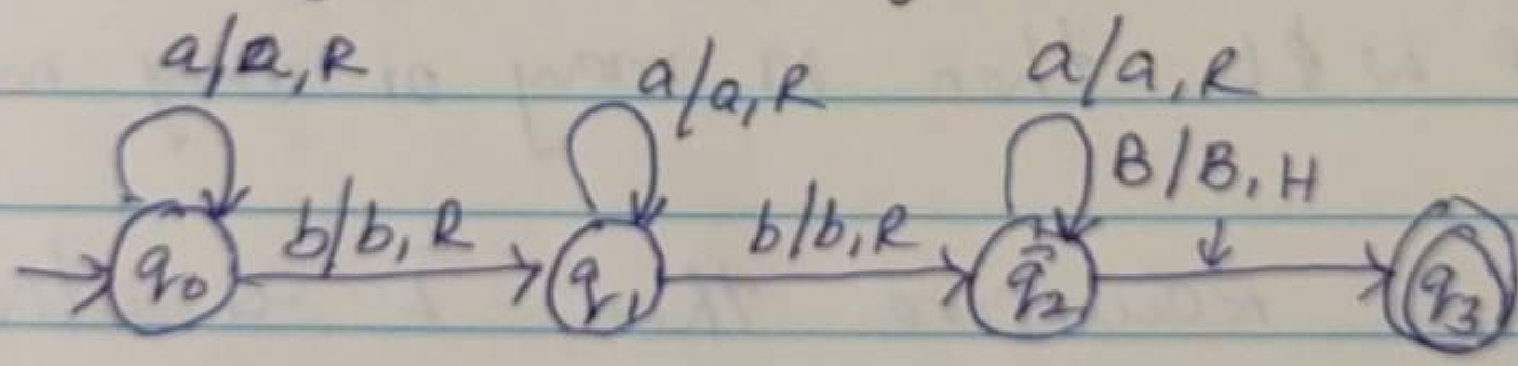
Bloom's Taxonomy Level	Remembering (K1)	Understanding (K2)	Applying (K3)	Analysing (K4)	Evaluating (K5)	Creating (K6)
Percentage	26.67	33.33	26.17	13.33	-	--

Part A

1. Language Accepted by PDA
   1. empty stack
   2. Final State

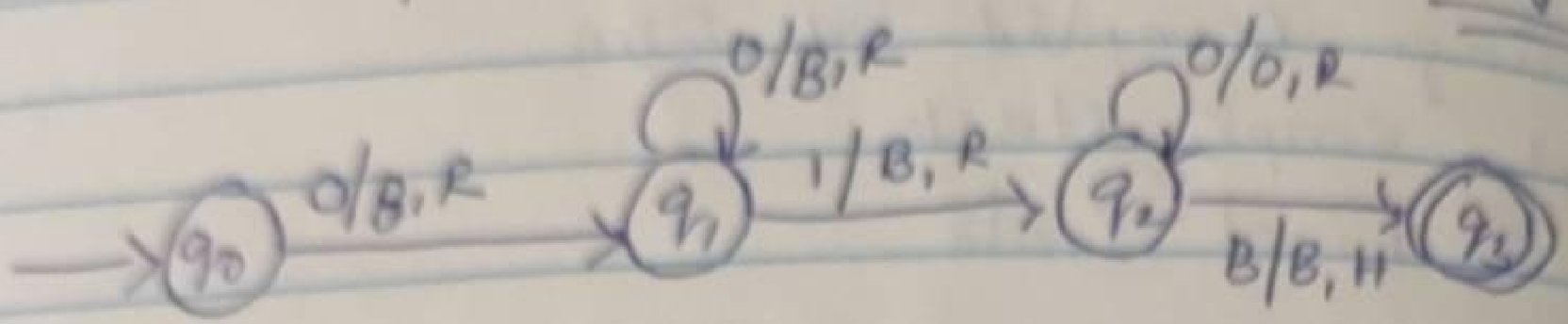
2. TM $M = (Q, \Sigma, \Gamma, \delta, q_0, B, F)$
   Q - Finite set of states
   Σ - " i/p symbol
   Γ - Tape Symbol
   δ - Transition function
   $\delta(q, x) = (P, Y, D)$
   ↳ may be L or R.
   q_0 - Start state
   B - Blank Symbol
   F - Set of accepting states

3. TM for accepting string that contains exactly 2 b's over $\{a, b\}$



4. ID for PDA.
   Execution status of PDA.
   Represented by (q, w, γ)
   q - state
   w - remaining i/p
   γ - Stack contents

5. TM to compute $f(x, y) = y$ $\quad x, y > 0$



6. Recursively Enumerable

A Lang L is RE if $L = L(M)$ for some TM M.

