QUESTIONS BANK
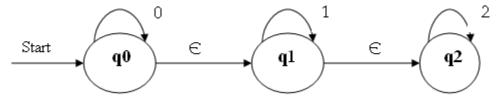
CS6503-THEORY OF COMPUTATION

UNIT-1

FINITE AUTOMATA

PART-A

1. What is a finite automaton? (Nov/Dec 2015)
2. What are the Applications of Automata theory? [May – 2008]
3. What is Induction principle? Give an example. [NOV/DEC 2012]
4. Draw a non-deterministic automata to accept strings containing the substring 0101. (may-2016)
5. State the pumping lemma for regular languages. (may/June 2016)
6. Write Regular Expression for the set of strings over {0,1} that have atleast one.(NOV/DEC-2015)
7. What is meant by DFA? [MAY/JUNE 2013]
8. What is a Non-Deterministic Finite Automaton (NDFA)? (Nov/Dec 2013)
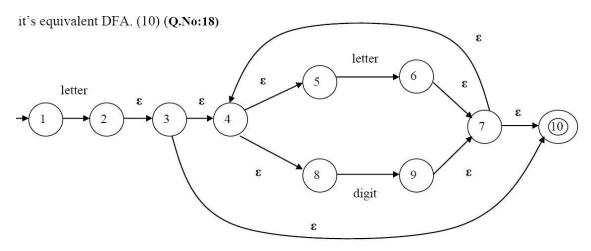9. Obtain the □ closure of states q0 and q1 in the following NFA with □ transition?[Dec 2014]

10. Define NFA with ε transition. [MAY/JUNE 2013] [APR/MAY 2018]
11. Difference between DFA and NFA.
12. What is a Regular Expression? [NOV/DEC 2012].
13. What are the applications of pumping lemma? [NOV/DEC 2007]
14. Construct a DFA for the regular expression aa*bb*.
15. What is {10,11}*?
16. Construct NFA for regular expression a*b*.
17. Construct a DFA that will accept strings on {a,b} where the number of b's divisible by 3.
18. Differentiate L^* and L^+.
19. Construct the DFA that accepts input string of 0's and 1's not containing 101 as substring. [APR/MAY 2018]
20. Differentiate regular expression and regular language.

PART-B

1.Explain inductive proof with example.(13)

2.Write about the various form of proof.(7)

3. Prove that "A language L is accepted by some DFA if and only if L is accepted by some
NFA"(13)

4. consider the following ε-NFA for an identifier. Consider the ε-closure of each state and find
it's equivalent DFA.(13) or (14)
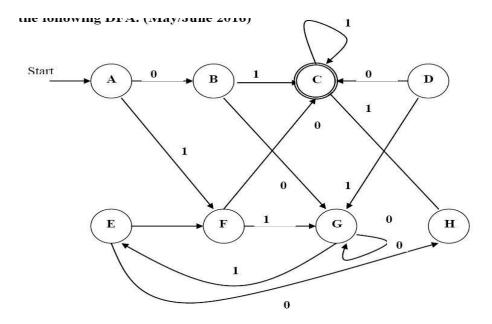
it's equivalent DFA. (10) **(Q.No:18)**

5.convert the given NFA to DFA.(13)

state/input	0	1
→ q0	{q0,q1}	q0
q1	q2	q1
q2	q3	q3
*q3	φ	q2

6.Write any one example for NFA-ε to NFA without ε.(6)

7.Construct the minimal DFA for the regular expression (b \ a)*baa.(13).

