Title : Question Paper

FF No. 868

Reg.No.

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination: End Semester Examination

Year: SY
Branch: Information Technology
Subject: Automata Theory
Subject Code : IT207TH
Max. Marks: 100
Total Pages of Question Paper: ~~02~~ 2
Day & Date : 12/05/2018
Time : 2.30 - 5.30 pm

Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1 Solve following 18

1 Describe different notions of acceptance of a string (acceptance by final state, by empty stack) for push-down automata ? In case of NPDA show that both these notions are computationally equally powerful. For DPDAs which notion of acceptance is more powerful? Why?

2 Define deterministic push down automata (DPDA). Clearly explain the points which distinguishes DPDA from the non-deterministic PDA. Give example for each of the following with brief supporting argument:
A language which is DCFL (i.e. Can be recognized by DPDA) but not regular
A language which is CFL but not DCFL
A language which is not a CFL

3 Is the language $\{ww^Rw \mid w \in \{0,1\}^*\}$ is context-free? Justify.

Q.2 Solve any 2 16

1 Let L be set of all binary strings w such that total number of zeros in w is strictly more than the total numbers of ones in w.

2 Construct PDA equivalent to following grammar
S-> aAA
A->aS | bS | a

3 Design a PDA for the language $\{a^i b^{i+j} a^j \mid i,j >= 0\}$.

Q.3 Solve following 18

1 Design Turing Machine for testing whether given number is Prime or not. You can assume that to begin with input tape of turing machine contains string # 0n # , where n is the input number. You can use multiple tapes.

2 Is Turing Machine model robust? Justify.

3 How does universal turing machine work?

Q.4 Solve any 2 16

1 Define the Turing Machine model. Design a TM that accepts the set of all strings of the form w#w where w is in $\{0,1\}^*$. First give a description of your algorithm and then give the complete TM.

2 Define the Turing Machine Model. Design a TM accepting language of non palindrome strings over alphabet {0,1}.

3 Below an initial and the final tape contents are given. You need to design a Turing Machine which transforms the initial tape contents to the final tape contents.
Assume that initially tape contains "#w#" for a string w over {0,1} alphabet. Let m=number of zeros in w and n = number of ones in w.
Final tape contents should be $\#0^m1^n\#$.

Q.5 Solve following 16

1 What are countable sets? Show that set of all rational numbers is a countable set.

2 State the Halting Problem for Turing Machines and prove that the Halting Problem is not decidable.

Q.6 Solve any 2 16

1 Are Recursive Languages closed under union, intersection, Kleene star?
Are Recursively Enumerable Languages closed under union, intersection, complementation?
Give a brief justification supporting your answer.

2 Let A be a set and P(A) is collection of all possible subsets of A. E.g. If A={1,2,3} then P(A)= { phi, {1}, {2},{3}, {1,2}, {2,3}, {1,3}, {1,2,3}} Show that there doen't exist any one-one and onto function from A to P(A).
Using above result show that there exist languages which are not recursively enumerable.

3 What is Post Correspondence Problem(PCP). Show that PCP over unary alphabet {x} is decidable.

Title : Question Paper

FF No. 868

Reg.No.

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination: Mid Semester Examination

Year: SY

Subject: Automata Theory

Max. Marks: 100

Day & Date: Thursday, 08/03/2018

Branch: Information Technology

Subject Code: IT207TH

Total Pages of Question Paper: 03

Time: 2.30 – 5.30 p.m.

Instructions to Candidate

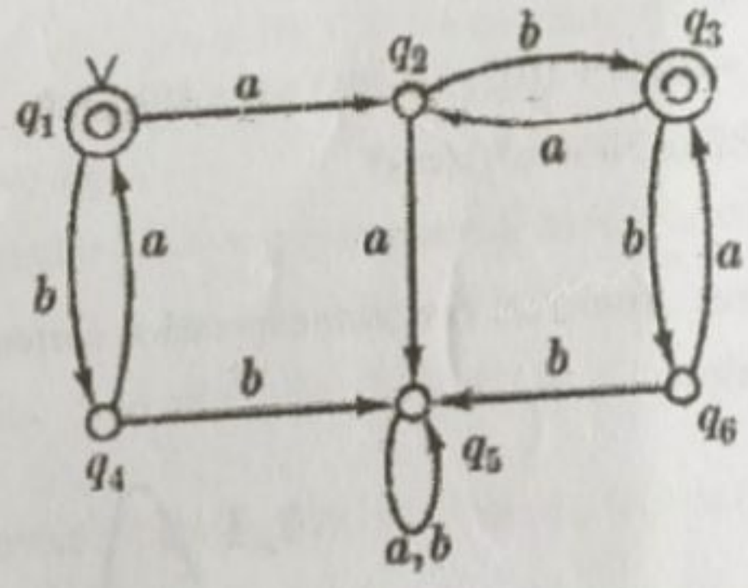
MSE - SE - 086, 87, 88

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

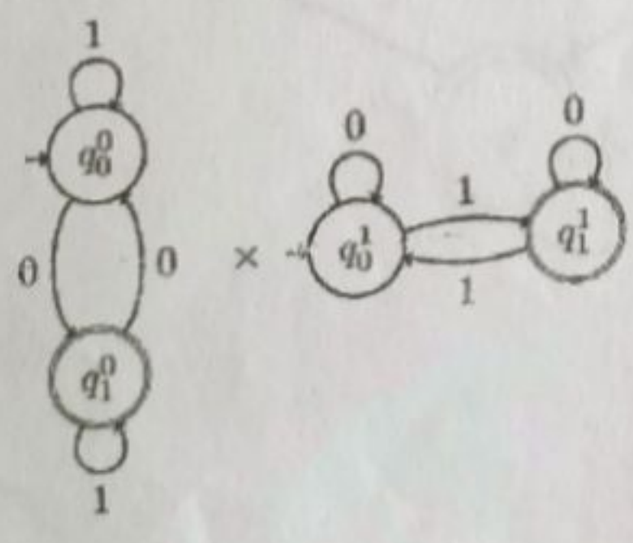
18

Q.1 Solve following

1 Minimize following DFA:



2 Construct DFA for difference of languages L1-L2, where L1, L2 are represented by following two DFAs respectively.



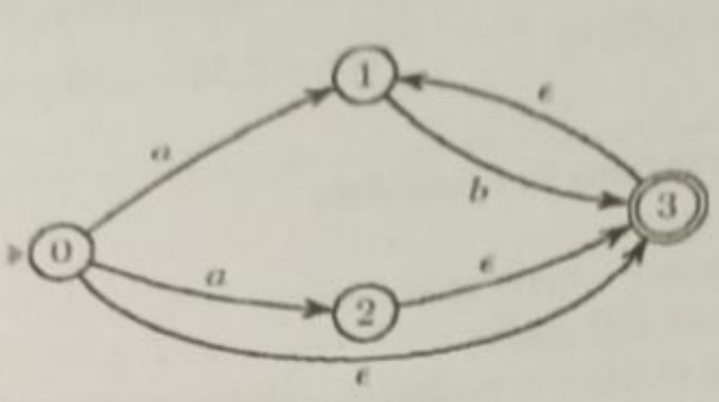
3 Write yes or no whether one can construct an NFA or DFA for the languages given below (with brief justification):

1. $\{a^n b^n \mid 1<=n<=5\}$
2. $\{a^n b^n \mid 1<=n<=100\}$
3. $\{(ab)^n \mid 1<=n<=100\}$
4. $\{a^n b^n \mid n>=1\}$
5. $\{(ab)^n \mid n>=1\}$