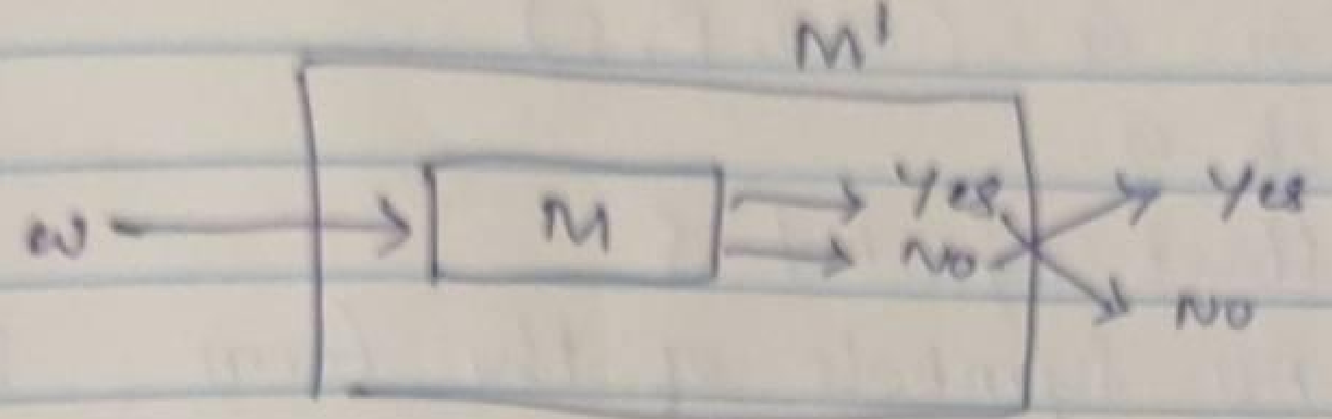
If $w \in L$ then M accepts and halts

If $w \notin L$ then M may or may not be

7. If L is Recursive then $\bar{L}$ is also rec

If L is Recursive then there is a TM which is halted when the string is accepted or not. We can design a TM for the Lang. $\bar{L}$ using TM M, whi

also halted for the string whether it is accepted or not. So $\bar{L}$ is also Recursive.



8. PCP

An instance of PCP consists of two lists of strings over Σ:

$A = w_1, w_2 \cdots w_k$

$B = x_1, x_2 \cdots x_k$ for some integer k.

The instance of PCP has a solution if there is any sequence of integers $i_1, i_2 \cdots i_m$ with $m \geq 1$ such that

$$w_{i_1} w_{i_2} \cdots w_{i_m} = x_{i_1} x_{i_2} \cdots x_{i_m}.$$

is a solution to this instance of PCP.

9. DPDA

DPDA $P = (Q, \Sigma, \Gamma, \delta, q_0, Z_0, f)$ is DPDA iff

① $\delta(q, a, x)$ has at most one member (transition).

② If $\delta(q, a, x)$ is non empty then $\delta(q, \epsilon, x)$ must be empty.

10. Rules for converting PDA to CFG:

Let PDA $P = (Q, \Sigma, \Gamma, \delta, q_0, z_0)$ then the CFG $G = (V, T, P, S)$

V consists of
1) Start symbol S
2) All symbols of the form $[p x q]$ where $p, q \in Q$ and $x \in \Gamma$

Terminals $T = \Sigma$

Productions of G:

a) For all states p

$$S \rightarrow [q_0 z_0 p]$$

b) Let $\delta(q, a, x) = (r, Y_1, Y_2 \dots Y_k)$ where $a \in \Sigma$ or $a = \epsilon$ and k

$[q x r_k] = a [r Y_1 r_1] [r_1 Y_2 r_2] \dots$

Part B

11. $V = \{S, [q_0 z_0 q_0], [q_0 z_0 q_1] [q_1 z_0 q_0] [q_1 z_0 q_1]$
$[q_0 a q_0], [q_0 a q_1] [q_1 a q_0] [q_1 a q_1],$
$[q_0 b q_0], [q_0 b q_1] [q_1 b q_0], [q_1 b q_1]\}$

$T = \{a, b\}$

S - start symbol.

Productions P:

① For start symbol S, productions are:

$S \to [q_0 z_0 q_0] \mid [q_0 z_0 q_1]$

② For every transition function, Productions are:

i) For $\delta(q_0, a, z_0) = (q_0, a z_0)$

$[q_0 z_0 q_0] \to a [q_0 a q_0] [q_0 z_0 q_0] \mid$
$a [q_0 a q_1] [q_1 z_0 q_0]$

$[q_0 z_0 q_1] \to a [q_0 a q_0] [q_0 z_0 q_1] \mid$
$a [q_0 a q_1] [q_1 z_0 q_1]$

