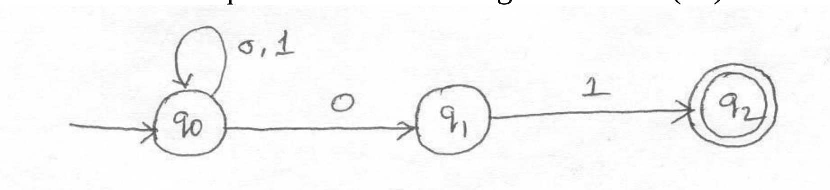
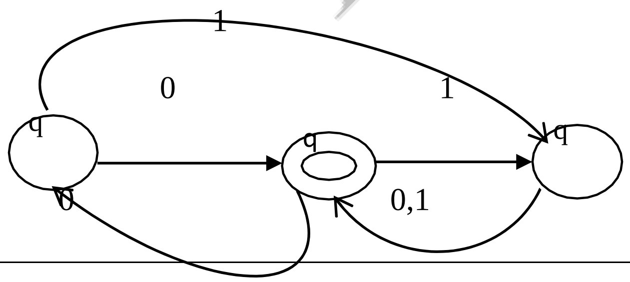
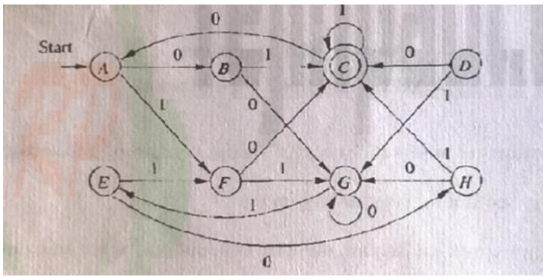
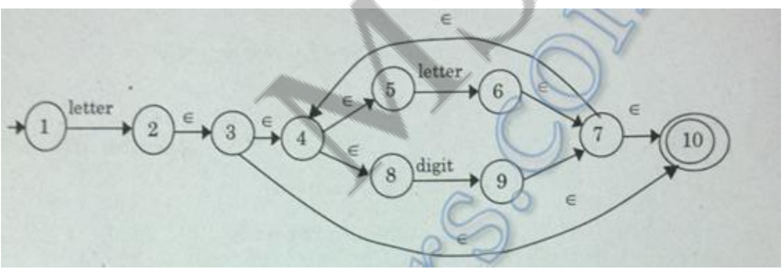
TOC IMPORTANT QUESTIONS

UNIT I AUTOMATA FUNDAMENTALS			
Introduction to formal proof – Additional forms of Proof – Inductive Proofs –Finite Automata – DeterministicFinite Automata – Non-deterministic Finite Automata – Finite Automata with Epsilon Transitions			
PART – A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Differentiate between DFA and NFA.	BTL-2	Understand
2.	Define DFA	BTL-1	Remember
3.	Define inductive proof.	BTL-1	Remember
4.	Identify NFA- ε to represent a*b | c	BTL-1	Remember
5.	Consider the String X=110 and y=0110 find i) XY ii) X^2 iii) YX iv) Y^2	BTL-4	Analyze
6.	Describe the following language over the input set A={a,b} L={ $a^n b^n$ | n>=1}	BTL-4	Analyze
7.	Describe what is non-deterministic finite automata and the applications of automata theory.	BTL-1	Remember
8.	Illustrate the induction principle.?	BTL-3	Apply
9.	What is proof by contradiction ?	BTL-1	Remember
10.	Describe an identifier with a transition diagram (automata).	BTL-2	Understand
11.	Define ε-NFA	BTL-1	Remember
12.	Summarize minimization of DFA	BTL-5	Evaluate
13.	Give the non-deterministic automata to accept strings containing the substring 0101	BTL-2	Understand
14.	Illustrate if L be a set accepted by an NFA then there exists a DFA that accepts L.	BTL-3	Apply
15.	Define the term epsilon transition.	BTL-2	Understand
16.	Summarize the extended transition function for a ε-NFA	BTL-5	Evaluate

<table>
<tr><td>17.</td><td>Create a FA which accepts the only input 101 over the input set Z={ 0,1}</td><td>BTL-6</td><td>Create</td></tr>
<tr><td>18.</td><td>Describe a Finite automata and give its types.</td><td>BTL-4</td><td>Analyze</td></tr>
<tr><td>19.</td><td>Illustrate deductive proof.</td><td>BTL-3</td><td>Apply</td></tr>
<tr><td>20.</td><td>Create a FA which checks whether the given binary number is even.</td><td>BTL-6</td><td>Create</td></tr>
<tr><td colspan="4">PART – B</td></tr>
<tr><td>1.</td><td>(i) Explainif L is accepted by an NFA with ε-transition then show that L is accepted by an NFA without ε-transition. (6)