16

Q.2 Solve any 2

1 Convert following NFA to DFA.



2 Let $\Sigma = \{0,1\}$. $\{x \in \Sigma^* \mid$ length of the string x is divisible by 2 or 3$\}$.

3 Let $\Sigma = \{0,1\}$. Define a recognizer for 1. Φ (phi) 2. $\{\varepsilon\}$.

18

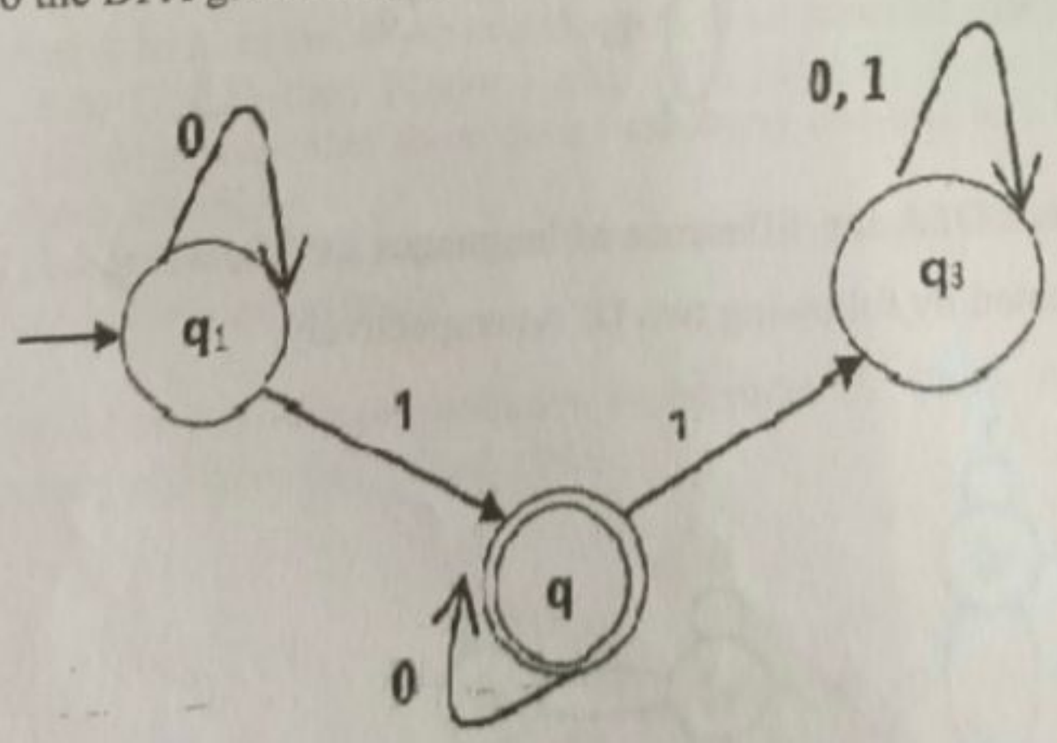
Q.3 Solve following

1 Is following true? Justify.

$(\varepsilon + 1)(01)^* (\varepsilon + 0) = (01)^* + 1(01)^* + (01)^* 0 + 1(01)^* 0$

2 Convert following RE to NFA. a*(b|cd)*

3 Using Arden's theorem, construct a regular expression corresponding to the DFA given below:



16

Q.4 Solve any 2

1 Write regular expressions for the following languages over $\Sigma = (a,b)$

The set of strings over {0,1} that have at least one 1.

The set of strings over {0,1} that have at most one 1.

The set of strings over {0,1} with length at least 2 that begin and end in the same symbol.

The set of identifiers in 'C'

2 Give RE corresponding to the complement of following RE :

(ba U ab)*

3 State Myhill-Nerode theorem and Pumping Lemma for regular Languages.

Q.5 Solve following 16

1 State whether following languages are regular and/or context-free? (with brief justification)

a. Equal a's, b's, c's
b. $\{ww \mid w \in \{0, 1\}^*\}$
c. $\{ w \in \{a, b\}^* \mid w = w^R \}$
d. $\{a^i b^j c^i d^j \mid i, j \geq 0\}$

2 Give context-free grammars that generate the following languages.

1. $\{0^n 1^n \mid n>0\} \cup \{0^n 1^{2n} \mid n>0\}$
2. $\{ w \in \{0, 1\}^* \mid$ w contains at least three 1s $\}$

Q.6 Solve any 2 16

1 Consider following grammars. Which languages do they generate?

a. $S \rightarrow abScB \mid \lambda; B \rightarrow bB \mid b$
b. $S \rightarrow aSa \mid aBa; B \rightarrow bB \mid b$

2 Convert following CFG to Chomsky Normal Form:

$S \rightarrow aXbX; X \rightarrow aY \mid bY \mid \varepsilon; Y \rightarrow X \mid c.$

3 Describe Decision Properties of CFLs.

Title : Question Paper **FF No. 868**

Reg.No.							

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination: Mid Semester Examination

Year: TY **Branch:** Computer Engineering

Subject: Theory of Computation **Subject Code:** CS314TH

Max. Marks: 100 **Total Pages of Question Paper:** 02

Day & Date: 4/10/17 **Time:** 2.30 pm.

Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1 **a** Solve following **18**

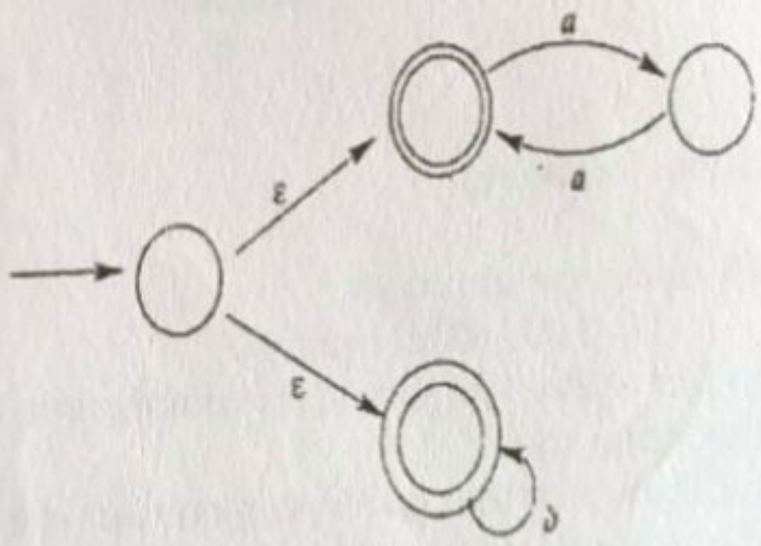
1 Construct DFA for all strings with at least one a and exactly two b's

2 Give formal definition of DFA. What are applications of DFA?

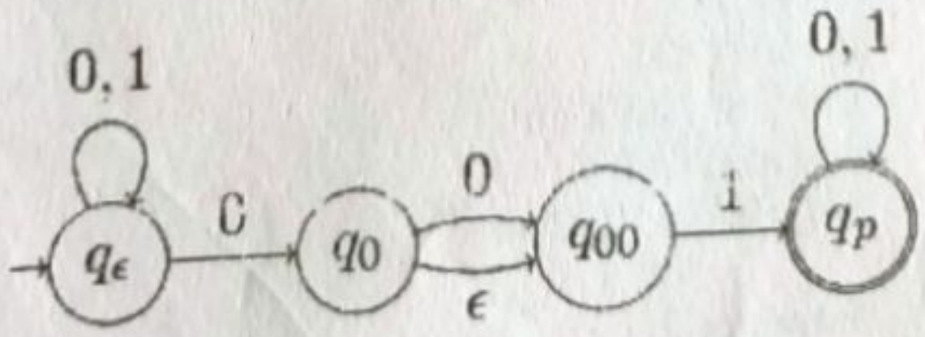
3 Is the class of languages recognized by NFAs closed under complement? Justify. **16**

Q.1 **b** Solve any 2

1 Convert following NFA to DFA:



2 Show whether string 0100 is accepted or not by the given NFA using parallel computation view:

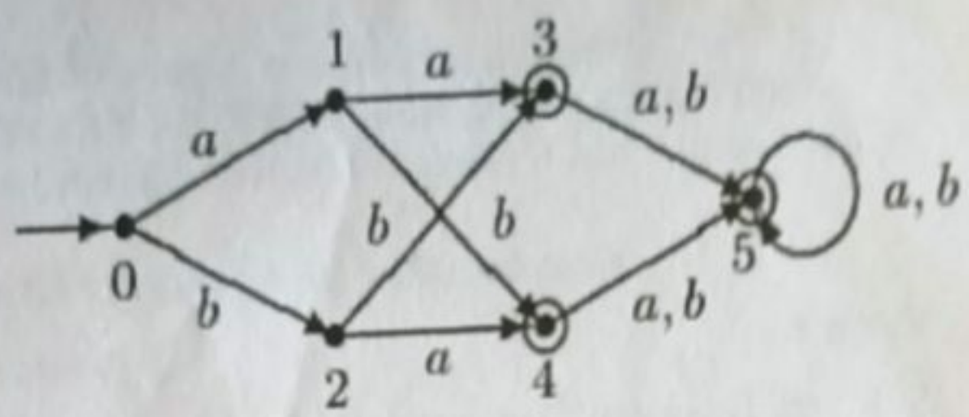


3 Is a language L over Σ = (a,b), which is concatenation of following languages i.e. L = L1 . L2 regular? Prove.
L1: words starting with a, L2: words ending with b