ii) For $\delta(q_0, a, a) = (q_0, aa)$

$[q_0 a q_0] \to a [q_0 a q_0] [q_0 a q_0] \mid$
$a [q_0 a q_1] [q_1 a q_0]$

$[q_0 a q_1] \to a [q_0 a q_0] [q_0 a q_1] \mid$
$a [q_0 a q_1] [q_1 a q_1]$

iii) For $\delta(q_0, b, a) = (q_0, a)$

$[q_0 a q_0] \to b [q_0 a q_0]$

$[q_0 a q_1] \to b [q_0 a q_1]$

iv) For $\delta(q_0, a, a) = (q_1, \epsilon)$

$[q_0 a q_1] \to a$

v) $\delta(q_1, \epsilon, z_0) = (q_1, \epsilon)$

$[q_1 z_0 q_1] \to \epsilon$

Resultant Grammar after simplification

$S \to [q_0 z_0 q_1]$

$[q_0 z_0 q_0] \to a\,[q_0 a q_1]\,[q_1 z_0 q_1] \mid a\,[q_0 a q_1]$

$[q_0 a q_1] \to b\,[q_0 a q_1] \mid a$

~~$[q_1 z_0 q_1] \to \epsilon$~~

Final Grammar by Sub $A = [q_0 z_0 q_1]$

$B = [q_0 a q_1]$

$S \to A$

$A \to aB$

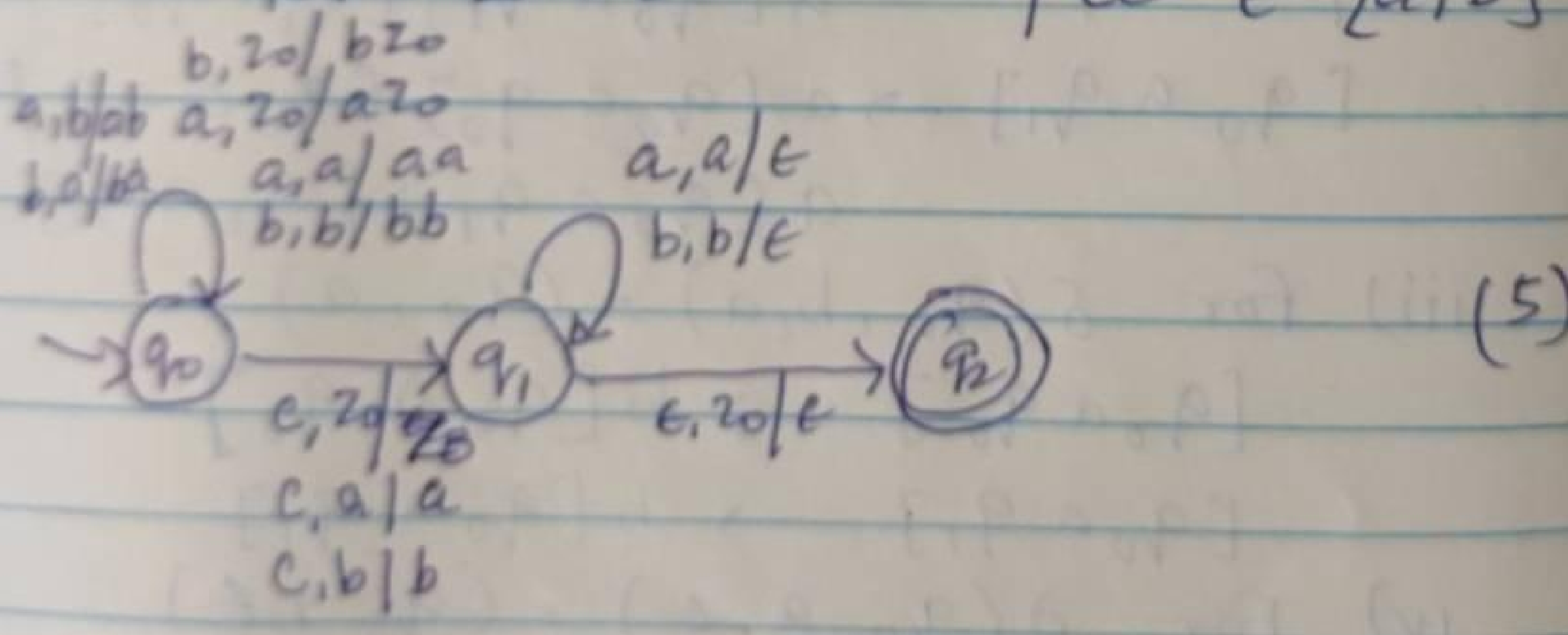
$B \to bB \mid a$

$\Rightarrow$ (or)

$S \to aB$

$B \to bB \mid a$

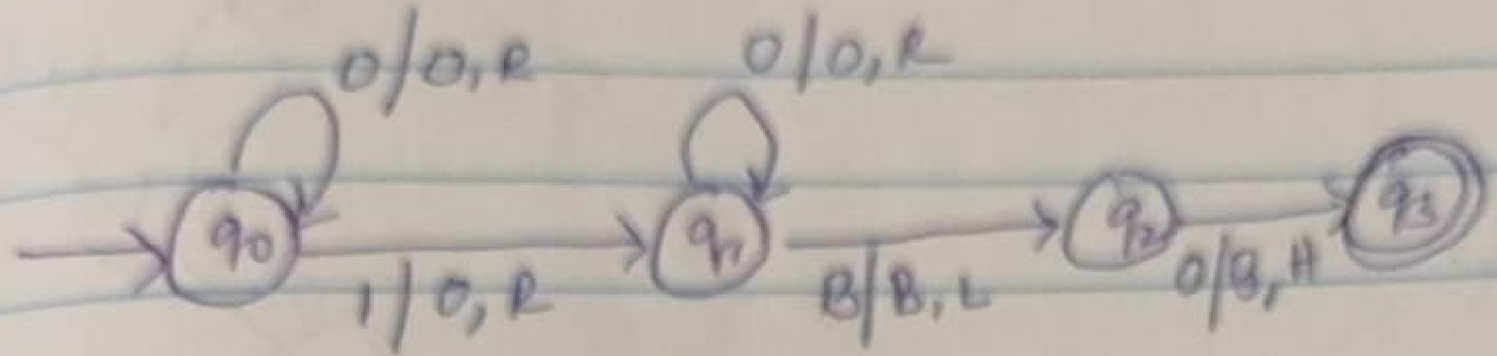
Q. i PDA for $L = \{ w c w^R \mid w \in \{a,b\}^+ \}$



(5)