(ii) Construct a DFA equivalent to the NFA. M=({p,q,r},{0,1},δ,p,{q,s}) Where δ is defined in the following table.(7)
<table>
<tr><td></td><td>0</td><td>1</td></tr>
<tr><td>p</td><td>{q,s}</td><td>{q}</td></tr>
<tr><td>q</td><td>{r}</td><td>{q,r}</td></tr>
<tr><td>r</td><td>{s}</td><td>{p}</td></tr>
<tr><td>s</td><td>-</td><td>{p}</td></tr>
</table></td><td>BTL-5</td><td>Evaluate</td></tr>
<tr><td>2.</td><td>Prove for every n>=1 by mathematical induction
$\sum$ (i)={n(n+1)/2}. (13)</td><td>BTL-3</td><td>Apply</td></tr>
<tr><td>3.</td><td>Let L be a set accepted by a NFA then show that there exists a DFA that accepts L.(13)</td><td>BTL-1</td><td>Remember</td></tr>
<tr><td>4.</td><td>Give the NFA that accepts all strings that end in 01.Give its transition table and the extended transition function for the input string 00101.Also construct a DFA for the above NFA using subset construction method.(13)</td><td>BTL-2</td><td>Understand</td></tr>
<tr><td>5.</td><td>Construct DFA equivalent to the NFA given below: (13)

</td><td>BTL-2</td><td>Understand</td></tr>
</table>

<table>
<tr><td>6.</td><td>(i) Compose that a language L is accepted by some ε–NFA if and only if L is accepted by some DFA. (6)
(ii) Consider the following ε–NFA. Compute the ε–closure of each state and find it" s equivalent DFA. (7)
<table>
<tr><td></td><td>ε</td><td>a</td><td>b</td><td>C</td></tr>
<tr><td>→ p</td><td>ф</td><td>{p}</td><td>{q}</td><td>{r}</td></tr>
<tr><td>q</td><td>{p}</td><td>{q}</td><td>{r}</td><td>ф</td></tr>
<tr><td>*r</td><td>{q}</td><td>{r}</td><td>ф</td><td>{p}</td></tr>
</table></td><td>BTL-6</td><td>Create</td></tr>
<tr><td>7.</td><td>i)Classify how a language L is accepted by some DFA if L is accepted by some NFA(7)
(ii)Convert the following NFA to its equivalent DFA.(6)
<table>
<tr><td></td><td>0</td><td>1</td></tr>
<tr><td>p</td><td>{p,q}</td><td>{p}</td></tr>
<tr><td>q</td><td>{r}</td><td>{r}</td></tr>
<tr><td>r</td><td>{s}</td><td>ф</td></tr>
<tr><td>*s</td><td>{s}</td><td>{s}</td></tr>
</table></td><td>BTL-3</td><td>Apply</td></tr>
<tr><td>8.</td><td>i)Construct the DFA to recognize odd number of 1's and even number 0's (7)
ii) Construct the DFA over {a,b} which produces not more than 3 a's (6)</td><td>BTL-1</td><td>Remember</td></tr>
<tr><td>9.</td><td>(i) Point out the steps in conversion of NFA to DFA and for the following convert NFA to a DFA(7)
<table>
<tr><td>δ</td><td>a</td><td>b</td></tr>
<tr><td>p</td><td>{p}</td><td>{p,q}</td></tr>
<tr><td>q</td><td>{r}</td><td>{r}</td></tr>
<tr><td>r</td><td>{φ}</td><td>{φ}</td></tr>
</table>
(ii) Infer the following to a regular expression(6)

</td><td>BTL-4</td><td>Analyze</td></tr>
</table>

<table>
<tr><td>10.</td><td>Identify and explain the algorithm for minimization of DFA.Using the above algorithm minimize the followingDFA.(13)

</td><td>BTL-1</td><td>Remember</td></tr>
<tr><td>11.</td><td>Tabulate the difference between the NFA and DFA .Convert the following ε-NFA to DFA.(13)
<table>
<tr><td>states</td><td>ε</td><td>a</td><td>b</td><td>c</td></tr>
<tr><td>P</td><td>Φ</td><td>{p}</td><td>{q}</td><td>{r}</td></tr>
<tr><td>Q</td><td>{p}</td><td>{q}</td><td>{r}</td><td>Φ</td></tr>
<tr><td>*r</td><td>{q}</td><td>{r}</td><td>ϕ</td><td>{p}</td></tr>
</table></td><td>BTL-1</td><td>Remember</td></tr>
<tr><td>12.</td><td>(i).Describe the extended transition function for NFA ,DFA and – ε-NFA (6)
(ii) Consider the following ε-NFA for an identifier
Consider theε-closure of each state and give it's equivalent
DFA.(7)