18

Q.2 a Solve following

1 Apply DFA minimization algorithm:



2 Simplify RE: (0 + (ε+1) (ε+1)* 0) to 1*0

3 State Myhill-Nerode Theorem. Use it to prove that language A = $\{0^n1^n : n>= 0\}$ is not regular.

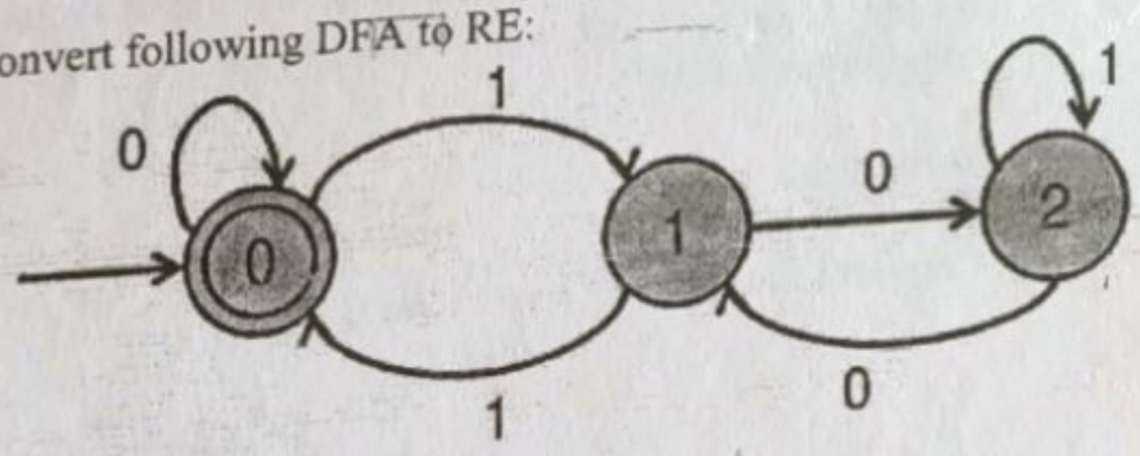
16

Q.2 b Solve any 2

1 Write regular expressions for the following languages over Σ = (a,b)
{w Ɛ Σ* | |w| is odd}
{w Ɛ Σ* | w does not end in a double letter}
{w Ɛ Σ* | w has an odd number of a's}

2 Give RE corresponding to the complement of following RE:(a U ab)*

3 Convert following DFA to RE:



16

Q.3 a Solve following

1 Consider the grammar:
S -> aS | aSbS | epsilon
a) Show that the grammar is ambiguous, by giving two parse trees for the string aaabb.
b) Show that this grammar generates strings such that in any prefix of the string there are at least as many a's as b's.
c) Find an unambiguous grammar that generates these strings.

2 What is a useless symbol? Remove the useless symbols from the given CFG:
S -> aB / bX
A -> Bad / bSX / a
B -> aSB / bBX
X -> SBD / aBx / ad

16

Q.3 b Solve any 2

1 Write a CFG for language L = $\{0^i 1^j 2^k \mid k <= i \text{ or } k <= j\}$

2 What is Chomsky Normal Form? Convert following CFG to CNF:
S->ABa, A->aab, B->Ac

3 Describe decision properties of CFLs.

Reg.No.

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to University of Pune)

Examination : ESE

Year: TY
Branch : IT

Subject : Theory of Computation
Subject Code : IT344TH

Max. Marks: 100
Total Pages of Question Paper :02

Day & Date :
Time :

Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1. Solve following 16

1 Design a finite automaton in the form of a transition diagram, that accept all strings over 0,1 that has

1. odd length
2. even length.

2 Discuss how NFA with epsilon is converted to equivalent DFA.

Q. 2. Solve any 2 of following 18

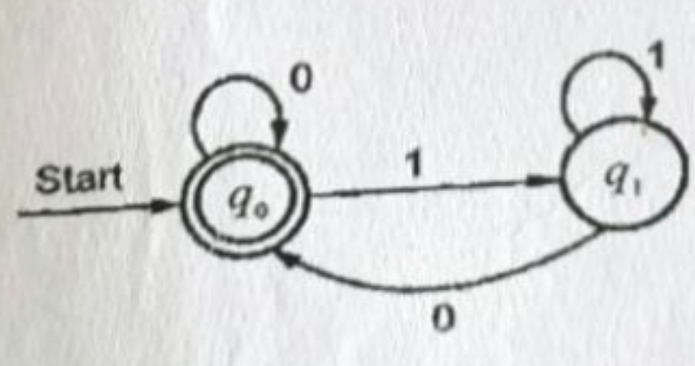
1 Write R.E. For following $\Sigma = \{0,1\}$

Strings where only 0's may occur in the even positions.

Strings containing the pattern 00

Strings of length three

2 Derive R.E. For following FA:



3 Are following two expressions equivalent? Justify.

$R1=(a+bb)^* (b+aa)^*$, $R2 = (a+b)^*$

Q. 3. Solve following 18

1 Prove that following CFG is ambiguous by generating the word aaabb.

$S \rightarrow ASB \mid ab \mid SS$, $A \rightarrow aA \mid \Lambda$, $B \rightarrow bB \mid \Lambda$

2 Write CFG for matching of parenthesis.

Q.4. Solve any 2 of following 16

1 Construct PDA for the language $\{a^n b^n, n>0\}$.

2 Define and give example for Recursive and Recursively enumerable languages.

3 Convert the CFG into PDA.

S-> aSa | bSb| a| b| aa| bb

Q.5. Solve any 2 of following 16

1 What is post correspondence problem? Is it solvable?

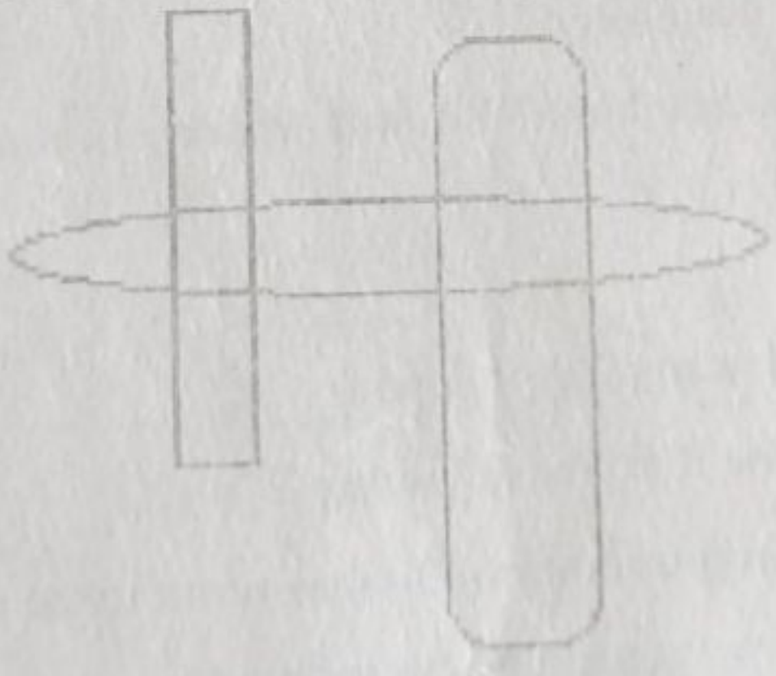
2 Design Turing machine to find 2's complement of given binary number.

3 Design Turing machine which will divide two unary numbers m and n; and produces remainder as output.

Q. 6. Solve following 16

1 Discuss applications of CFG.

2 What are closure properties of regular languages?



Title : Question Paper **VF No. 868**

Reg.No.							

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination : MSE

Year : SY **Branch :** IT

Subject : Automata Theory **Subject Code :** IT2004

Max. Marks : 30 **Total Pages of Question Paper :** 01

Day & Date : 28/9/18 **Time :** 11-12 noon

Instructions to Candidate

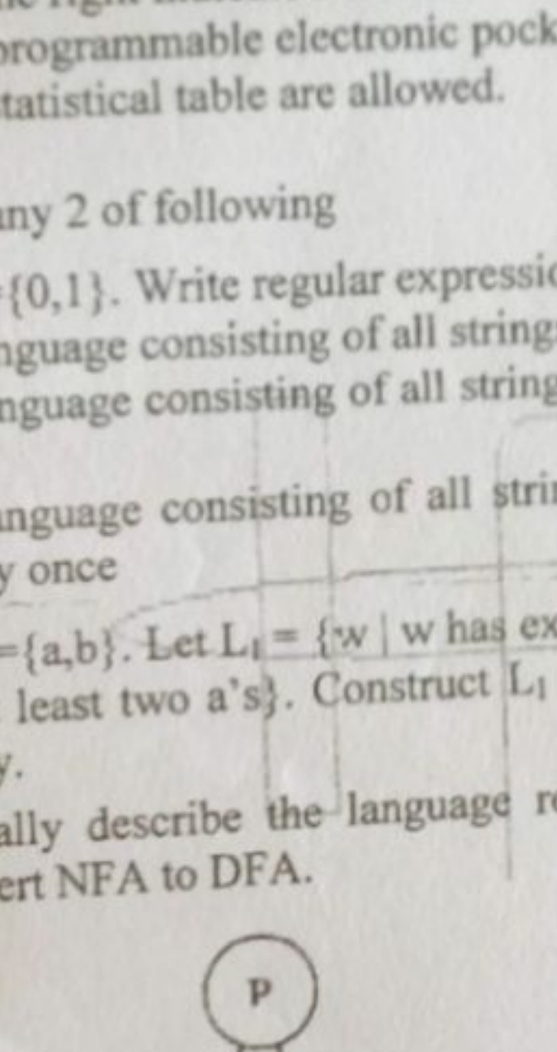
1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1 Solve any 2 of following **16**

1 Let $\sum=\{0,1\}$. Write regular expression for following:
The language consisting of all strings of length three or more
The language consisting of all strings containing the pattern 000 or 010
The language consisting of all strings containing the pattern 000 exactly once

2 Let $\sum=\{a,b\}$. Let $L_1 = \{w \mid w$ has exactly two a's$\}$ and $L_2 = \{w \mid w$ has at least two a's$\}$. Construct $L_1 \cap L_2$. Is this language regular? Justify.

