HALDIA INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION UNDER MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL)

Paper Code: PCC-CS 302

Paper Name: FORMAL LANGUAGE AND AUTOMATA THEORY

Time Allotted: 1 Hour 30 Minutes *Full Marks*: 70

The figures in the margin indicate full marks
Candidates are required to give their answers in their own words as far as practicable

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives from the followings: 30 x 1 = 30

(i) The class of CFG is not closed under [CO4]

a) concatenation b) intersection c) union d) repeated concatenation

(ii) A multi tape Turing machine is _____ powerful than a single tape turing machine. [CO6]

a) more b) less c) equal d) not equal

(iii) PDA is more powerful than [CO4]

a) Turing machine b)Multi tape Turing machine c)Finite automata d) All of these

(iv) A push down automata is different than finite automata by: [CO4]

a) Its memory b) Number of states c) Both (a) and (b) d) None of these

(v) Push down automata accepts _____ languages. [CO4]

a) Type 3 b) Type 2 c) Type 1 d) Type 0

(vi) Limitation of PDA can overcome by: [CO4]

a) Mealy machine b) Moore machine c) Turing Machine d) FA

(vii) Turing machine was invented by: [CO6]

a) Alan Turing b) Turing man c) Ginsburg d) None of these

(viii) Which automata takes stack as storage? [CO4]

a) Finite automata b)Push down automata c)Turing machine d) Regular expression

(ix) Recursive language is also called [CO6]

a) turing recognizable language b) turing decidable language c) turing recognizable and decidable both d) none of these

(x) $L=\{a^nb^n \mid n>=0\}$ is [CO5]

a) Regular b) Context Free c) Both regular and context free d) None of these

(xi) Instantaneous description of PDA is defined by how many tuples? [CO4]

a) 4 b) 3 c) 1 d) 2

(xii) $L=\{ww^R \mid w^R$ is the reverse of w$\}$is an example of [CO1]

a) Deterministic PDA b) Non-Deterministic PDA c) Both a and b d) None of these

(xiii) If L1 and L2 are recursively ennumerable languages over S, then the following is/are recursively ennumerable? [CO1]

a) L1 U L2 b)L1 ∩ L2 c) L1 U L2 and L1 ∩ L2 both d) None of these

(xiv) If a language L is recursively enumerable, then it is not closed under which of the following operations? [CO6]

a) union b) intersection c) complement d)all of these

(xv) In the context-free grammar below, S is the start symbol, a and b are terminals, and ϵ denotes the empty string S → aSa | bSb | a | b | ϵ Which of the following strings is NOT generated by the grammar? [CO4]

a) aaaa b) baba c) abba d) babaaabab

(xvi) The logic of pumping lemma is a good example of [CO5]

a) The pigeon-hole principle b) The divide and conquer technique c) Recursion d) Iteration

(xvii) Which of the following strings can be obtained by the language $L=\{a^ib^{2i} \mid i>=1\}$ [CO1]

a) aaabbbbbb b) aabbb c) abbabbba d) aaaabbbabb

(xviii) Which of the following production is in CNF? [CO5]

a) S → aA b) SA→ AS c) S → AB d) All of these

(xix) The solution to the equation R=Q+RP is [CO2]

a) $R=QP^*$ b) $R=Q^*P$ c) $P=RQ^*$ d) R=P

(xx) A turing machine operates over: [CO6]
a) finite memory tape b) infinite memory tape c) depends on the algorithm d) none of the mentioned

(xxi) A turing machine with several tapes in known as: [CO6]
a) Multi-tape turing machine b) Poly-tape turing machine c) Universal turing machine
d) All of the mentioned

(xxii) Which of the following was not a part of Chomsky hierarchy? [CO5]
a) Context sensitive grammar b) Unrestricted grammar c) Recursive grammar
d) None of the mentioned

(xxiii) Given Grammar: S->A, A->aA, A->e, B->bA
Which among the following productions are Useless productions? [CO3]
a) S->A b) A->aA c) A->e d) B->bA

(xxiv) Inorder to simplify a context free grammar, we can skip the following operation: [CO4]
a) Removal of null production b) Removal of useless symbols c) Removal of unit productions d) None of the mentioned

(xxv) Which of the following is the format of unit production? [CO4]
a) A->B b) A->b c) B->Aa d) None of the mentioned

(xxvi) Given Grammar G:
S->aA
A->a| A
B->B
The number of productions to be removed immediately as Unit productions: [CO4]
a) 0 b) 1 c) 2 d) 3

(xxvii) The pumping lemma is often used to prove that a language is:[CO5]
a) Context free b) Not context free c) Regular d) None of the mentioned

(xxviii) The instantaneous PDA is has the following elements [CO4]
a) State b) Unconsumed input c) Stack content d) All of the mentioned

(xxix) Which of the following statement is correct? [CO3]
a) All Regular grammar are context free but not vice versa b) All context free grammar are regular grammar but not vice versa c) Regular grammar and context free grammar are the same entity d) None of the mentioned

(xxx) There exists a language L. We define a string w such that $w \in L$ and w=xyz and |w| >=n for some constant integer n. What can be the maximum length of the substring xy according to pumping lemma, i.e. |xy|<=? [CO1]
a) n b) |y| c) |x| d) none of the mentioned

Group – B
((Multiple Choice Type Questions))

2. Choose the correct alternatives from the followings: 20 x 2 = 40

(i) L = (an bn an | n = 1,2,3) is an example of a language that is [CO1]

a) Context free b) Not context free c) Not context free but whose complement is CF d) Both (b) and (c)

(ii) What is the highest type number which can be applied to the following grammar? [CO3]
S —> Aa, A —> Ba, B —> abc