</td><td>BTL-2</td><td>Understand</td></tr>
<tr><td>13.</td><td>(i)Given ∑ ={a,b}Analyze and construct a DFA which recognizethe language L={b^m a b^n: m,n>0}
(13
)</td><td>BTL-4</td><td>Analyze</td></tr>
<tr><td>14.</td><td>(i) Analyze and Prove that if n is a positive integer such that nmod 4 is 2 or 3 then n is not a perfect square.(6)
(ii) Construct a DFA that accept the string {0,1} that always ends with 00 (7)</td><td>BTL-4</td><td>Analyze</td></tr>
<tr><td colspan="4">PART – C</td></tr>
</table>

<table>
<tr><td>1.</td><td>(i) Draw and Explain the transition diagram for recognizing the setof all operators in c Language.(8)

(ii) Evaluate a DFA from the given NFA(7)
M=({qo,q1},{a,b},δ,q0,{q1} with the state table diagram for δ givenbelow:
<table>
<tr><td>δ</td><td>A</td><td>b</td></tr>
<tr><td>qo</td><td>{qo,q1}</td><td>q1</td></tr>
<tr><td>q1</td><td>Φ</td><td>{qo,q1}</td></tr>
</table></td><td>BTL-5</td><td>Evaluation</td></tr>
<tr><td>2.</td><td>Construct the following ε-NFA to DFA.(15)
<table>
<tr><td>states</td><td>ε</td><td>a</td><td>B</td><td>c</td></tr>
<tr><td>p</td><td>Φ</td><td>{p}</td><td>{q}</td><td>{r}</td></tr>
<tr><td>q</td><td>{p}</td><td>{q}</td><td>{r}</td><td>{p,q}</td></tr>
<tr><td>*r</td><td>{q}</td><td>{r}</td><td>Φ</td><td>Φ</td></tr>
</table></td><td>BTL-6</td><td>Create</td></tr>
<tr><td>3.</td><td>Infer the DFA which is accepting the following language over the alphabet{0,1}.The set of all the strings beginning with a1 that when interrupted as a binary integer , is multiple of 5, For example strings 101,1010 and 1111 are in the language 0,100 and 111 are not.(15)</td><td>BTL-4</td><td>Analyze</td></tr>
<tr><td>4.</td><td>Rewrite the basic approach to convert from NFA to regularexpression. Illustrate with an example(15)</td><td>BTL-6</td><td>Create</td></tr>
</table>

UNIT II REGULAR EXPRESSION AND LANGUAGES

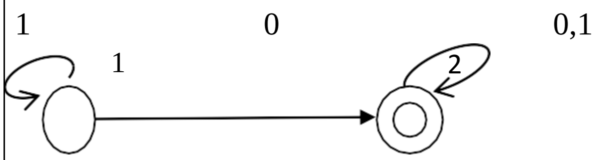
Regular Expressions – FA and Regular Expressions – Proving Languages not to be regular – Closure Propertiesof Regular Languages – Equivalence and Minimization of Automata.

.

PART – A

Q.No	Questions	BT Level	Competence
1.	List the operators of Regular Expressions	BTL-1	Remember
2.	Differentiate between regular expression and regular	BTL-1	Remember
3.	Tabulate the regular expression for the following L1=set of strings 0 and 1 ending in 00	BTL-4	Analyze
4.	What are the closure properties of regular languages?	BTL-2	Understand
5.	Explaina finite automaton for the regular expression 0*1*.	BTL-1	Remember
6.	Illustrate a regular expression for the set of all the strings	BTL-1	Remember

7.	Illustrate a regular expression for the set of all the strings have odd number of 1's R.E=1(0+11)*	BTL-3	Apply
8.	Compose the difference between the + closure and * closure	BTL-4	Analyze
9.	Illustrate a regular expression for the set of all strings of 0's	BTL-2	Understand
10.	What is the Closure property of regular set S.?	BTL-2	Understand
11.		BTL-2	Understand
12.	Find out the language generated by the regularexpression(0+1)*.	BTL-5	Evaluate
13.	Name the four closure properties of RE.	BTL-1	Remember
14.	Is it true the language accepted by any NFA is different fromthe regular language? Justify your answer.	BTL-4	Analyze
15.	Show the complement of a regular language is also regular.	BTL-3	Apply
16.	Construct a DFA for the regular expression aa*bb*.	BTL-3	Apply
17.	State the precedence of RE operator.	BTL-5	Evaluate
18.	Construct RE for the language over the set z={a,b} in which total number of a's are divisible by 3.	BTL-6	Create
19.	Define RE.	BTL-1	Remember
20.	Create RE to describe an identifier and positive integer.	BTL-6	Create
PART – B			
1.	Demonstrate how the set L= $\{ab^n/n>=1\}$ is not aregular.(13)	BTL5	Evaluate
2.	Express that the regular languages are closed under:(13) (a)union (b)intersection(c)Kleene Closure(d)Complement(e)Difference	BTL-1	Remember
3.	Examine whether the language $L=(0^n1^n\| n>=1)$ is regular ornot? Justify your answer (13)	BTL-2	Understand
4.	(i) Describe a Regular Expression. Write a Regular Expression for the set of strings that consists of alternating 0'sand 1's.(6) (ii) Construct Finite Automata equivalent to the regularexpression (ab+a)*(7).	BTL1	Remember
5.	(i) Describe the closure properties of regular languages.(6) (ii) Describe NFA with epsilon for the RE=(a/b)*ab andconvert it into DFA and further find the minimized DFA.(7)	BTL1	Remember