3 Formally describe the language represented by following NFA. Convert NFA to DFA.



Q.2 Solve any 2 of following **14**

1 Define following: DFA, NFA, CFG

2 Consider CFG: S → ASB; A → aAS | a | ε; B → SbS | A | bb;
Convert it in CNF.

3 Is $\{ a^n b^n c^n \mid n \geq 0\}$ regular? Justify.

Title : Question Paper

FF No. 868

Reg.No. | | | | | | | |

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination : ESE

Year: TY
Subject : Theory of Computation
Max. Marks : 100
Day & Date : 10-7-2019

Branch : IT
Subject Code : IT344TH
Total Pages of Question Paper : 02
Time : 11 am – 2 pm

Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1 Solve the following **16**

1 Convert following NFA to DFA

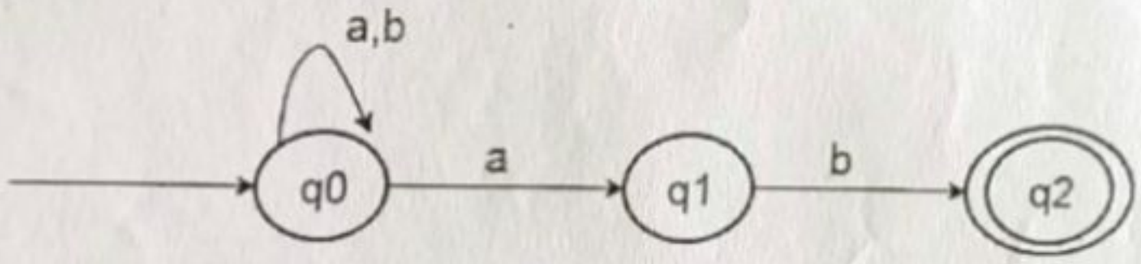


Figure 1

2 Define the languages represented by following REs:
1. (a+b)* (a+bb)
2. (a+b)* a(a+b)* a(a+b)*

Q.2 Solve any 2 of following **18**

1 Consider a CFG containing following productions:
$S \rightarrow XY \mid W$
$X \rightarrow aXb \mid \varepsilon$
$Y \rightarrow cY \mid \varepsilon$
$W \rightarrow aW\,c \mid Z$
$Z \rightarrow bZ \mid \varepsilon$

Does it generate words aabbc, abbccc, abbc, abccc? If yes, then derive them using leftmost or rightmost derivation.

2 Construct CFG for the language containing at least one occurrence of a double a.

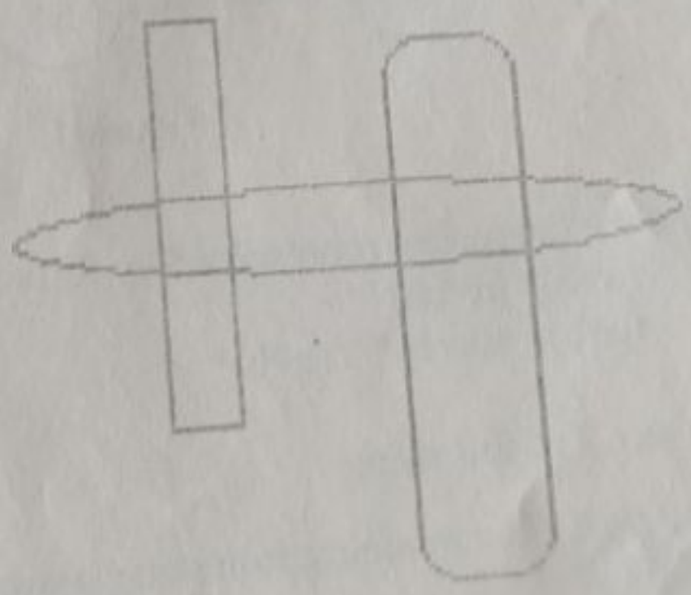
3 Regular languages are closed under union. Is the statement correct? Justify.

Q.3. Solve the following **18**

1 Define a PDA. Which are the two ways in which it accepts a string?

2 What is universal Turing machine? Explain with suitable diagram.

Q.4.		Solve any 2 of following	16
	1	Give definition and examples of Context Sensitive Grammars.	
	2	Compare finite automata, pushdown automata and Turing machine. List languages accepted by each of them.	
	3	Is every CFL a regular language? Justify.	
Q.5.		Solve any 2 of following	16
	1	Construct a PDA for the following language: $\{a^n b^{2n} : \text{where } n >= 0\}$	
	2	How CFG is converted into an equivalent PDA?	
	3	Construct a Turing machine to accept strings of the form $\{0+1\}^*$	
Q.6.		Solve the following	16
	1	What is recursive language? Is it different than Turing-recognizable language?	
	2	Discuss post correspondence problem. Is it solvable?	



Title : Question Paper **VF No. 868**

Reg.No.

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination: Mid Semester Examination

Year: SY **Branch:** Information Technology

Subject: Automata Theory **Subject Code:** IT207TH

Max. Marks: 100 **Total Pages of Question Paper:** 03

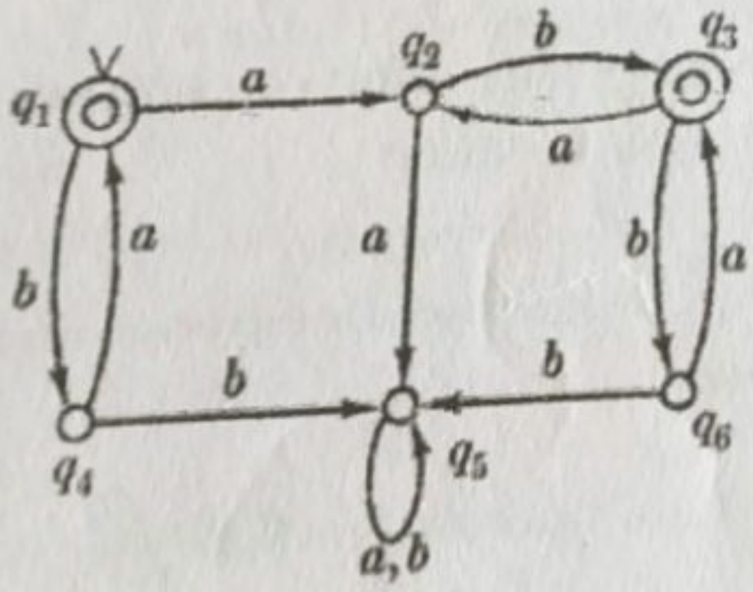
Day & Date: Thursday, 08/03/2018 **Time: 2.30 – 5.30 p.m.**

Instructions to Candidate

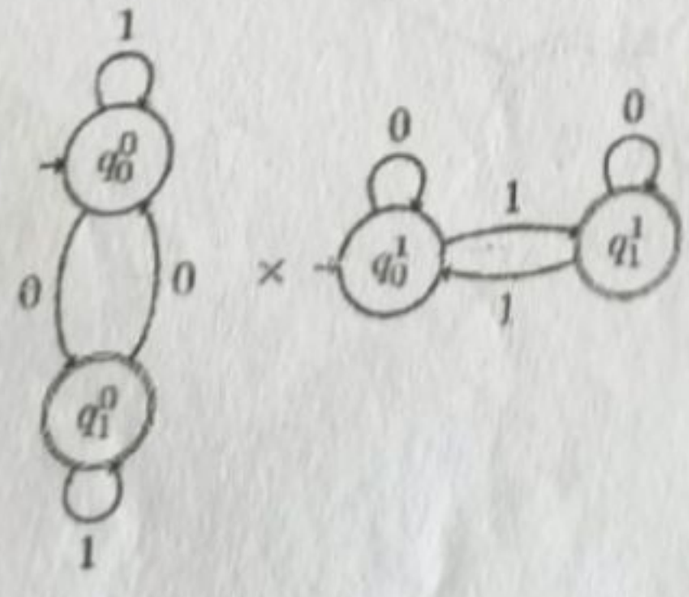
1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1 Solve following 18

1 Minimize following DFA:



2 Construct DFA for difference of languages L1-L2, where L1, L2 are represented by following two DFAs respectively.

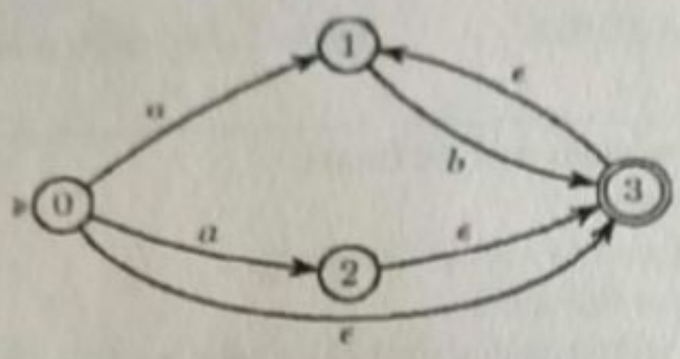


3 Write yes or no whether one can construct an NFA or DFA for the languages given below (with brief justification):

1. $\{a^n b^n \mid 1<=n<=5\}$
2. $\{a^n b^n \mid 1<=n<=100\}$
3. $\{(ab)^n \mid 1<=n<=100\}$
4. $\{a^n b^n \mid n>=1\}$
5. $\{(ab)^n \mid n>=1\}$