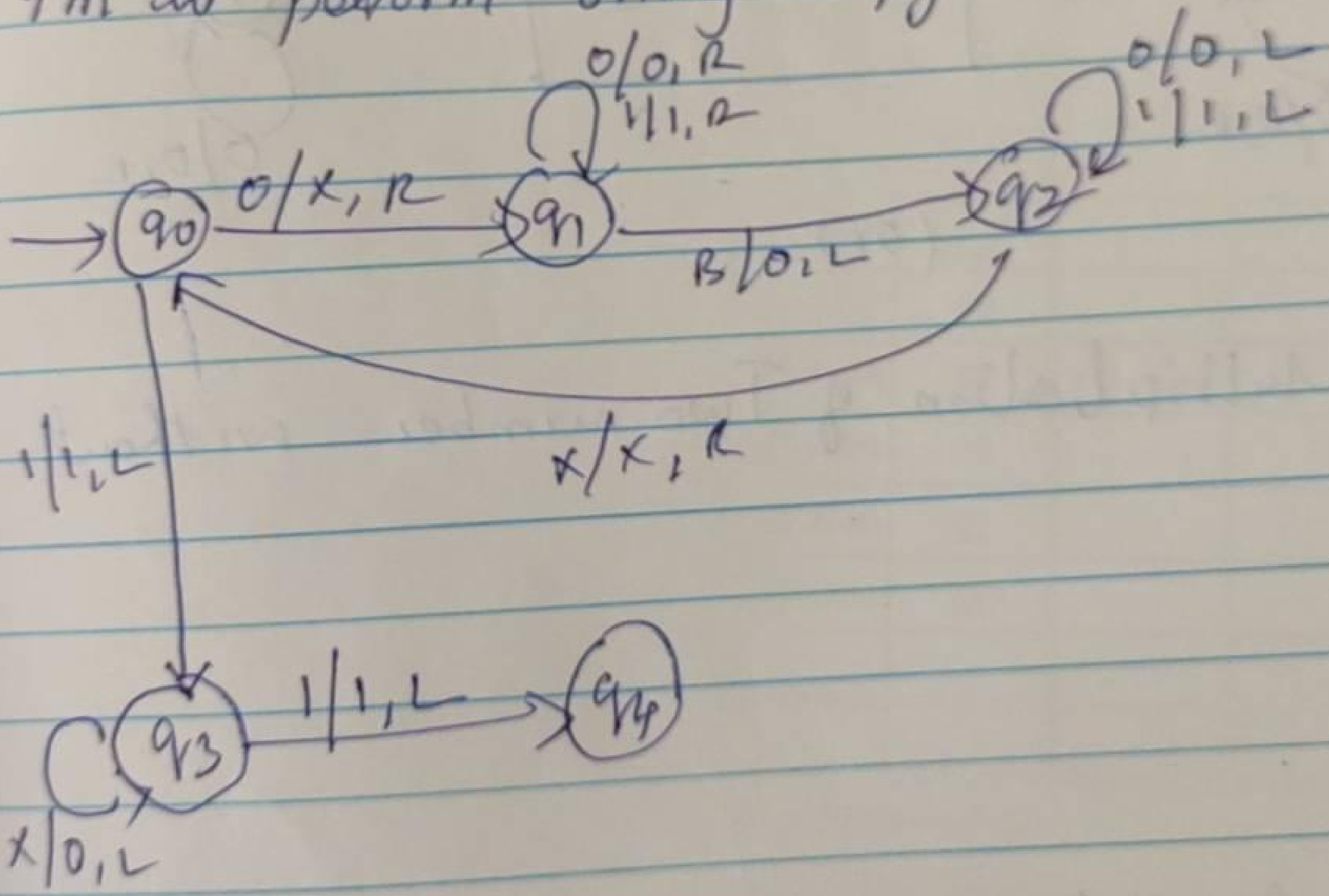
ii) TM to perform addition two numbers.

Input $0^x 1 0^y$ if to add $x+y$.

