



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: 3 Hours

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)

Choose the correct alternatives from the followings:

15 x 1 = 15

1. (i) $\{a^n b^n \mid n \geq 1\}$ is accepted by a PDA [CO4]

- a) by null store and also by final state b) by null store but not by final state
c) by final state but not by null store d) by none of these

(ii) $\{a^n b^{2n} \mid n \geq 1\}$ is accepted by [CO1]

- a) a finite automata b) a nondeterministic finite automaton
c) a pda d) none of these

(iii) The intersection of a context-free language and a regular language is [CO4]

- a) context-free b) regular but not context free
c) neither context-free nor regular d) both regular and context-free

(iv) If a grammar G has three productions $S \rightarrow aSa \mid bSb \mid c$, then [CO4]

- a) $abcba$ and $bacab \in L(G)$ b) $bcba$ and $abcab \in L(G)$
c) $acca$ and $bcccb \in L(G)$ d) $accb$ and $bccca \in L(G)$

(v) The regular grammar generating $\{a^n : n \geq 1\}$ is [CO3]

- a) $(\{S\}, \{a\}, \{S \rightarrow aS\}, S)$ b) $(\{S\}, \{a\}, \{S \rightarrow SS, S \rightarrow a\})$
c) $(\{S\}, \{a\}, \{S \rightarrow aS\}, S)$ d) $(\{S\}, \{a\}, \{S \rightarrow aS, S \rightarrow a\}, S)$

(vi) $\{a^n b^n c^n \mid n \geq 1\}$ is [CO2]

- a) regular b) context-free but not regular
c) context-sensitive but not context-free d) none of these.

(vii) $\{a^n b^n \mid n \geq 1\}$ is [CO2]

- a) regular b) context-free but not regular
c) a context-sensitive but not context-free d) none of these.

(viii) The set of all strings over $\{a, b\}$ of even length is represented by the regular expression [CO3]

- a) $(ab+aa+bb+ba)^*$ b) $(a+b)^*(a^*+b)^*$ c) $(aa+bb)^*$ d) $(ab+ba)^*$

(ix) The set of all strings over $\{a, b\}$ of length 4, starting with an a is represented by the regular expression [CO3]

- a) $a(a+b)^*$ b) $a(ab)^*$ c) $(ab+ba)(aa+bb)$ d) $a(a+b)(a+b)(a+b)$

(x) $(0^*1^*)^*$ is the same as [CO3]

- a) $(0+1)^*$ b) $(01)^*$ c) $(10)^*$ d) none of these

(xi) if L is the set of all strings over $\{a, b\}$ containing at least one a, then it is not represented by the regular expression [CO3]

- a) $b^*a(a+b)^*$ b) $(a+b)^*a(b+a)^*$ c) $(a+b)^*ab^*$ d) $(a+b)^*a$

(xii) $\{a^{2n} \mid n \geq 1\}$ is represented by the regular expression [CO3]

- a) $(aa)^*$ b) a^* c) aa^*a d) a^*a^*

(xiii) The set of strings over $\{a,b\}$ having exactly 3b's is represented by the regular expression [CO3]

- a) a^*bbb b) $a^*ba^*ba^*b$ c) ba^*ba^*b d) $a^*ba^*ba^*ba^*$

(xiv) The set of all strings over $\{a,b\}$ having abab as a substring is represented by [CO3]

- a) a^*ababb^* b) $(a+b)^*abab(a+b)^*$ c) $a^*b^*ababa^*b^*$ d) $(a+b)^*abab$

(xv) $(a+a^*)^*$ is equivalent to [CO3]

- a) $a(a^*)^*$ b) a^* c) aa^* d) none

Group – B

(Short Answer Type Questions)

Attempt any three from the followings:

3 x 5 = 15

2. What is Kleene closure and Positive closure? Explain with example. [CO1]

3. Find Regular expression over $\Sigma = \{a,b\}$ for the languages defined as follows-

i) $L_1 = \{a^m b^n : m > 0, n > 0\}$

ii) $L_2 = \{a^{2n} b^{2m+1} : m \geq 0, n \geq 0\}$ [CO2]

4. Using Pumping lemma prove that $L = \{a^n b^n c^n : n \geq 0\}$ is not Context Free. [CO4]

5. prove $t+RR^*=R^*$ where t is null string and R is a regular expression. [CO3]

6. Using Pumping lemma prove that $L = \{a^i \mid i \geq 1\}$ is not regular. [CO5]

Group – C

(Long Answer Type Questions)

Attempt any four from the followings:

4 x 10 = 40

7. a) What is push down automata? Write two advantage of push down automata. [CO4]

b) Design a PDA for accepting a language $\{a^n b^{2n} \mid n \geq 1\}$. [CO4]

2+2+6

8. a) Explain Greibech Normal Form (GNF) with example. [CO5]

b) Convert the following grammar into GNF. [CO5]

$$S \rightarrow AB/BC$$

$$A \rightarrow aB/bA/a$$

$$B \rightarrow bB/cC/b$$

$$C \rightarrow c$$

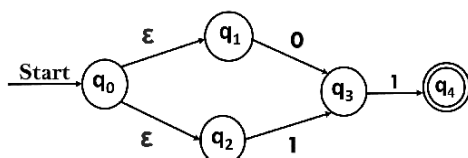
(3+7

9. a) State the difference between NFA and DFA. [CO2]

b) Design FA for the language $L = \{(01)^i 1^{2j} \mid i \geq 1, j \geq 1\}$ [CO2]

c) Convert the NFA with ϵ into its equivalent DFA. [CO2]

2+3+5



10. Let G be the grammar $S \rightarrow SS, S \rightarrow aSb, S \rightarrow bSa, S \rightarrow \lambda$. For the string abab, find leftmost derivation and rightmost derivation. Draw the parse trees for leftmost and rightmost derivations. [CO4]

5+5

11. What is Turing machine (TM)? Design TM which accepts the language $L = \{aba\}$ over $\Sigma = \{a,b\}$. [CO6] 2+8

12. What is halting problem? Prove that the halting problem of Turing machine is undecidable. [CO6] 2+8

Answer Key:

Group – A

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