8. Write and explain the algorithm for minimization of a DFA. Using the above algorithm minimize the following DFA. (May/June 2016)(14)

9.State pumping lemma with example.(13)

10.Describe the closure properties of regular languages. [APR/MAY 2018]

11.Determine DFA from a given NFA

$M = (\{q0,q1\},\{0,1\},\delta,q0,\{q1\})$where is given by

δ (qo,0)=$\{q0,q\}$,δ (q0,1)=$\{q1\}$,δ (q1,0)=φ, δ(q1,1)=q0,q1\}   [APR/MAY 2018]

UNIT-II

GRAMMERS

PART-A

1.Define a Context Free Grammar. [**May/June 2010**]
2.What are the applications of Context free languages? [**Dec 2009**]
3.What is: (a) Derivation (b) Sub tree.
4.What is an ambiguous grammar? [**Dec 2009**]
5.Construct the grammar for the language L= { a^nba^n | n>=1}.
6.Construct the context-free grammar representing the set of palindromes over $(0+1)*$ (Nov/Dec 2015)
7.Let the productions of a grammar be S →0B, A→0/0S/1AA, B→1/1S/0BB. For the string 0110 find a right most derivation. [**MAY/JUNE 2007**]
8.Construct a context free grammar for generating the language L = { a^nb^n | n≥1} (Nov/Dec-2004, 2010, 2013, May-05, 06)

9.Convert the following grammar into an equivalent one with no unit productions and no useless symbols S→ABA, A→ aAA | aBC | bB, B→A | bB | Cb, C→CC | cC .

(Nov/Dec 2011)

10. When a grammar is said to be ambiguous? (May 2013) [APR/MAY 2018]

11. Consider the following grammar G with productions (May 2010)

S→ABC | BaB

A→ aA | BaC | aaa

B→ bBb | a

C→ CA | AC.

12. Let G be the grammar S→aB|bA, A→a|aS|bAA, B→b|b|S|aBB. For the string aaabbabbba find a leftmost derivation.(May/June'07)(Apr/May'08)(Nov/Dec 2015)

13. What do you mean by null production and unit production? Give an example.

14. Construct a CFG for set of strings that contain equal number of a's and b's over Σ={a,b} (May/June 2016)

15. What is meant by left and right sentential form?

16. Find the grammar for the language $L = \{a_{2n}bc,$ where n>1\}

17. Find the language generated by a CFG. G = ({S}, {0 , 1}, { S→0/1/ϵ, S→0S0/1S1/S})

18. Define Chomsky Normal Form? [APR/MAY 2018]

19. Derive the rules to remove ϵ productions with an suitable example (Dec'09)

20. Find the grammar for the language $L = \{a_{2n}bc,$ where n>1\}

PART-B

1) Derive the strings a*(a+b00) using leftmost and rightmost derivation for the following production.(8)

1. E→I
2. E→E+E
3. E→E*E
4. E→(E)
5. I→a
6. I→b
7. I→Ia
8. I→Ib
9. I→I0
10. I→I1

2. Show that the grammar S→aSbS | bSaS | e is ambiguous and what is the language generated by this grammar? (Nov/Dec 2006)(8)

3. The following grammar generates the language of Regular expression 0*1(0+1)*.

S→A1B

A→0A | ϵ

B→0B | 1B | ϵ

Give leftmost and rightmost derivations of the following strings
00101 b) 1001 c) 00011 (May/June 2006) (16)

4. Given the grammar G = (V,Σ,R,E), where

V={E,D,1,2,3,4,5,6,7,8,9,0,+,-,*,/,(,) }

Σ={1,2,3,4,5,6,7,8,9,0,+,-,*,/,(,) }, and R contains the following rules:

   E→D | (E) | E+E | E-E | E*E \ E | E

   D→0 | 1 | 2 |.....9

   Find a parse tree for the string 1+2*3. (6) (Nov/Dec 2015) (16)

5. Let G be the grammar S→0B|1A, A→0|0S|1AA, B→1|1S|0BB.
   For the string 00110101 find (Apr/May 2004) (May/Jun2007)(8)

6. Find the language L(G) generated by the grammar G with variables S, A, B terminals
a, b   and productions S→aB, B→b, B→bA, A→aB.(8)