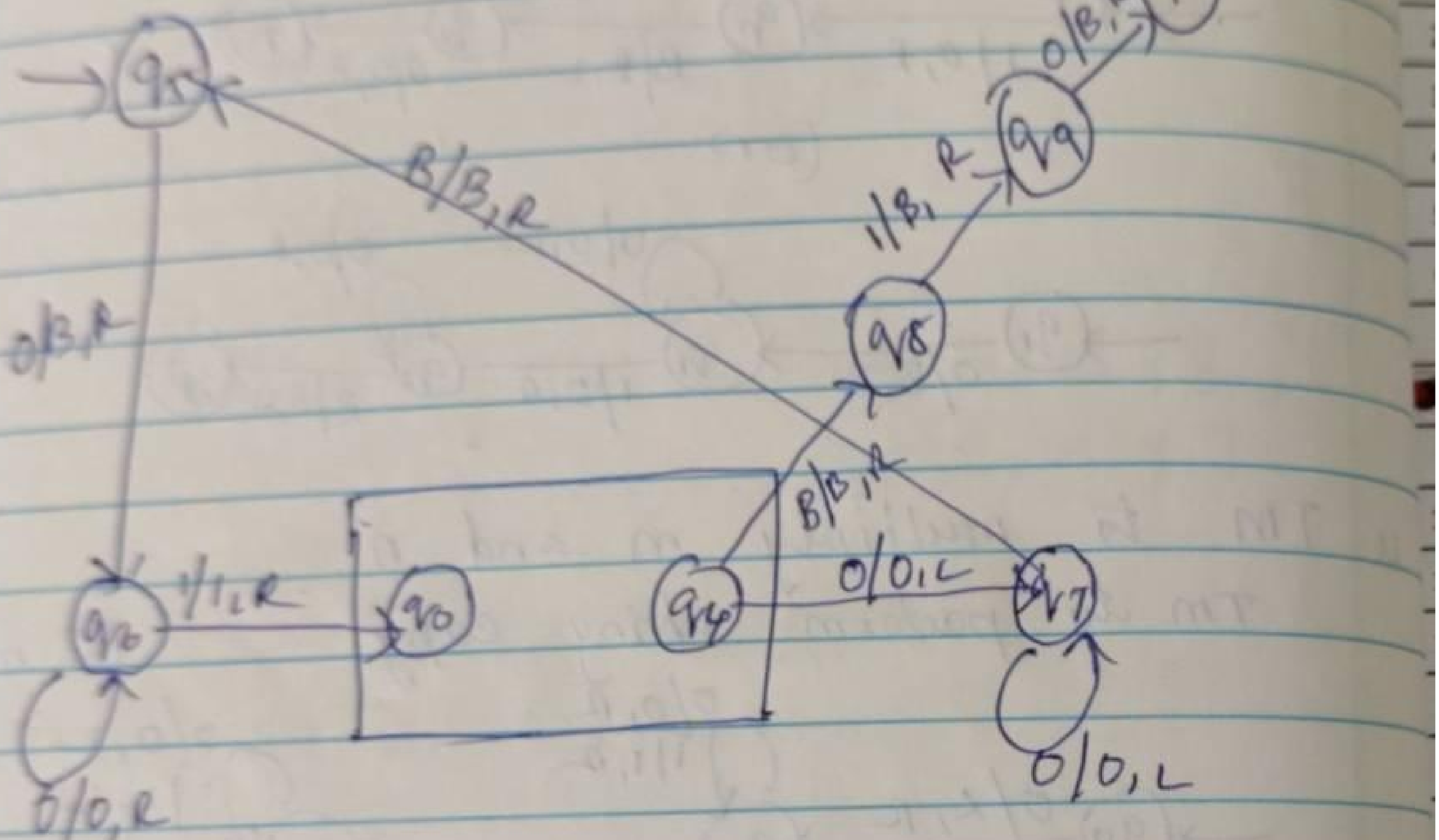


b. TM to multiply m and n.

TM to perform string copy: (5 marks)



TM for Main function : 15 marks



(OR)

Multiplication of Two number without Subrou
Cloni

14.

Code for States - (1)
Code for Tape symbol - (1)
code for Direction - (L)

TM code = $0^1 1 0^2 1 0^3 1 0 1 0^2 1 1 0^3 1 0 1 0^1 1 0^2 1 0^2 1 1 0^3 1 0^2 1 0^2 1 0 1 0^2 1$

$0^3 1 0^3 1 0^3 1 0^2 1 0$

(1)

DEPT. OF COMPUTER SCIENCE & ENGG.
KONGU ENGINEERING COLLEGE,
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Vani Rajagopal	25/10/17
Name and Signature of Hall Supdt. with Date	

Estd : 1984

KONGU ENGINEERING COLLEGE

PERUNDURAI ERODE - 638 060.

(Autonomous)

TUV

Name of the Student	M. RAGUVARSHINI	Register No.	1	5	C	S	R	1	6	0
Programme	BE	Branch & Semester	CSE - 'C' V						
Course Code and Name	14CS512 THEORY OF COMPUTATION	Date	25.10.17		Nd. of Pages Used.	9			

MARKS TO BE FILLED IN BY THE EXAMINER

PART - A		PART - B			Grand Total Max. Marks : 50
Question No.	Max Marks : 2	Question No.		Max Marks : 10	
1	2	11	i)	10	48½ / 50
2	2		ii)		
3	1½	12	i)		V. good.
4	1½		ii)		
5	2	13	i)	10	
6	2		ii)		
7	2	14	i)	10	
8	2		ii)		
9	2				M. Raguvarshini
10	2				
TOTAL	18½	TOTAL		30	

Total Marks in Words : Forty Nine

INSTRUCTION TO THE CANDIDATE

1. Check the Question Paper, Programme, Course Code, Branch Name etc., before answering the questions.
2. Use both sides of the paper for answering questions.
3. POSSESSION OF ANY INCRIMINATING MATERIAL AND MALPRACTICE OF ANY NATURE IS PUNISHABLE AS PER RULES.

R. C. Suganya

Name of the Examiner

Signature of the Examiner with Date 26/10/17

Part: A

1. language accepted by PDA
   1. Acceptance by empty stack
   2. Acceptance by final state

2. Definition of TM

   TM. M : (Q, Σ, Γ, δ, q_0, B, F)

   where Q - finite of states

   Σ - finite set of input symbols

   Γ - finite set of stack symbols

   δ - transition function

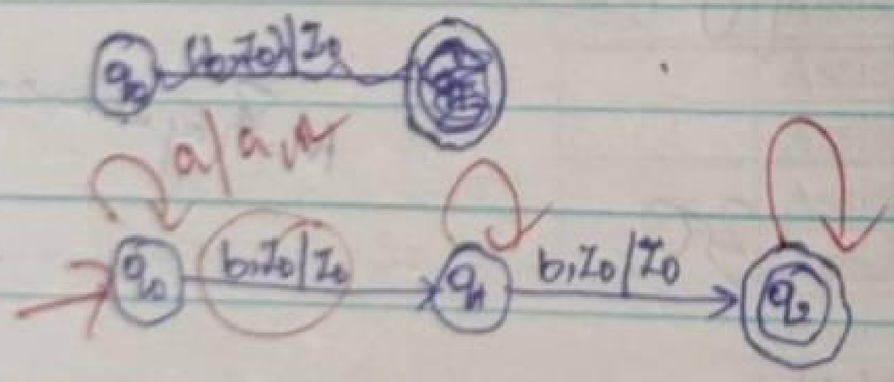
   q_0 - start symbol

   B - Blank space

   F - Final state

3. M = {String contains exactly 2b's over {a,b}}

   w = bb



String processing

δ	a	b
q_0	ϕ	$\{q_1, Z_0\}$
q_1	ϕ	$\{q_2, Z_0\}$
q_2	ϕ	ϕ

$q_0bb \vdash q_1Z_0b$

[illegible]

4. Instaneous Description of PDA

- Execution state of TM
- $\delta(q,a,x) \vdash (p,y,D)$
  1. q - states in TM
  2. x - tape head
  3. D - direction of movement

$x_1, x_2, \ldots\ldots x_{i-1} q\, x_i, x_{i+1}, \ldots\ldots x_n$

$\delta(q,a,x) = (p,y,R)$

$x_1, x_2, \ldots\ldots x_{i-1} p\, x_{i-1}, x_{i+1}, \ldots\ldots x_n$.