6.	Demonstrate how the set L= $\{a^n b^n / n>=0\}$ is not aregular.(13)	BTL -3	Apply
7.	Verify the whether L ={ a 2n| n>=1} regular (13)	BTL -3	Apply
8.	i) Prove The reverse of a regular language is regular (6) ii) A homomorphism of regular language is regular (7)	BTL -4	Analyze
9.	Discuss on regular expressions (13)	BTL -2	Understand
10	Construct NDFA for given RE using Thomson rule. (13) i) a.(a+b)* ab ii) (a.b)* iii) (a+b)	BTL -6	Create
11	Explain the DFA Minimization algorithm with an example.(13)	BTL -1	Remember
12	Demonstrate how the set L= $\{a^n b^m \| m,n>=1\}$ is not aregular.(13)	BTL 2	Understand
13	i) Prove the L1 and L2 are two languages then L1-L2 isregular (7) ii) Prove the L1 and L2 are two languages then L1 . L2 isregular (6)	BTL 4	Analyze
14	i) Prove the L1 and L2 are two languages then L1 U L2is regular (7) ii) Prove the L1 and L2 are two languages then L1intersection L2 is regular (6)	BTL -4	Analyze
	PART-C		
	(i) Deduce into regular expression that denotes the languageaccepted by following DFA.(7)  (ii) Evaluate the equalities for the following RE and prove forthe same (8) a. b+ab* +aa*b+aa*ab* b. a*(b+ab*). c. a(a+b)*+aa(a+b)*+aaa(a+b)*	BTL -5	Evaluate

UNIT III CONTEXT FREE GRAMMAR AND LANGUAGES

CFG – Parse Trees – Ambiguity in Grammars and Languages – Definition of the Pushdown Automata – Languages of aPushdown Automata – Equivalence of Pushdown Automata and CFG, Deterministic Pushdown Automata.

PART – A

Q.No	Questions	BT Level	Competence
1.	Express the ways of languages accepted by PDA and define them?	BTL 2	Understand
2.	Summarize PDA .Convert the following CFG to PDAS aAA , A aS|bS|a.	BTL 2	Understand
3.	Define ambiguous grammar and CFG	BTL 1	Remember
4.	Define parse tree and derivation.	BTL 1	Remember
5.	Examine the context free Grammar representing the set of Palindrome over (0+1)*	BTL 2	Understand
6.	Compare Deterministic and Non deterministic PDA. Is it true that non deterministic PDA is more powerful than that of deterministic PDA? Justify your answer.	BTL 2	Understand
7.	When is PDA said to be deterministic?	BTL 1	Remember
8.	Examine the string aaabbabbba for the Grammar G with $S \rightarrow aB\|bA$ $A \rightarrow a\|aS\|bAA$ $B \rightarrow b\|bS\|aBB$	BTL 5	Evaluate
9.	Examine whether a pushdown automata has a memory?	BTL 1	Remember
10.	Designequivalence of PDA and CFG.	BTL 6	Create
11.	Point out the languages generated by a PDA using final state of the PDA and empty stack of that PDA	BTL 4	Analyze
12.	Illustrate the rule for construction of CFG from given PDA	BTL 3	Apply
13.	Give a CFG forthe language of palindrome string over {a,b}.Write the CFG for the language ,$L=(a^n b^n \| \geq n)$.	BTL 5	Evaluate
14.	What is Instantaneous Descriptions (ID)	BTL 1	Remember
15.	Show that $L=\{a^{p/p}$ is prime$\}$ is not context free.	BTL 3	Apply