Q.2 Solve any 2 16

1 Convert following NFA to DFA.



2 Let $\Sigma = \{0,1\}$. $\{x \in \Sigma^* \mid$ length of the string x is divisible by 2 or 3$\}$.

3 Let $\Sigma = \{0,1\}$. Define a recognizer for 1. Φ (phi) 2. $\{\varepsilon\}$.

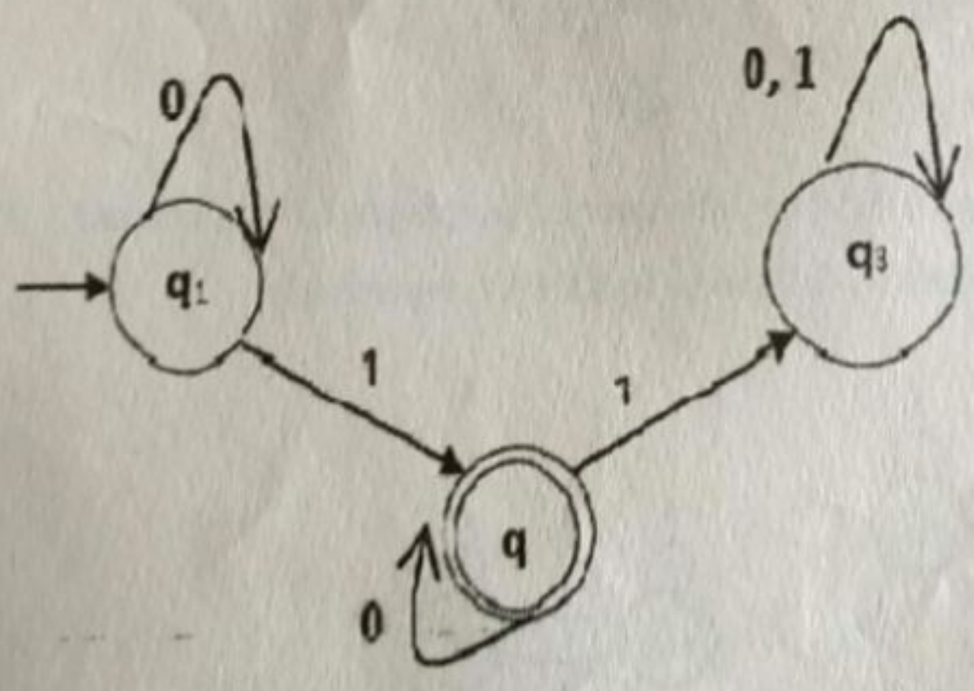
Q.3 Solve following 18

1 Is following true? Justify.

$(\varepsilon + 1)(01)^* (\varepsilon + 0) = (01)^* + 1(01)^* + (01)^* 0 + 1(01)^* 0$

2 Convert following RE to NFA. $a^*(b|cd)^*$

3 Using Arden's theorem, construct a regular expression corresponding to the DFA given below:



Q.4 Solve any 2 16

1 Write regular expressions for the following languages over $\Sigma = (a,b)$

The set of strings over {0,1} that have at least one 1.

The set of strings over {0,1} that have at most one 1.

The set of strings over {0,1} with length at least 2 that begin and end in the same symbol.

The set of identifiers in 'C'

2 Give RE corresponding to the complement of following RE :

(ba U ab)*

3 State Myhill-Nerode theorem and Pumping Lemma for regular Languages. 16

Q.5 Solve following

1 State whether following languages are regular and/or context-free? (with brief justification)

a. Equal a's, b's, c's
b. $\{ww \mid w \in \{0, 1\}^*\}$
c. $\{ w \in \{a, b\}^* \mid w = w^R \}$
d. $\{a^i b^j c^i d^j \mid i, j \geq 0\}$

2 Give context-free grammars that generate the following languages.

1. $\{0^n 1^n \mid n>0\} \cup \{0^n 1^{2n} \mid n>0\}$
2. $\{ w \in \{0, 1\}^* \mid w$ contains at least three 1s $\}$ 16

Q.6 Solve any 2

1 Consider following grammars. Which languages do they generate?

a. $S \rightarrow abScB \mid \lambda; B \rightarrow bB \mid b$
b. $S \rightarrow aSa \mid aBa; B \rightarrow bB \mid b$

2 Convert following CFG to Chomsky Normal Form:

$S \rightarrow aXbX; X \rightarrow aY \mid bY \mid \varepsilon; Y \rightarrow X \mid c.$

3 Describe Decision Properties of CFLs.

Reg.No. | | | | | | | |

Bansilal Ramnath Agarwal Charitable Trust's

VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination : ESE

Year: SY **Branch :** IT

Subject : Automata Theory **Subject Code :** IT2004

Max. Marks : 100 **Total Pages of Question Paper :** 02

Day & Date : 2-7-2019 **Time :** 11 am – 2 pm

Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1 Solve the following **16**

1 Design a NFA which accepts the language { $w \in \Sigma^*$ | w contains at least two 0s, or exactly two 1s }

2 Define the languages represented by following REs:

1. $(a+b)^* (a+bb)$
2. $(a+b)^* a(a+b)^* a(a+b)^*$

Q.2 Solve any 2 of following **18**

1 Find CFL associated with following CFG:

$S \rightarrow aB \mid bA$

$A \rightarrow a \mid aS \mid bAA$

$B \rightarrow b \mid bS \mid aBB$

2 Construct CFG for the language containing at least one occurrence of a double a.

3 List closure properties CFL. Discuss in brief.

Q.3. Solve the following **18**

1 Construct a Turing machine to accept strings of the form $\{0^n 1^n\}$

2 Define a PDA. Which are the two ways in which it accepts a string?

Q.4. Solve any 2 of following **16**

1 What are different variants of Turing machine? Explain in brief.

2 Give definition and examples of Context Sensitive Grammars.

3 What are undecidable problems? Discuss with examples.

Q.5. Solve any 2 of following **16**

1 What are Recursive and Recursively Enumerable languages?

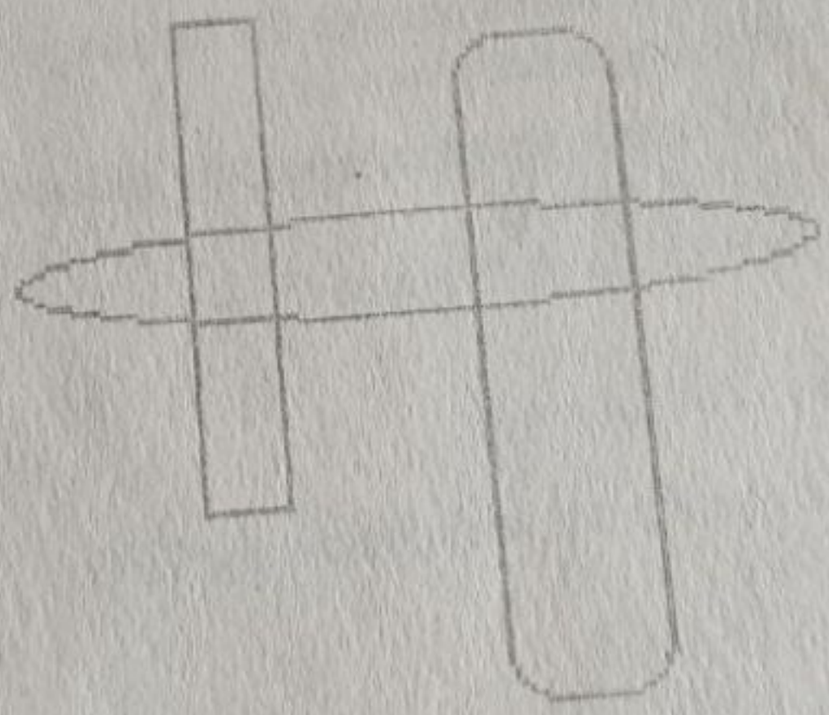
2 Construct a PDA for language L = $\{0^n1^m2^m3^n \mid n>=1, m>=1\}$

3 Construct a Turing machine to accept strings of the form $\{0+1\}^*$ 16

Q.6. Solve the following

1 What is Post Correspondence Problem?

2 What is Chomsky hierarchy of grammars?



Title : Question Paper **VF No. 868**

Reg.No. | | | | | | | |

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination : ESE

Year: SY **Branch :** IT

Subject : Automata Theory **Subject Code :** IT207TH

Max. Marks : 100 **Total Pages of Question Paper :** 02

Day & Date : 11-7-2019 **Time :** 11 am – 2 pm

Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1 Solve the following **16**