5. $f(x,y) = y$

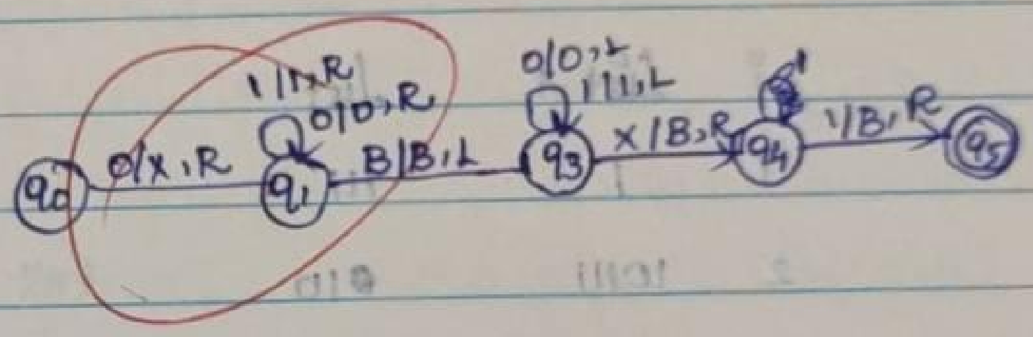
$f(1,2) = 2$.

B0100B

↓

BX100B

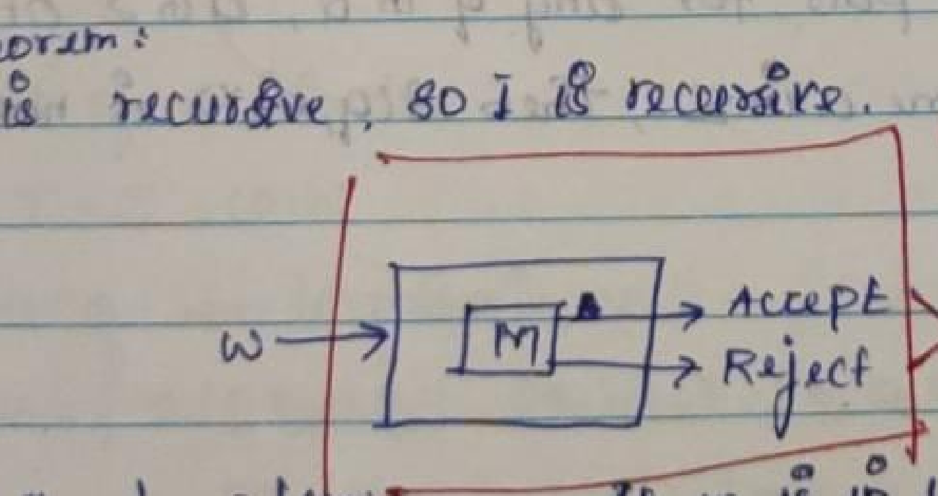
BBB00B



6. A language L is said to be Recursively enumerable for some L = L(M) TM halts whether or not accept the input.

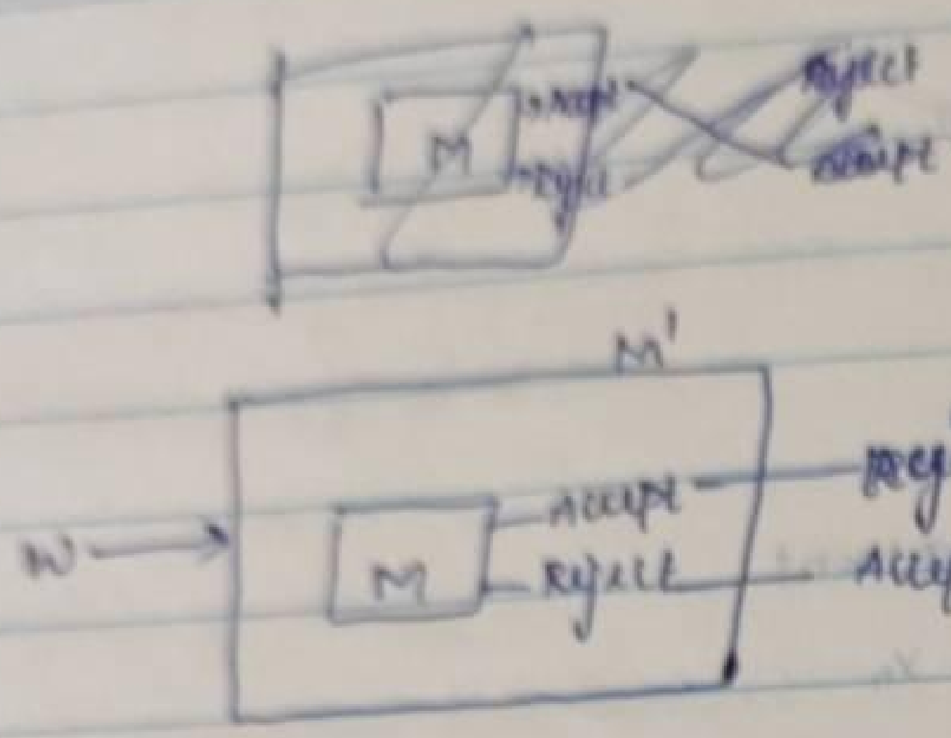
Theorem:

7. L is recursive, so $\bar{L}$ is recursive.



If L = L(M) If w is in L, then M accepts w

$\bar{L} = L(\bar{M})$ If w is not in L, then $\bar{M}$ accepts w.