7. If G is a grammar S→SbS | a prove that G is ambiguous (Apr/May 2004)(8)

8. Show that the grammar S →a | Sa | bSS | SSb | SbS is ambiguous (8) (Nov/Dec2007)

9. Find a derivation tree of a*b+a*b given that a*b+a*b is in L(G) where G is given by
S→S+S/S*S/a/b (May/June 2007).(8)

10. Let G=(V,T,P,S)be a Context free Grammar then prove that if the recursive
inference procedure tells us that terminal string W is in the language of variable A, then
there is a parse tree with root A and yields w. (Nov/Dec 2015)(16)

11. Begin with the grammar

   S→ASB/ε

   A→aAS/a

   B→SbS/A/bb

   (a) Are there any useless symbols? Eliminate them

   (b) Eliminate ε productions

   (c) Eliminate unit productions

   (d) Put the grammar into Chomsky normal form. (Nov/Dec 2015)(16) [APR/MAY
2018]

12. Find the CNF for the following grammar,
   S→aB/bA
   A→aS/bAA/a
   B→bS/aBB/b. (Nov/Dec 2005) (Nov/Dec 2006)

13. What is the purpose of normalization? Construct the CNF and GNF for the following
grammar and explain the steps. [APR/MAY 2018]

   S→aAa | bBb | Є

   A→C | a

   B→C | b

   C→CDE | Є

   D→A | B | ab (May/June 2016).

14. Convert the following grammar to GNF
   S→AB
   A→BS/b
   B→SA/a.

UNIT-3

PUSH DOWN AUTOMATA

PART-A

1. Define Pushdown Automata. (May/June 2016)
2. What are the different types of language acceptances by a PDA and define them. (Nov/Dec 2015)
3. Define Deterministic PDA. [APR/MAY 2018]
4. Define Instantaneous description (ID) in PDA. (MAY-06/09)
5. How do you convert CFG to a PDA.
6. State the pumping lemma for CFLs.(May-08)
7. Convert the following CFG to a PDA (Nov/Dec 2015)
   i. S→aAA, A→aS | bS | a
8. Does a pushdown Automata has memory? Justify. (May/June 2016)
9. Give an example of PDA.(DEC-05)
10. Is the language of DPDA and NPDA same? (MAY-06/09)
11. Define the languages generated by a PDA using the Two methods of accepting a language.(May-07)
12. Construct a PDA to accept a language $\{(an)^n|n>=1\}$ by empty stack.(Dec-09)
13. Compare NFA and PDA.(Dec-13)
14. Draw the symbols used in PDA.
15. Design PDA for the language L={001}
16. Design PDA for the language L={0011}
17. Define NDPDA.
18. What are the ways of language acceptance in PDA. [APR/MAY 2018].
19. Design DPDA for L=$a^n b^n$ where n>=1.
20. Write algorithm for getting production rule of CFG.

PART-B

INSTANTANEOUS DESCRIPTION:

1.Design PDA to accept the language L={wcw^R / w={0,1}*}(8) [APR/MAY 2018]

2.Design PDA for the language L = {anb2n | n ≥0 } (Nov/Dec 2008) (8)

3.Construct a transition table for PDA which accepts the Language L= { a3nbn | n ≥ 0 } (16)

4.Design a PDA to accept $\{0^n 1^n \mid n \geq 1\}$.Draw the transition diagram for the PDA. Show by instantaneous description that the PDA accepts the string '0011'. (10) (Nov/Dec 2015)(8)

5.Construct a pushdown automaton to accept the following language L on $\Sigma = \{a, b\}$ by empty stack L= { $ww^R \mid w \in \Sigma +$} (May/June 2016)(8)

Problems for converting PDA to CFG:

6.Convert the PDA P = ({q, P}, {0, 1},{X,Z0},δ,q,z0) to a CFG if δ is given by
(a) $\delta(q,1,z0) = \{(q,Xz0)\}$
(b) $\delta(q,1,X) = \{(q,XX)\}$
(c) $\delta(q,0,X) = \{ (P,X)\}$
(d) $\delta(q,\varepsilon,X) = \{(q,\varepsilon)\}$
(e) $\delta(P,1,X) = \{(P,\varepsilon)\}$
(f) $\delta(P,0,z0) = \{(q,z0)\}$ (16)

7.Construct CFG for the following PDA where δ is given by,
P=({q0,q1},{0,1},{X,Z0},δ,q,z0,Φ)
(a) $\delta(q0,0,z0) = \{ (q0,Xz0)\}$

(b) $\delta(q0,0,X) = \{ (q0,XX)\}$

(c) $\delta(q0,1,X) = \{ (q1,\varepsilon)\}$ (8) [APR/MAY 2018]

8.Convert PDA to CFG. PDA is given by P = ({p, q},{0,1},{X,Z},δ, q, Z), δ is defined by
$\delta(p,1,Z)=\{(p, XZ)\}$,
$\delta(p,\varepsilon,Z)=\{(p, \varepsilon)\}$,
$\delta(p,1,X)=\{(p, XX)\}$,
$\delta(q,1,X)=\{(q, \varepsilon)\}$,
$\delta(p,0,X)=\{(q, X)\}$,
$\delta(q,0,Z)=\{(p, Z)\}$, (Nov/Dec 2015) (16)

Converting CFG To PDA

9.Construct the PDA for the following grammar E $\rightarrow$ E+E | E * E | a (8)
10.Consider the grammar G=(V,T,P,S) when S $\rightarrow$ aA, A $\rightarrow$ aABC/bB/a, B $\rightarrow$ b, C$\rightarrow$c and find the PDA.(8)
11.Construct the CFG for L = { $0^n 1 0^n \mid n \geq 0$} and use it to construct PDA.(8)
DETERMINISTIC PUSHDOWN AUTOMATA
 12.What are deterministic PDA's? Give example for Non-deterministic and deterministic PDA? (8) (Nov/Dec 2015)

PROBLEMS ON PUMPING LEMMA
13.State pumping Lemma for CFL. Use pumping lemma to show that the language
L = { $a^i b^j c^k \mid i<j<k$} is not a CFL. (8) [APR/MAY 2018]

14.Show that the language L = { $a^n b^n c^n \mid n \geq 0$} is not a context free language.(8) [APR/MAY 2018]

UNIT-4

TURING MACHINE
PART-A

1. What is a Turing Machine?(MAY/JUNE-16) [APR/MAY 2018]
2. What is a multitape Turing machine?(NOV/DEC-15)
3. Write about the chomskian hierarchy of languages.(APR/MAY-17) [APR/MAY 2018]
4. What is halting problem?(APR/MAY-17)
5. Define instantaneous description and move of a turing machine.
6. what are the features of universal turing machine?
7. What is meant by multihead turing machine?
8. What are the applications of Turing machine? (Dec-12)
9. List out techniques for Turing machine construction.(Dec -13)
10. What are the possibilities of a TM when processing an input string?
11. What are the techniques for Turing machine construction?
12. Differentiate Multitape and Multitrack machines.(Dec-08)
13. When is checking off symbols used in TM?
14. What is a 2-way infinite tape TM?
15. What are the reasons for a TM not accepting its input?
16. Construct a Turing machine to compute 'n mod 2' where n is represented in the tape in unary form consisting of only 0's. (May – 11)
17. Design a Turing machine with not more than states that accepts languages a $(a+b)*$. Assume $\Sigma = \{a, b\}$(May-05).
18. What are the Comparison of FM, PDA and TM?
19. Define Power of turing Machine.
20. What are the differences between a finite automata and a Turing machine?(APR/MAY-16)

PART-B

TURING MACHINE
1.Explain the programming techniques for Turing Machine construction. (14)(Nov/ Dec-12)(13)
2.Explain briefly about Two way Turing Machine.(7) (May/June-04,05, Nov/Dec-05,08,09,12,13)