16.	Infer the CFG for the set of strings that contains equal numberof a’s and b’s over ∑ ={a,b}	BTL 4	Analyze
17.	Point out the various types of grammar with example	BTL 1	Remember
18.	Illustrate the rightmost derivation (a+b)*c for using the grammar and also state whether a given grammar is ambiguous one or not. E→E+E/E*E/(E)/id	BTL 3	Apply
19.	Point out the additional features a PDA has when comparedwith NFA.	BTL 4	Analyze
20.	Convince your answer of acontext free grammar for the givenexpression (a+b) $(a+b+0+1)^*$	BTL6	Create
PART – B			
1.	(i) Discuss about PDA and CFL Prove the equivalence of PDAand CFL.(6) (ii) If L is Context free language then prove that there existsPDA M such that L=N(M). (7)	BTL 2	Understand
2.	**(i)** Describe the different types of acceptance of a PDA. Are they equivalent in sense of language acceptance? Justify youranswer. (7) **(ii)** Design a PDA to accept $\{0^n1^n \mid n>1\}$.Draw the transition diagram for the PDA and identify the instantaneous description(ID)of the PDA which accepts the string ‘0011.(6)	BTL 1	Remember
3.	(i) Identify that deterministic PDA is less powerful than non nondeterministic PDA.(7) (ii) Construct a PDA accepting $\{a^nb^ma^n$ / m, n>=1} by emptystack. Also tell the corresponding context-free grammar accepting the same set.(6)	BTL 1	Remember
4.	(i)Describe and draw the parse tree for the string 1+2*3Given the grammar G=(V, Σ ,R,E)where V={E,D,1,2,3,4,5,6,7,9,0,+,-,*,/,9,)} Σ ={1,2,3,4,5,6,7,8,9,0,+,-,*,/,(,)} where R contains th efollowing rules : E D|(E)|E+E|E-E|E/E D 0|1|2|…9 (6) (ii)Let G=(V,T,P,S) be a Context Free Grammar then prove that if the recursive inference procedure call tells us that terminal string W is in the language of variable A ,then there is a parse tree with a root A and yield w. (7)	BTL 6	Create

5.	(i)Define Non Deterministic Push Down Automata. Is it truethat DPDA and NDPDA are equivalent in the sense oflanguage acceptance is concern? Justify Your answer.(5) (ii)Convert PDA to CFG.PDA is given by P=({p,q},{0,1},{X,Y},δ,q,Z}, δ is defined byδ(p,1,z)={(p,XZ)}, δ(p,ε,Z)={p, ε)}, δ(p,1,X)={(p,XX)}, δ(q,1,X)={(q, ε)}, δ(p,0,X)={(q,X0} δ(q,0,Z)={(p,Z)} (8)	BTL 1	Remember
6.	(i) Define PDA. Give an Example for a language acceptedbyPDA by empty stack.(7) (ii) Convert the grammarS ->0S1|A A ->1A0|S| εinto PDA that accepts the same language by theempty stack .Check whether 0101 belongs to N(M).(6)	BTL 2	Understand
7.	**(i)** Analyze the theorem: If L is Context free language thenprove that there exists PDA M such that L=N (M). (7) **(ii)** Prove that if there is PDA that accepts by the final statethen there exists an equivalent PDA that accepts by Null State.(6)	BTL 4	Analyze
8.	Solve the following grammar S→aAa | bBb | B C → S | ε for the string abaaba. Give i) Left most derivation(3) ii)Right most derivation(3) iii)Derivation Tree(3) iv) For the string abaabbba, find the right most derivation.(4)	BTL 5	Evaluate
9.	(i) ExamineConstruct the grammar for the following PDAM. M=({q0, q1},{0,1},{X,z0},δ,q0,Z0,Φ) and where δis given byδ(q0,0,z0)={(q0,XZ0)}, δ(q0,0,X)={(q0,XX)}, δ(q0,1,X)={(q1, ε)}, δ(q1,1,X)={(q1, ε)}, δ(q1,ε,X)={(q 1, ε)},δ(q1, ε, Z0)={(q1, ε)}. (ii) Prove that if L is N(M1) for some PDA M1 then L isL(M2) for some PDA M2. (6)	BTL 3	Apply
10.	Construct a PDA that recognizes and analyzesthe language {$a^i b^j c^k$| i,j,k>0 and i=j or i=k}. Explain about PDA acceptance i) From empty Stack to final state. (6) ii) From Final state to Empty Stack. (7)	BTL 4	Analyze