8. post Correspondence problem is used to solve a problem about string is undecidable.

i	List 1	List 2
1	1	111
2	1011	010
3	10	0

$w_2 w_1 w_1 w_3 = x_2 x_1 x_1 x_3$.

9. A PDA is said to Deterministic, there is never choice of move any situation.

PDA is DPDA iff

1) $\delta(q, a, x)$ has atmost 1 number pair for any q in Q, a in Σ or a
2) $\delta(q, a, x)$ is non empty for some a in Σ, then $\delta(q, \epsilon, x)$ is non-em

10. Rules for converting pda to CFG

1) PDA $P = (Q, \Sigma, \Gamma, \delta, q_0, Z_0)$ for some $L = L(P)$ then CFG $G = (V, T, P, S)$

2) Start symbol - S

$S \rightarrow [q_0 Z_0 p]$

p - Input states.

3) T - Set of terminals

4) V - start symbol and all forms of states $[pxq]$

where $p, q \in Q$, $x \in \Gamma$

V - Set of non-terminals

5) P - Production.

$\delta(q, a, y) = (t, \epsilon)$

$[qyt] \rightarrow a$

$\delta(q, a, y) = (t, Y_1 Y_2 Y_3 \cdots Y_k)$

$[qyr_k] \rightarrow a[tY_1 r_1][r_1 Y_2 r_2] \cdots [r_{k-1} Y_k r_k]$

Part - B

11. $M = \{(q_0, q_1), \{a, b\}, \delta, q_0, Z_0, \phi\}$

CFG, $G = (V, T, P, S)$

1) Set of Terminals - T

$T = \Sigma = (a, b)$

2) Set of non terminals - V

$V = \{S, [q_0 a q_0], [q_0 b q_0], [q_0 Z_0 q_0], [q_0 a q_1], [q_0 b q_1], [q_0 Z_0 q_1],$

$[q_1 a q_0], [q_1 b, q_0] [q_1 Z_0 q_0], [q_1 a q_1], [q_1 b q_1], [q_1 Z_0 q_1]\}$

Resultant productions:

$[q_0 a q_1] \to a$

$A \to [q_0 a q_1]$

$A \to a.$

13. $f(m,n) = m \times n.$

$m = 2 \quad n = 3.$

subroutine: string copy.

Input : B00100001BB.

string copy :

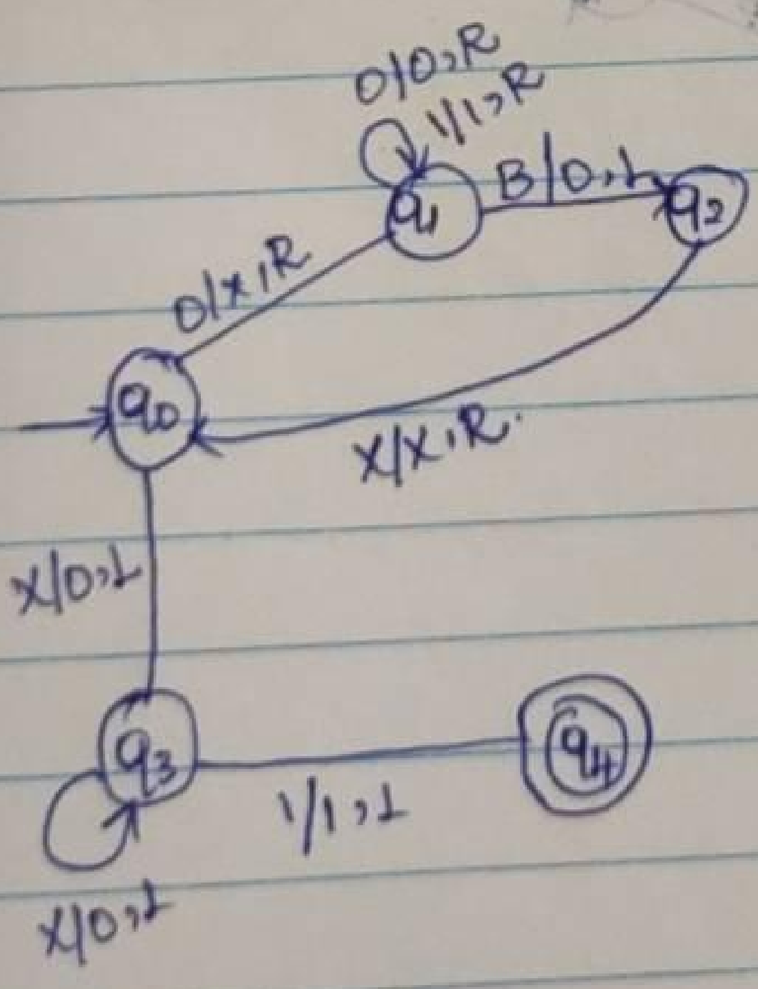
10001BBB.

