



MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : PCC-CS 403/PCC-CS403/PCC-CSBS401/PCCCS403 Formal Language & Automata Theory

UPID : 004423

Time Allotted : 3 Hours

Full Marks : 70

The Figures in the margin indicate full marks.

Candidate are required to give their answers in their own words as far as practicable

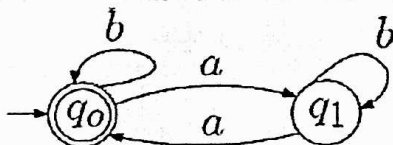
Group-A (Very Short Answer Type Question)

1. Answer any ten of the following :

[1 x 10 = 10]

- (I) Which Machine is specific for Context sensitive grammar?
- (II) Which one of the following is correct?
 - A) Recursive language is closed under complement.
 - B) The complement of a recursively enumerable language is recursively enumerable.
 - C) The complement of a recursive language is either recursive or recursively enumerable.
 - D) The complement of a context-free language is context-free.
- (III) Which of the following strings is a member of the set represented by the regular expression $a(a|b)^*a$?
 - (A) aabab
 - (B) aababa
 - (C) aaab
 - (D) bababa
- (IV) What is the difference between δ (delta function) and δ^* (extended delta function)?
- (V) Let R_1 and R_2 be regular sets defined over alphabet Σ then identify which of the following is not regular set.
 - A) $R_1 \cap R_2$
 - B) $R_1 \cup R_2$
 - C) $\Sigma^* - R_2$
 - D) $R_2 \cap R_1' : R_2'$ denotes complement of R_2
- (VI) What is the difference between kleene plus and kleene star.
- (VII) If production rules are of the following kind then identify its Grammar type, then identify the Grammar type and its corresponding language.

$\alpha \rightarrow \beta$ where
 $\alpha, \beta \in (T \cup N)^*$ and $\text{len}(\alpha) \leq \text{len}(\beta)$ and α should contain atleast 1 non terminal.
- (VIII) 1. Consider a language L given by
 $L = \{a^p \mid p \text{ is a prime}\}$.
 Which of the following is true?
 - A) A Turing Machine does not accept L .
 - B) L is regular but not context-free.
 - C) L is context-free but not regular.
 - D) L is neither regular nor context-free but accepted by a Turing Machine.
- (IX) Write down a problem which is undecidable.
- (X) How many bit strings of length exactly five are matched by the regular expression $0(0|1)^*1$?
- (XI) What is the language of the following finite automaton?



- (XII) The logic of pumping lemma is a good example of _____ principle.

Group-B (Short Answer Type Question)

Answer any three of the following :

[5 x 3 = 15]

2. State the Pumping lemma for the Context Free Language (CFL).
3. What is the most general phase of structured grammar?

[5]

[5]

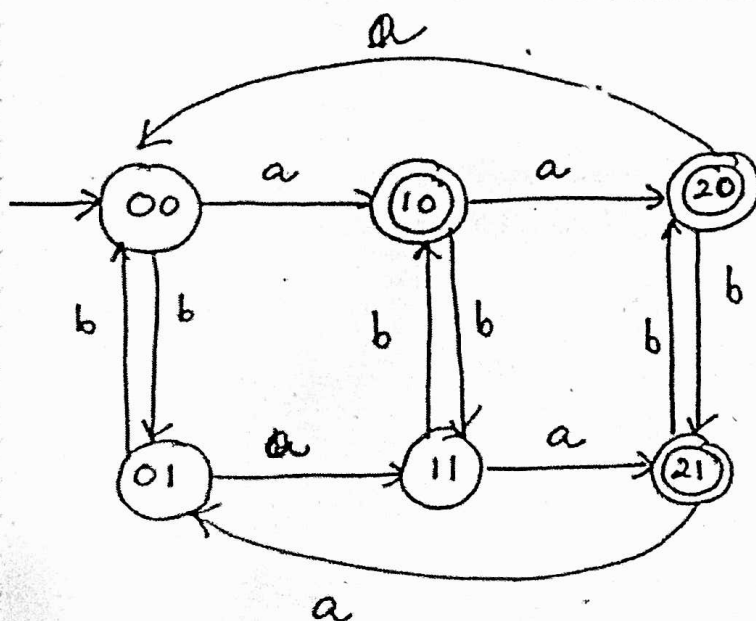
4. Let M be the encoding of a Turing Machine as a string over $\Sigma=\{a,b\}$. Let $L=\{M \mid M \text{ is a TM that accepts a string of length } 2014\}$, Then L is what type of language and whether it is decidable? [5]
5. What are Universal Turing Machines? [5]
6. Convert the following Context Free Grammar Into GNF : [5]
 $S \rightarrow aABb \mid a$
 $A \rightarrow aaA \mid B$
 $B \rightarrow bAb$

Group-C (Long Answer Type Question)

Answer any three of the following :

[15 x 3 = 45]

7. (a) Prove that Context Free Languages are not closed under Intersection. [5]
 (b) Convert the following grammar into GNF. [6]
 $S \rightarrow AA/a$
 $A \rightarrow SS/b$
 (c) Find a reduced grammar equivalent to the grammar: [4]
 $S \rightarrow aAa$
 $A \rightarrow bBB$
 $B \rightarrow ab$
 $C \rightarrow aB$
8. (a) Construct a PDA accepting $\{a^n b^m a^n : m, n \geq 1\}$ by null state. [6]
 (b) Construct the corresponding Context-Free-Grammar of the above PDA accepting the same set. [9]
9. (a) Design a Turing Machine which accepts the language $L = \{a^n b^n, n \geq 1\}$. [10]
 (b) Write a short note on Multi-Tape and Multi Head Turing Machine. [5]
10. (a) Define PDA by giving a block diagram. Explain how a string be accepted by a PDA ? [5]
 (b) Design PDA for Odd-length palindrome for the language $L=\{wcwR : w \in \{a,b\}^*\}$. Show the representation for i) Final state PDA ii) Empty Stack PDA. [10]
 Consider W^R is the reverse of W .
11. (a) Design a DFA for the following languages over $\Sigma=\{a,b\}$. $L=\{vww : v, w \in \{a,b\}^*, |v|=2\}$ [6]
 (b) Consider the following DFA and answer the following: [4]
 i) Are the strings 'aaaabb' and 'aabbb' acceptable?
 ii) Describe 5-tuple format of the following DFA.



- (c) Construct a minimum state automaton equivalent to the following DFA. [5]

PS	Input	
	0	1
$\rightarrow P$	Q	U
Q	V	R
*R	P	R
S	R	V
T	W	U
U	R	V
V	V	T
W	V	R

*** END OF PAPER ***