11.	Examine and construct a CFG G which accepts N(M), whereM=($\{q_0, q_1\},\{a,b\},\{z_0,z\},\delta,q_0,z_0,\Phi$) and where δis given by $\delta(q_0,b,z_0)=\{(q_0,zz_0)\}$ $\delta(q_0, \varepsilon,z_0)=\{(q_0, \varepsilon)\}$ $\delta(q_0,b,z)=\{(q_0,zz)\}$ $\delta(q_0,a,z)=\{(q_1,z)\}$ $\delta(q_1,b,z)=\{(q_1, \varepsilon)$ $\delta(q_1,a,z_0)=\{(q_0,z_0)\}$ Show that $a^nb^nc^n$ is not context free language i.e show that theset of strings of a' s and b's and c's with an equal number of each is not context free(13)	BTL-1	Remember
12.	(i) Describe the PDA that accept the given CFG (7)S→xaax X→ax/bx/€ (ii) Express a PDA for the language $a^nb^ma^{n+m}$ (6)	BTL-2	Understand
13.	(i) Illustratea PDA for the language {WCWR/W€{0,1}}.(7) (ii) Illustrate a CFG for the constructed PDA. (6)	BTL-3	Apply
14.	(i) Identify CFG for the language $L=\{0^i1^j 0^k \mid j>i+k\}$ (7) (ii) Define derivation tree. Explain its uses with anexample.(6)	BTL-4	Analyze
	PART – C		
1.	(i) Design and Explaina PDA to accept each of the followinglanguage $\{a^ib^jc^k \mid i=j \text{ or } j=k\}$(7) (ii) The set of all string with twice as many 0's and 1's. (8)	BTL-5	Evaluation
2.	(i) Let P be a PDA with empty stack language L=N(P) and suppose that ε is not in L. Designhow you would modify P so that it accepts L U { ε} by empty stack.(8). (ii) Design a DPDA for even length palindrome.(7)	BTL-6	Create
3.	(i) Convert the following CFG to PDA and analyze the answer(a+b) and a++. (8) I→a|b|Ia|Ib|I0|I 1 E→I|E+E|E*E| (E) (ii) Convert the following CFG to PDA by empty stack.(7)S→0S1/A; A→1A0/S/ ε Infer whether 0101 belongs to N(M).	BTL-4	Analyze
4.	(i)If L is a CFL then prove that there exists PDA M, such thatL=N(M) , language accepted by empty stack .(7) (ii)Construct a PDA empty store , $L= \{a^m b^n \mid n<m\}$.(8)	BTL-6	Create

UNIT IV PROPERTIES OF CONTEXT FREE LANGUAGES

Normal Forms for CFG – Pumping Lemma for CFL – Closure Properties of CFL – Turing Machines –Programming Techniques for TM.

PART – A

Q.No	Questions	BT Level	Competence
1.	Conclude the procedure for converting CNF to GNF with anexample	BTL 2	Understand
2.	Illustrate the Basic Turing Machine model and explain in onemove. What are the actions take place in TM?	BTL 3	Apply
3.	Define the two normal forms of CFG	BTL 1	Remember
4.	Point out the hierarchy summarized in the Chomskyhierarchy..	BTL 4	Analyze
5.	Define the pumping Lemma for CFLs	BTL1	Remember
6.	Define Turing Machine.	BTL1	Remember
7.	Discuss the applications of Turing machine.	BTL 2	Understand
8.	Define Chomskian hierarchy of language.	BTL 1	Remember
9.	What is the class of language for which the TM has both accepting and rejecting configuration? Can this be called a Context free Language? Discuss.	BTL 2	Understand
10.	Show the following grammar into an equivalent one with nounit productions and no useless symbols S→ABA A→aAA|aBC| bB B→A|bB|Cb C→CC|cC	BTL 3	Apply
11.	Explain the special features of TM? Define universal TM.Define Instantaneous description of TM	BTL 5	Evaluate
12.	Define GNF.	BTL 1	Remember
13.	Prepare the difference between finite automata and turingmachine.	BTL 6	Create
14.	List the three ways to simplify a context free grammar. Whatare the properties of the CFL generated by a CFG?	BTL 5	Evaluate
15.	Draw a transition diagram for a Turing machine to identify n mod 2.	BTL 1	Remember
16.	Express the techniques for TM construction.	BTL 2	Understand
17.	Develop the short notes on two-way infinite tape TM.	BTL 6	Create
18.	Differentiate TM and PDA.	BTL 4	Analyze
19.	Point outthe role of checking off symbols in a Turing Machine	BTL 4	Analyze
20.	Illustrate Halting Problem.	BTL 3	Apply