COMPUTATIONAL LANGUAGES AND FUNCTIONS
3.Construct TM for the language L = $\{a^n b^n\}$ where n$\geq$1. (May – 09)(7)
4.Construct a TM for L = $\{1^n0^n1^n / n\geq0\}$.(May – 12)(6)
5.Construct TM for performing subtraction of two unary numbers f(a-b) = c where a is always greater than b.(Dec -03,Dec – 05,May -11)(7)

TWO WAY TURING MACHINE
6.Construct a TM for a language having equal number of a's and b's.(7)
7.Construct a TM for a language obtaining two's complement of a binary number.(7)
8.Construct a TM for reversing a binary string on the input tape.(6)
9.Build a multitrack turing machine for checking whether given number is prime or not?(7)

10.Design a turing machine which reverses the given string{abb}.(6) [APR/MAY 2018]

TYPES OF TURING MACHINE
11.Explain about Types of Turing machine.(7)
HALTING PROBLEM
12.Explain Halting problem. Is it solvable or unsolvable problem? Discuss.(13) (May/June-16)
CHOMSKY HIERARCHY OF LANGUAGES
13.Explain about the Chomsky hierarchy of languages.(DEC-15)(7)
14.construct Turing machine perform unary multiplication. [APR/MAY 2018]

UNIT-5

UNSOLVABLE PROBLEMS AND COMPUTABLE FUNCTIONS
PART-A

1. When a problem is said to be decidable and give an example of undecidable problem. (Nov/Dec 2015)

2. Show that the complement of a recursive language is recursive.(Dec-04,may-05)

3. Give two properties of Recursively Enumerable Sets which are undecidable.

4. When a language is said to be recursive? Is it true that every regular set is not recursive?(Nov/Dec -05)

5. Differentiate between recursive and recursively enumerable languages.(Apr/May-07)

6. When do you say a problem is NP-hard?(Dec-09)

7. Mention the difference between P and NP problems.

8. What is recursively enumerable? (May-12,Nov/Dec-13) [APR/MAY 2018]

9. Show the union of recursive language is recursive.

10. What are a) Recursively Enumerable b) Recursive sets? (Nov/Dec-13)

11. Define the class NP problem.(Nov/Dec-13)

12. What do you mean by universal turing machine?(Nov/Dec-05,13)

13. Define the classes P and NP problems. (May-14)

14. When a recursively enumerable language is said to be recursive? Is it true that the language accepted by a non-deterministic Turing machine is different from recursively
    enumerable language? (May/June 2016)

15. What are the different types of grammars/languages?

16. Define PCP or Post Correspondence Problem?

17. Define MPCP or Modified PCP.

18. What is a universal language Lu? (Nov/Dec 2015) [APR/MAY 2018]

19. Define Rice Theorem?

20. What is primitive recursive function?(May-2017)

PART-B

1. (i) Prove that "MPCP reduces to PCP". (10) (**Nov/Dec 2015)**
   (ii) Discuss about the tractable and intractable problems. (6) (**Nov/Dec 2015)**
2. (i) State and explain RICE theorem. (10) (**Nov/Dec 2015)**
   (ii) Describe about Recursive and Recursively Enumerable languages with examples.
   (6)
3. What is a universal Turing machine? Bring out its significance. Also construct a Turing
   machine to add two numbers and encode it. (16) (**May/June 2016)**
4. What is a post corresponding problem (PCP)? Explain with the help of an example.(10)   (**May/June 2016)**
5. Explain recursive and recursive enumerable language with suitable example.(16) (May-2017)
6. Explain Tractable and intractable problems with suitable example.(16) (May-2017)
7. Describe about the Universal TM.(7)
8. rite notes on primitive recursive function. [APR/MAY 2018]

9. Write note on NP complete problem and polynomial time reduction. [APR/MAY 2018]