1 Convert following NFA to DFA

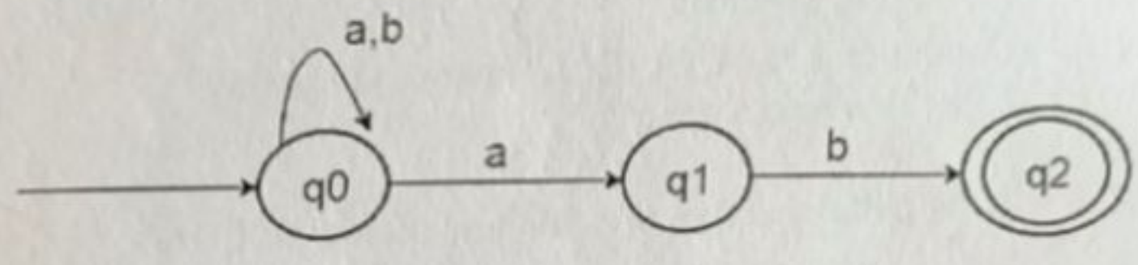
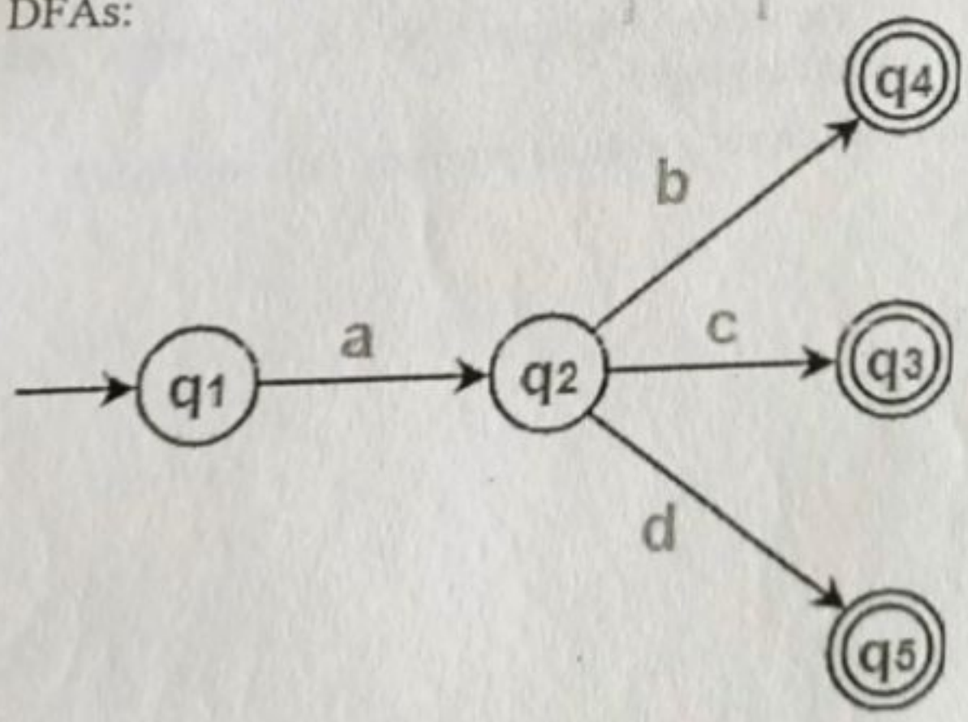


Figure 1

2 Construct REs to represent languages corresponding to following DFAs:



Q.2 Solve any 2 of following **18**

1 Consider a CFG containing following productions:

$S \rightarrow XY \mid W$
$X \rightarrow aXb \mid \varepsilon$
$Y \rightarrow cY \mid \varepsilon$
$W \rightarrow aW\,c \mid Z$
$Z \rightarrow bZ \mid \varepsilon$

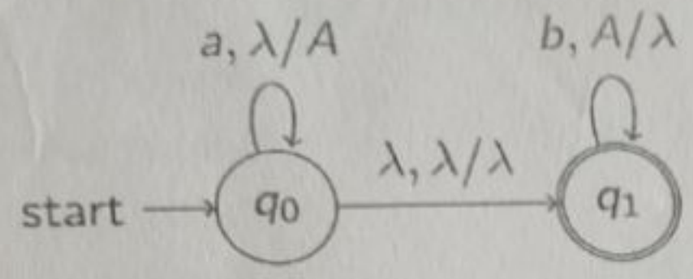
Does it generate words aabbc, abbccc, abbc, abccc? If yes, then derive them using leftmost or rightmost derivation.

2 Construct a CFG to generate following language:
{ w ∈ {0, 1}* | length of w is odd and the middle symbol is 0 }

3 Regular languages are closed under union. Is the statement correct? Justify.

Q.3. Solve the following **18**

1 Identify language accepted by following PDA. Justify your answer.



2 What is universal Turing machine? Explain with suitable diagram.

Q.4. Solve any 2 of following **16**

1 Define Turing machine and explain its working in brief.

2 Compare finite automata, pushdown automata and Turing machine. List languages accepted by each of them.

3 Is every CFL a regular language? Justify.

Q.5. Solve any 2 of following **16**

1 Construct a PDA for the following language:
$\{a^n b^{2n} : \text{where } n >= 0\}$

2 How CFG is converted into an equivalent PDA?

3 Design Turing Machine accepting language $\{a^n b^n c^n \mid n \geq 1\}$

Q.6. Solve the following **16**

1 What is recursive language? Is it different than Turing-recognizable language?

2 Discuss post correspondence problem. Is it solvable?

Title : Question Paper FF No. 868

Reg.No.								

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination: End Semester Examination

Year: SY **Branch:** IT

Subject: Automata Theory **Subject Code:** IT207TH

Max. Marks: 100 **Total Pages of Question Paper:** 02

Day & Date : 05-07-2018 **Time :** 10 am – 1 pm

Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1 Solve following 18

1 Consider language L over alphabet {0,1} defined as below:
L={w | third symbol from end in w is 1}
First construct an NFA for language L. Then convert this NFA to DFA, try to remove un-necessary states.

2 Give formal definition of DFA. What are applications of DFA?

3 Construct DFA for a language over Σ={0,1}, which accepts all strings that begin and end with different symbols.

Q.2 Solve any 2 16

1 Describe given language: L = {ww^R : w ∈ {a, b}*}. Is it a regular language? Justify.

2 Simplify RE: (0 + (Ɛ+1) (Ɛ+1)* 0) to 1*0

3 Check the equivalence of the regular expressions, give brief argument supporting your claim.
(01+0)*0 and 0(10+0)*

Q.3 Solve following 18

1 Write a CFG to generate strings of 0,1 such that each 0 is followed by at least as many 1's. Also derive few words

2 Consider the grammar:
S -> aS | aSbS | epsilon
a) Show that the grammar is ambiguous, by giving two parse trees for the string aaabb.
b) Show that this grammar generates strings such that in any prefix of the string there are at least as many a's as b's.
c) Find an unambiguous grammar that generates these strings.

3 Discuss closure properties of CFL.

Q.4 Solve any 2 16

1 Design a pushdown automaton for the language $\{a^n b^n, n>0\}$

Is PDA more powerful than DFA? Justify.

2 Construct PDA equivalent to following grammer
S ->0S1|A
A -> 1A0|S | epsilon

3 Design PDA for the language "set of strings of 0's and 1's such that no prefix has more 1's than 0's".

Q.5 Solve following 16

1 Design a turing machine for well formedness of brackets.

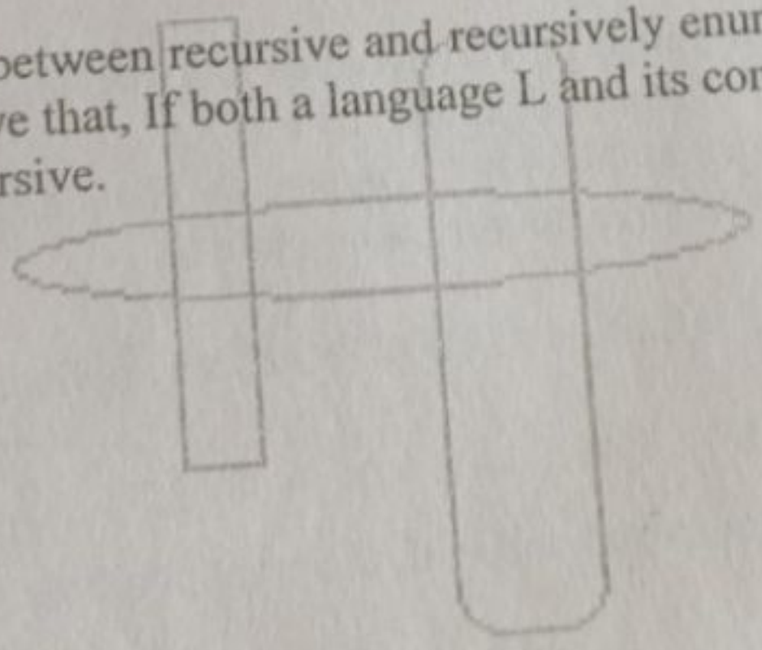
2 What is non-deterministic Turing machine? Show that every non-deterministic Turing machine has an equivalent deterministic Turing machine.