PART – B			
1.	Express the following grammar G into Greibach NormalForm(GNF) (13) S→XA|BB B →b| SB X→ b A→ a	BTL 1	Remember
2.	Use the CFL pumping lemma to show how each of these languages not to be context-free{$a^i b^j c^k$| i<j<k} (13)	BTL 2	Understand
3.	**(i)** Discussa TM to accept the language LE={1^n 2^n 3^n|n >= 1}(6) **(ii)** Construct a turing machine that estimate unarymultiplication (Say 111 X 11 = 11111) (7)	BTL 2	Understand
4.	**(i)** Illustrate the Turing machine for computing f(m, n)=m-n(proper subtraction). (7) **(ii)** Demonstrate a Turing Machine to compute f(m+n)=m+n,m,n>=0 and simulate their action on the input 0100. (6)	BTL 3	Apply
5.	(i) Examinethe role of checking off symbols in a TuringMachine.(6) (ii) Describe a Turing Machine M to implement the function"multiplication" using the subroutine copy(7)	BTL 1	Remember
6.	**(i)** Demonstrate the implications of halting problem.(7) **(ii)** Show that if a language is accepted by a multitapeturingmachine ,it is accepted by a single-tape TM .(6)	BTL 3	Apply
7.	(i) Summarize in detail about multihead and multitape TMwith an example.(7) (ii) Construct a Turing Machine to accept palindromes in analphabet set ∑={a,b}.Trace the strings "abab" and "baab".(6)	BTL 5	Evaluate
8.	(i) Explain the TM as computer of integer function with anexample.(7) (ii) Design a TM to implement the function f(x)= x+1. (6)	BTL 4	Analyze
9.	**(i)** Design a TM to accept the set of all strings {0,1} with 010as substring.(7) **(ii)** Write shot notes on Two –way infinite tape TM.(6)	BTL 6	Create
10.	(i)Describe computing a partial function with a TM.(6) (ii)Design a TM to accept the language LE={$a^n b^n c^n$ |n >1}.(7)	BTL 1	Remember
11.	(i) Define Turing machine for computing f(m, n)=m*n,n€N. (7) (ii) Write notes on Partial solvability.(6)	BTL -1	Remember
12.	(i) Construct a TM to reverse the given string {abb}. (6) (ii) Explain Multi tape and Multi head Turing machine withsuitable example.(7)	BTL 2	Understand

13.	(i) **Analyze** and Construct a TM to compute a function f(w) $=W^R$ where W€{a,b}.(7) (ii) **Construct** Turing machine (TM) that replace all occurence of 111 by 101 from sequence of 0's and 1's.(6)	BTL 4	Analyze
14.	(i) **Infer** the Chomsky grammar classification with necessary example. (6) (ii) **Explain** a TM with no more than three states that accepts the language. a(a+b) *.Assume €={a,b}. (7)	BTL 4	Analyze
PART – C			
1.	(i) **Compose** the limitation of automata for Type 3, Type 2, type 0 languages.(7) (ii) Consider two-tape Turing Machine (TM) and determine whether the TM always writes a nonblank symbol on its second tape during the computation on any input string 'w'. **Formulate** this problem as a language and show it is undecidable.(8)	BTL-6	Create
2.	i) Define pumping lemma for CFL. Show that $L=\{a^ib^jc^k, i<j<k\}$ is not context free and **Judge** your answer.(6) ii) Construct a TM to move an input string over the alphabet A={a} to the right one cell. **Consider** that the tape head starts somewhere on a blank cell to the left of the input string to the right one cell , leaving all the remaining cell blank.(9)	BTL-5	Evaluate
3.	(i) Design and **explain** a TM to compute f(m,n) = m*n , for all m,n€ N.(6) (ii) **Explain** how a multi track in a TM can be used for testing given positive integer is a prime or not(9).	BTL-4	Analyze
4.	(i) **Prepare** a subroutine to move a TM head from its current position to the right, skipping over all 0's until reaching a 1 or a blank. If the current position does not hold 0, then the TM should halt. You may assume that there are no tape symbol other than 0,1 and B(blank). Then , use this subroutine to design to TM that accepts all strings of 0's and 1's that do not have two 1's in a row.(8) (ii) **Write** short notes on checking off symbols(7)	BTL-6	Create

UNIT V
UNDECIDABILITY

Non Recursive Enumerable (RE) Language – Undecidable Problem with RE – Undecidable Problems about TM –Post‘s Correspondence Problem, The Class P and NP

PART – A

Q.No	Questions	BT Level	Competence
1.	Distinguish between PCP and MPCP? What are the conceptsused in UTMs?	BTL 2	Understand
2.	List out the features of universal turing machine.	BTL 1	Remember
3.	When a recursively enumerable language is said to be recursive? Discuss on it.	BTL 2	Understand
4.	Compare and contrast recursive and recursively enumerable Languages	BTL 4	Analyze
5.	State when a problem is said to be decidable and give anexample of an undecidable problem.	BTL 1	Remember
6.	Define NP hard and NP completeness problem.	BTL 1	Remember
7.	Define a universal language Lu?	BTL 1	Remember
8.	Is it true that the language accepted by a non-deterministicTuring Machine is different from recursively enumerable language? Judge your answer.	BTL 5	Evaluate
9.	Formulate the two properties of recursivelyenumerable sets which are undecidable	BTL 6	Create
10.	When a problem is said to be decidable? Give an example ofundecidable problem. Analyze it.	BTL 4	Analyze
11.	What is (a) recursively enumerable languages (b) recursivesets? Generalize your answer.	BTL 6	Create
12.	Define the classes of P and NP.	BTL 1	Remember
13.	Is it true that complement of a recursive language is recursive? Discuss your answer	BTL 2	Understand
14.	Describe an example of an undecidable problem	BTL 1	Remember
15.	Point out the properties of recursive and recursive enumerable language.	BTL 4	Analyze
16.	Illustrate on Primitive Recursive Function.	BTL 3	Apply
17.	Show the Properties of Recursive Languages	BTL 3	Apply
18.	Explain about tractable problem.	BTL 5	Evaluate
19.	Describe post correspondence problem.	BTL 2	Understand
20.	Illustrate about Time and space complexity of TM.	BTL 3	Apply