(a) Type 0 (b) Type 1 (c) Type 2 (d) Type 3

(iii) If e1 and e2 are the regular expressions denoting the languages L1 and L2 respectively, then which of the following is wrong? [CO1]

(a) (e1) | (e2) is a regular expression denoting L1 ∪ L2 (b) (e1) .(e2) is a regular expression denoting L1. L2 (c) φ is not a regular expression (d) None of the above

(iv) The following grammar [CO3]
G = (N, T, P, S)
N = {S, A, B}
T = {a, b, c}
P : S -> aSa
S -> aAa
A -> bB
B -> bB
B -> c is
(a) Is type 3 (b) Is type 2 but not type 3 (c) Is type 1 but not type 2 (d) Is type 0 but not type 1

(v) If L1 = {x | x is a palindrome in (0 + 1)*}
L2 = {letter (letter + digit)* };
L3 = ($0^n 1^n 2^n$ | n > 1}
L4 = {$a^m b^n a^{m+n}$ | m, n > 1}
then which of the following statement is correct? [CO1]
(a) L1 is context free language and L3 is context sensitive language (b) L2 is a regular set and L4 is not a context free language (c) Both L1 and L2 are regular sets (d) Both L3 and L4 are context-sensitive languages

(vi) A language is represented by a regular expression (a)*(a + ba). Which of the following string does not belong to the regular set represented by the above expression. [CO1]
(a) aaa (b) aba (c) ababa (d) aa

vii)Which of the following CFG's can't be simulated by an FSM? [CO2]
(a) S --> Sa | b (b) S --> aSb | ab (c) both of them (d) None of these

(viii) Which of the following regular expressions denotes a language comprising of all possible strings over S = {a, b} of length where n is a multiple of 3. [CO2]
(a) (a + b + aa + bb + aba + bba)* (b) (aaa + bbb)* (c) ((a + b)(a + b)(a + b))* (d) (aaa + ab + a) + (bbb + bb + a)

(ix) Consider a grammar:

G = { { S } , { 0 , 1 } , p , s }
where elements of p are:
S--> 0S
S--> 1S
S--> empty
The grammar will generate [CO3]

(a) Regular language (b) Context-free language (c) Context-sensitive language (d) Recursive enumerable language

(x) A given grammar is called ambiguous if [CO3]
(a) Two or more productions have the same non-terminal on the left hand side
(b) A derivation tree has more than one associated sentence
(c) There is a sentence with more than one derivation tree corresponding to it
(d) Brackets are not present in the grammar

(xi) The language L = (0^n 1^n 2^n where n > 0) is a [CO1]
(a) Context free language (b) Context-sensitive language (c) Regular language (d) Recursive enumerable language

(xii) baa*c denotes the set [CO3]
(a) {$b^n a^m c^p$|n, m, p = 1} (b) {$ba^n c$|n = 0} (c) {$ba^n c$|n = 1} (d) {w|w is a string of a, b, c}

(xiii) Consider the grammar
S ---> PQ | SQ | PS
P ---> x
Q--> y
To get a string of n terminals, the number of productions to be used is [CO4]
(a) n2
(b) n + 1
(c) 2n
(d) 2n - 1

(xiv) For two regular languages

L1 = (a + b)* a and L2 = b (a + b) *

The intersection of L1 and L2 is given by [CO1]
(a) (a + b) * ab (b) ab (a + b) * (c) a (a + b) * b (d) b (a + b) * a

(xv) Palindromes can't be recognized by any FSA because [CO2]
(a) FSA cannot remember arbitrarily large amount of information (b) FSA cannot deterministically fix the midpoint (c) Even if the midpoint is known an FSA cannot find whether the second half of the string matches the first half (d) All of the above

(xvi) Let L be a language recognizable by a finite automaton. [CO1]
The language,

REVERSE (L) = {w such that w is the reverse of v where v ∈ L} is a

(a) Regular language (b) Context-free language (c) Context-sensitive language (d) Recursively enumerable language

(xvii) If every string of a language can be determined, whether it is legal or illegal in finite time, the language is called [CO1]
(a) Decidable (b) Un-decidable (c) Interpretive (d) Non-deterministic

(xviii) Consider a language L for which there exists a Turing machine TM, T, that accepts every word in L and either rejects or loops for every word not in L. The language L is [CO6]

(a) NP hard (b) NP complete (c) Recursive (d) Recursively enumerable

(xix) Which of the following conversion is not possible (algorithmically)? [CO1]
(a) Regular grammar to context-free grammar (b) Nondeterministic FSA to deterministic FSA (c) Nondeterministic PDA to deterministic PDA (d) Nondeterministic TM to deterministic TM

(xx) If a language is denoted by a regular expression
L = (x)* (x | y x) ,then which of the following is not a legal string within L? [CO2]
(a) yx (b) xyx (c) x (d) x y x y x

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Signature of the Paper Setter/Moderator

Answer Key:

Group – A

1. (i)	b	(ii)	a	(iii)	c	(iv)	a	(v)	b	(vi)	c
(vii)	a	(viii)	b	(ix)	b	(x)	b	(xi)	b	(xii)	b
(xiii)	c	(xiv)	c	(xv)	b	(xvi)	a	(xvii)	a	(xviii)	c
(xix)	a	(xx)	b	(xxi)	a	(xxii)	c	(xxiii)	d	(xxiv)	d
(xxv)	a	(xxvi)	c	(xxvii)	b	(xxviii)	d	(xxix)	a	(xxx)	a

Group B

2. (i)	d	(ii)	c	(iii)	c	(iv)	b	(v)	a	(vi)	c
(vii)	b	(viii)	c	(ix)	a	(x)	c	(xi)	b	(xii)	c
(xiii)	d	(xiv)	d	(xv)	d	(xvi)	a	(xvii)	a	(xviii)	d
(xix)	c	(xx)	d								