Q.6 Solve any 2 16

1 What is halting problem? Is it solvable?

2 Define countable sets. Let S is set of all 2-tuples of integers, that is S $=\{ (x_1,x_2) \mid x_1,x_2$ are integers$\}$. Prove that S is a countable set.

3 Differentiate between recursive and recursively enumerable language (RE) and prove that, If both a language L and its complement are RE, then L is recursive.



Title : Question Paper **FF No. 868**

Reg.No. | | | | | | | |

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination : ESE

Year: SY **Branch :** IT

Subject : Automata Theory **Subject Code :** IT207TH

Max. Marks : 100 **Total Pages of Question Paper :** ~~01~~ 02

Day & Date : 3-5-19 **Time :** 2.30 - 5.30

Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1 Solve the following **16**

1 Design a FA which accepts strings made up of 0, 1 that start with 0 and ends with either 0 or 1.

2 Design RE to represent set of all words over 0, 1 containing
1. At least one 1 and two or more zeroes
2. Words with odd length

Q.2 Solve any 2 of following **18**

1 Consider a CFG containing following productions:
S->SS | aSb| epsilon;
Derive 'abaabb' using leftmost and rightmost derivation.

2 Consider the given grammar with the following production rules. Identify the language represented by it. Justify your answer.
$S \rightarrow 0S0 \mid 0S1 \mid 1S0 \mid 1S1 \mid 0$

3 Are regular languages closed under complement and intersection? Prove.

Q.3. Solve the following **18**

1 Design a PDA whose language is $\{a^n b^{2n} \mid n \geq 0\}$

2 Construct a Turing machine to accept palindrome strings over {0,1}.

Q.4. Solve any 2 of following **16**

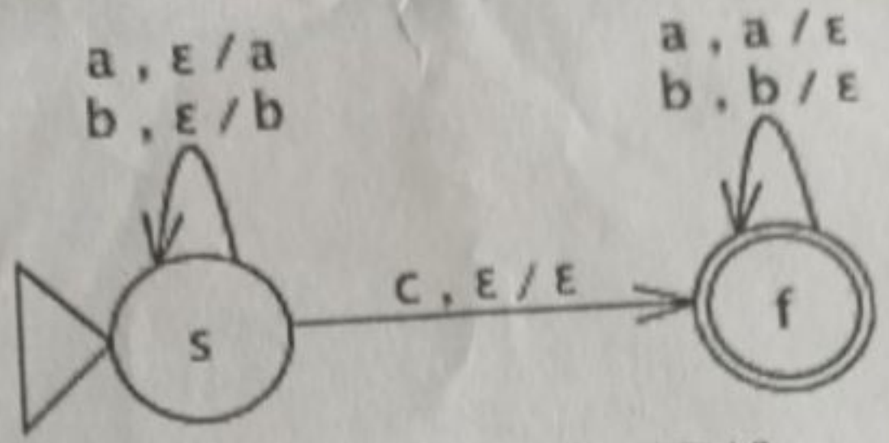
1 List different variants of Turing machine and explain in brief.

2 Define Pushdown automata and Turing machine. List languages accepted by TM but not by PDA.

3 Is PDA more powerful than DFA? Justify.

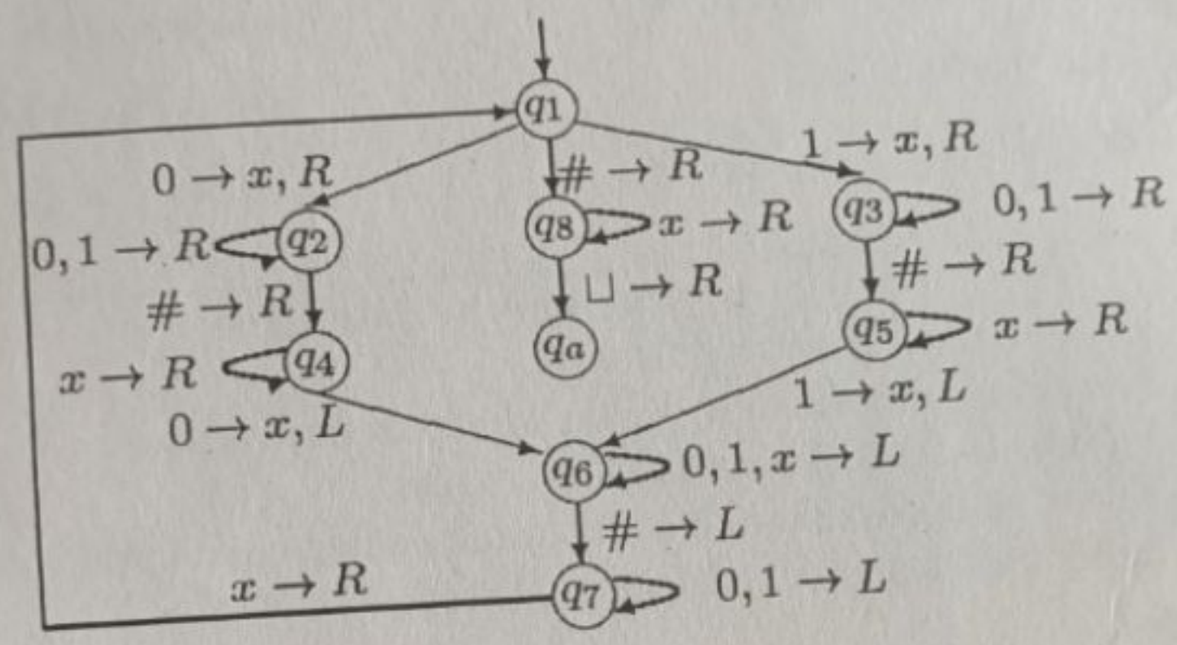
Q.5. Solve any 2 of following **16**

1 Identify the language represented by following PDA:



2 How CFG is converted into an equivalent PDA?

3 Generate some word belonging to the language accepted by the following turing machine.



16

Q.6. Solve the following

1 What is decidable language? How it is different than Turing-recognizable language?

2 Discuss halting problem. Is it unsolvable?

Title : Question Paper

FF No. 868

Reg.No.

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination: End Semester Examination

Year: SY
Branch: Information Technology
Subject: Automata Theory
Subject Code : IT207TH
Max. Marks: 100
Total Pages of Question Paper: ~~02~~ 2
Day & Date : 12/05/2018
Time : 2.30 - 5.30 pm

Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1 Solve following 18

1 Describe different notions of acceptance of a string (acceptance by final state, by empty stack) for push-down automata ? In case of NPDA show that both these notions are computationally equally powerful. For DPDAs which notion of acceptance is more powerful? Why?

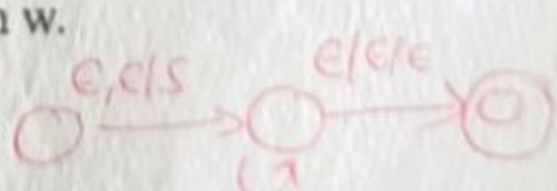
2 Define deterministic push down automata (DPDA). Clearly explain the points which distinguishes DPDA from the non-deterministic PDA. Give example for each of the following with brief supporting argument:
A language which is DCFL (i.e. Can be recognized by DPDA) but not regular
A language which is CFL but not DCFL
A language which is not a CFL

3 Is the language $\{ww^Rw \mid w \in \{0,1\}^*\}$ is context-free? Justify.

Q.2 Solve any 2 16

1 Let L be set of all binary strings w such that total number of zeros in w is strictly more than the total numbers of ones in w.

2 Construct PDA equivalent to following grammar
S-> aAA
A->aS | bS | a



3 Design a PDA for the language $\{a^i b^{i+j} c^j \mid i,j >= 0\}$.

Q.3 Solve following 18

1 Design Turing Machine for testing whether given number is Prime or not. You can assume that to begin with input tape of turing machine contains string # 0n # , where n is the input number. You can use multiple tapes.

2 Is Turing Machine model robust? Justify.

3 How does universal turing machine work?

Q.4 Solve any 2 16

1 Define the Turing Machine model. Design a TM that accepts the set of all strings of the form w#w where w is in $\{0,1\}^*$. First give a description of your algorithm and then give the complete TM.

2 Define the Turing Machine Model. Design a TM accepting language of non palindrome strings over alphabet {0,1}.

3 Below an initial and the final tape contents are given. You need to design a Turing Machine which transforms the initial tape contents to the final tape contents.
Assume that initially tape contains "#w#" for a string w over {0,1} alphabet. Let m=number of zeros in w and n = number of ones in w.
Final tape contents should be $\#0^m1^n\#$.

Q.5 Solve following 16

1 What are countable sets? Show that set of all rational numbers is a countable set.

2 State the Halting Problem for Turing Machines and prove that the Halting Problem is not decidable.

Q.6 Solve any 2 16

1 Are Recursive Languages closed under union, intersection, Kleene star?
Are Recursively Enumerable Languages closed under union, intersection, complementation?
Give a brief justification supporting your answer.