PART - B

<table>
<tr><td>1.</td><td>(i)Describe about the tractable and intractable problems.(7)(ii)Identify that “MPCP reduce to PCP”.(6)</td><td>BTL 1</td><td>Remember</td></tr>
<tr><td>2.</td><td>(i) Describe about Recursive and Recursive Enumerablelanguages with example. (7)
(ii) State and describe RICE theorem.(6)</td><td>BTL 1</td><td>Remember</td></tr>
<tr><td>3.</td><td>(i) Summarize diagonalization language. (6)
(ii) Discuss the significance of universal turing machine and also construct a turing machine to add two numbers and encodeit .(7)</td><td>BTL 2</td><td>Understan d</td></tr>
<tr><td>4.</td><td>Discuss post correspondence problem Let ∑={0,1}.Let A andB be the lists of three strings each ,defined as
<table>
<tr><td></td><td>List A</td><td>List B</td></tr>
<tr><td>I</td><td>wi</td><td>xi</td></tr>
<tr><td>1</td><td>1</td><td>111</td></tr>
<tr><td>2</td><td>10111</td><td>10</td></tr>
<tr><td>3</td><td>10</td><td>0</td></tr>
</table>
(i) Does the PCP have a solution?(7)
(ii) Prove that the universal language is recursivelyenumerable.(6)</td><td>BTL 2</td><td>Understan d</td></tr>
<tr><td>5.</td><td>(i)Explain computable functions with suitable example.(6)(ii)Explain in detail notes on Unsolvable Problems.(7)</td><td>BTL 4</td><td>Apply</td></tr>
<tr><td>6.</td><td>(i) Describe in detail notes on universal Turing machines withexample.(7)
(ii) Collect and write the short notes on NP-completeproblems.(6)</td><td>BTL 1</td><td>Remember</td></tr>
<tr><td>7.</td><td>(i) Show that the diagonalization language (L_d) is not arecursively enumerable.(7)
(ii) Illustrate about unsolvability.(6)</td><td>BTL 3</td><td>Apply</td></tr>
<tr><td>8.</td><td>(i)Compare the difference between recursive and recursively enumerable languages.(7)
(ii)Explain about PCP.(6)</td><td>BTL 5</td><td>Evaluate</td></tr>
<tr><td>9.</td><td>(i) Explain about Universal Turing machine and show that theuniversal language (L_u) is recursively enumerable but not recursive. Generalize your answer(8)
(ii) Design and explain how to measure and classifycomplexity.(5)</td><td>BTL 6</td><td>Create</td></tr>
<tr><td>10.</td><td>(i) Explain about the recursively Enumerable Language withexample.(6)
(ii) Point out that the following problem is undecidable.Given two CFGs G1 and G2 is $L(G1) \cap L(G2) = \emptyset$.(7)</td><td>BTL 4</td><td>Analyze</td></tr>
<tr><td>11.</td><td>(i) Show that the characteristic function of the set of all evennumber is recursive .(7)
(ii) Illustrate in detail notes on primitive recursive functionswith examples.(6)</td><td>BTL-3</td><td>Apply</td></tr>
</table>

12.	(i)Point out the Measuring and Classifying Complexity.(7) (ii)Does PCP with two lists x=(b,b ab^3,ba) and y=(b^3,ba,a) have a solution. Analyze your answer.(6)	BTL4	Analyze
13.	(i) Discuss in detail about Time and Space Computing of aTuring Machine(6) (ii) Express two languages which are not recursivelyenumerable.(7)	BTL-2	Understand
14.	(i) Describe in detail Polynomial Time reduction and NP-completeness.(7) (ii) List out the short notes on NP-Hard Problems.(6)	BTL 1	Remember
PART-C			
1.	Consider and find the languages obtained from the followingoperations: (i) Union of two recursive languages.(5) (ii) Union of two recursively enumerable languages.(5) (iii) L if L and complement of L are recursively enumerable.(5)	BTL 5	Evaluate
2.	Prove that the universal language is recursively enumerable butnot recursive. Generalize your answer.(15)	BTL-6	Create
3.	(i) Plan and explain on decidable and un-decidable problemswith an example(7) (ii) Design and prove that for two recursive languages L1 andL2 their union and intersection is recursive.(8)	BTL-6	Create
4.	(i) Compare and write about tractable and untractactable problems with an example.(10) (ii) Explain the language L_u and show that L_u is RElanguage.(5)	BTL-4	Analyze