1x001BBB

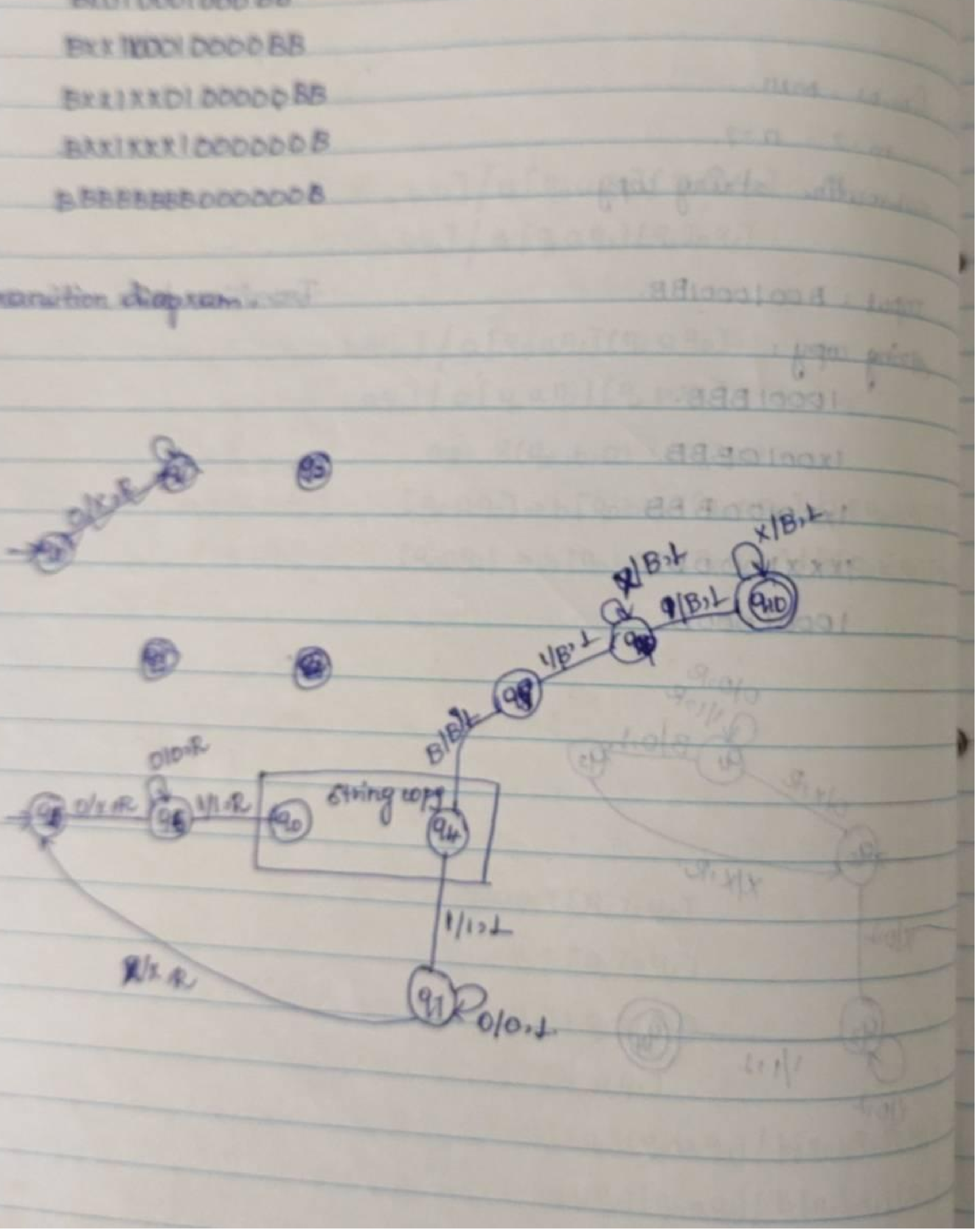
1xx01BBB

1xxx1BBB

10001BBB



Transition diagram:



Transition table:

δ	0	1	x	B
q_6	(q_6, X, R)	ϕ	ϕ	ϕ
q_6	$(q_6, 0, R)$	$(q_6, 1, R)$	x	x
q_0	(q_1, X, R)	ϕ	$(q_3, 0, L)$	ϕ
q_1	$(q_1, 0, R)$	$(q_1, 1, R)$	ϕ	$(q_2, 0, L)$
q_2	ϕ	ϕ	(q_6, X, R)	ϕ
q_3	ϕ	ϕ	$(q_3, 0, L)$	ϕ
q_4	ϕ	$(q_7, 1, L)$	ϕ	$\phi(q_8, B, L)$
q_7	$(q_7, 0, L)$	ϕ	(q_5, X, R)	ϕ
q_8	ϕ	(q_9, B, L)	ϕ	ϕ
q_9	ϕ	(q_{10}, B, L)	(q_9, B, L)	ϕ
q_{10}	ϕ	ϕ	(q_{10}, B, L)	ϕ

String Processing:

Ex. $M = \{(q_1, q_2, q_3), (0,1), (01, B), \delta(q_1, B, (q_0, 3\}$

$\delta(q_1, 1) = (q_3, 0, R)$

$C_1 = 00|00|000|0|00 = 0^2 1 0^2 1 0^3 1 0^1 1 0^2$

$\delta(q_3, 0) = (q_1, 1, R)$

$C_2 = 000|0|0|00|00 = 0^3 1 0^1 1 0^1 1 0^2 1 0^2$

$\delta(q_3, 1) = (q_2, 0, R)$

$C_3 = 000|00|00|0|00 = 0^3 1 0^2 1 0^2 1 0^1 1 0^2$

$\delta(q_3, B) = (q_3, 1, L)$

$C_4 = 000|000|0|00|0 = 0^3 1 0^3 1 0^1 1 0^2 1 0$

Code for TM, $M = C_1 11 C_2 11 C_3 11 C_4$

$M = 00|00|00|0|00||000|0|0|00|00|||000|00|00|0|00||000|000|0|00|00|$