2 Let A be a set and P(A) is collection of all possible subsets of A. E.g. If A={1,2,3} then P(A)= { phi, {1}, {2},{3}, {1,2}, {2,3}, {1,3}, {1,2,3}} Show that there doen't exist any one-one and onto function from A to P(A).
Using above result show that there exist languages which are not recursively enumerable.

3 What is Post Correspondence Problem(PCP). Show that PCP over unary alphabet {x} is decidable.

Title : Question Paper FF No. 868

Reg.No.

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Examination: Mid Semester Examination

Year: TY **Branch:** Information Technology

Subject: Theory of Computation **Subject Code:** CS30105

Max. Marks: 100 **Total Pages of Question Paper:** 02

Day & Date : Mon, 26/02/2018 **Time :** 08-11 a.m.

Instructions to Candidate

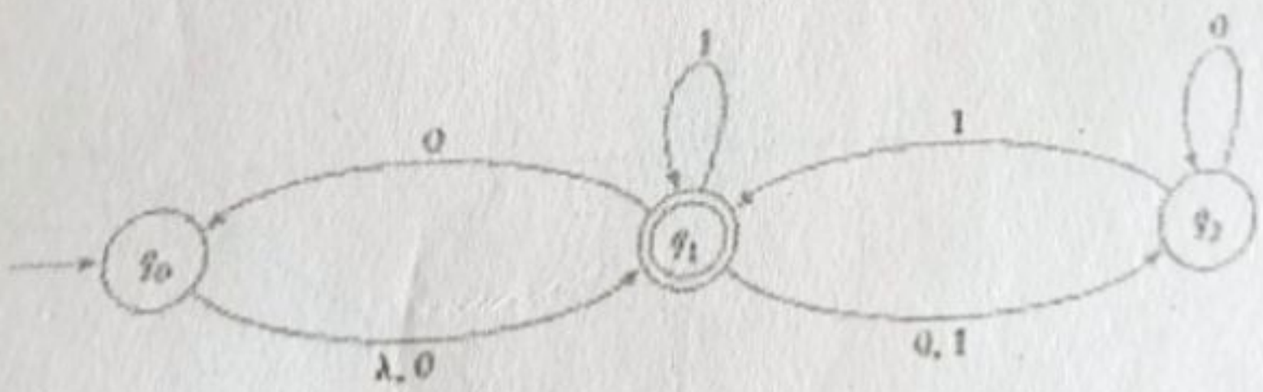
1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1 Solve following **18**

1 Construct DFA for a language over $\Sigma=\{0,1\}$, which accepts all strings that begin and end with different symbols.

2 Define DFA, NFA and compare them.

3 Convert following NFA to equivalent DFA



Q.2 Solve any 2 **16**

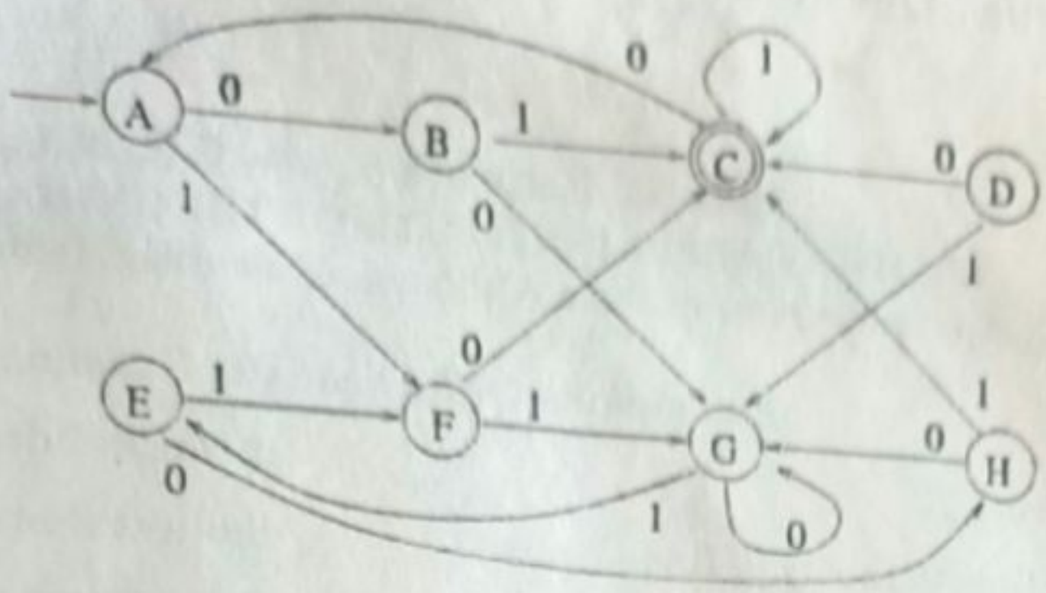
1 Give NFA for RE (a+b)*ab

2 Design a finite automaton in the form of a transition diagram, that accept all strings that start with 0 and has odd length or start with 1 and has even length. Also write transition table.

3 Design a Mealy machine for the language of all strings of 0's and 1's whose last two symbols are same.

Q.3 Solve following

1 Apply DFA minimization algorithm: 18



2 Simplify RE: ε+0+1+(ε+0+1)(ε+0+1)*(ε+0+1)

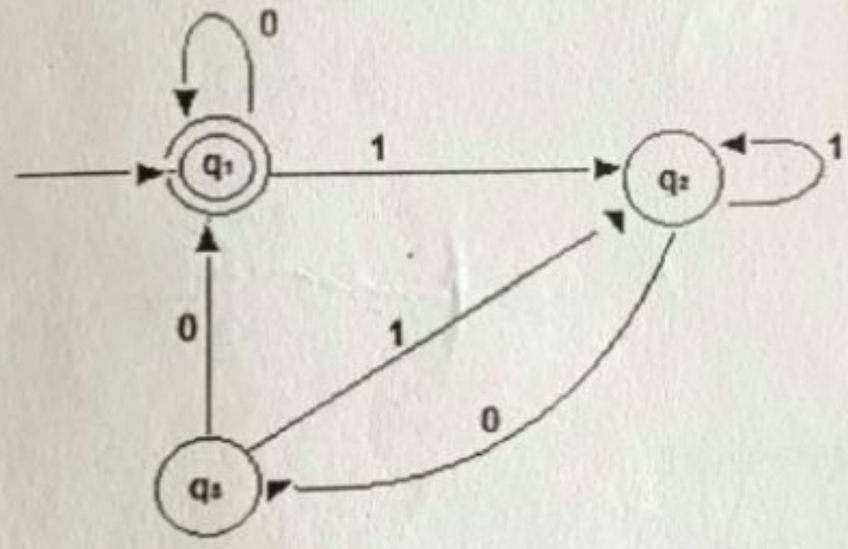
3 State Pumping Lemma. Use it to prove that language L = {ww | w in {0, 1}*} is not regular.

Q.4 Solve any 2 16

1 Write regular expressions for the following languages over Σ = (a,b)
{w Ɛ Σ* | |w| is odd}
{w Ɛ Σ* | w does not end in a double letter}
{w Ɛ Σ* | w has an odd number of a's}

2 Write algebraic identities for RE.

3 Convert following DFA to RE:



Q.5 Solve following 16

1 What are different types of grammar? Give example of each.

2 Convert the following grammar G = (V, T, P, S) into CNF:
S -> 0A0 | 1B1 | BB, A-> C, B-> S|A, C-> S|e

Q.6 Solve any 2

1 Write a CFG for language L = $\{0^n 1^n \mid n > 0\}$

2 Which language does the following grammar represent: S->aSa | bSb | a | b | ε? Generate two words of length >6 using leftmost derivation.

3 Write pumping lemma for context free languages.

Title : Question Paper

Reg.No. | | | | | | |

Bansilal Ramnath Agarwal Charitable Trust's
VISHWAKARMA INSTITUTE OF TECHNOLOGY, PUNE – 411037.
(An Autonomous Institute Affiliated to University of Pune)

Examination : ESE

Year: T.E. **Branch :** Computer

Subject : Theory of Computation **Subject Code :** CS0533

Max. Marks: 50 **Total Pages of Question Paper :**01

Day & Date : **Time :**

Instructions to Candidate

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.
4. Use of nonprogrammable electronic pocket calculator, mollier charts, steam tables and statistical table are allowed.

Q.1. a) Write R.E. for following languages over $\Sigma=\{0,1\}$ which accepts all strings, 8

1. containing exactly two 0's
2. containing at least two 0's
3. that do not end with 01

b) Is $L = \{0^i1^i \mid i>=0\}$ regular language? Justify your answer using pumping lemma. 7

OR

b) Design a Mealy machine for the language of all strings of 0's and 1's whose last two symbols are same. 7

Q. 2. a) Write equivalent CFG for given R.E. (011+1) * (01)* 8

b) Design DPDA to accept strings with more a's than b's. 7

OR

b) What is ambiguous grammar? Is following grammar ambiguous: S-> aAS | a, A-> SbA| SS| ba ? 7

Q. 3. a) Design TM for subtraction m-n which is defined to be m-n for m>=n and 0 for m<n. 7

b) What is Post Correspondance Problem? 7