SHAMBHUNATH INSTITUTE OF ENGINEERING AND TECHNOLOGY, PRAYAGRAJ

Subject Code: BCS-402 **Subject: Theory of Automata & Formal Languages**

Course: B.Tech. **Semester: IV**

SECOND SESSIONAL, EXAMINATION, EVEN SEMESTER, (2023-2024)

Branch: Computer Science & Engineering

Time –2 Hrs **Maximum Marks – 45**

1. Attempt any *FIVE* questions in brief.

Q. N.	QUESTION	Marks	CO	BL
a.	Define Grammar.	2	CO3	L1
b.	Consider the CFG 'G' whose productions are $S \rightarrow aAS / a$, $A \rightarrow SbA / SS / ba$ Show derivation of string *aabbaa* and construct derivation tree for same.	2	CO3	L3
c.	Construct a Context Free Grammar for a language L over alphabet {a,b} such that $L=\{ a^i b^j c^k \mid i=j \text{ or } j=k\}$	2	CO3	L3
d.	What is Unit & Null production?	2	CO3	L1
e.	Show that the following context free grammar is ambiguous. $S \rightarrow SbS \mid a$.	2	CO3	L3
f.	Write the difference between CNF and GNF.	2	CO3	L2

2. Attempt any *ONE* of the following.

Q. N.	QUESTION	Marks	CO	BL
a.	Design a CFG for the language: (i) $L=\{a^n b^m \mid n \text{ is not equal to } m\}$ (ii) $L=\{ w \mid n_a(w) = n_b(w)\}$	5	CO3	L5
b.	Explain Chomsky classification of grammars and languages along with their machines.	5	CO3	L3
c.	Prove that if L_1 and L_2 are two CFL then intersection of L_1 and L_2 may or may not be CFL	5	CO3	L4

3. Attempt any *FIVE* questions in brief.

Q. N.	QUESTION	Marks	CO	BL
a.	Draw the model of the finite automata and push down automata?	2	CO4	L1
b.	Define the formal definition of Push Down Automata.	2	CO4	L1
c.	Define Deterministic PDA.	2	CO4	L1
d.	What is Two Stack Push Down Automata?	2	CO4	L1
e.	What is the acceptance of string by Pushdown automata?	2	CO4	L1
f.	What is Instantaneous Description in a PDA?	2	CO4	L1

4. Attempt any *ONE* of the following.

Q. N.	QUESTION	Marks	CO	BL
a.	Find the PDA equivalent to the grammar $G = (\{S, A\}, \{a, b\}, P, S)$ where $P = \begin{cases} S \rightarrow aAA \\ A \rightarrow bS \mid aS \mid a \end{cases}$	5	CO4	L4
b.	What are useless symbols in CFG? Remove all useless symbols from following: S→aS | A | C A→ a B→aa C→aCb	5	CO4	L5
c.	Design a push down automata that accepts the language $L=\{a^n b^n \mid$ where n is natural number$\}$. .	5	CO4	L5

5. Attempt any *FIVE* questions in brief.

Q. N.	QUESTION	Marks	CO	BL
a.	Design a Turing machine for f(m)= m+1 where m is positive integer.	2	CO5	L3
b.	Write short note on Universal Turing Machine	2	CO5	L1
c.	Define the formal definition of Turing machine.	2	CO5	L1
d.	Write about The Halting problem.	2	CO5	L1
e.	What is Turing-recognizable language.	2	CO5	L1
f.	Write about Church-Turing thesis.	2	CO5	L1

6. Attempt any *ONE* of the following.

Q. N.	QUESTION	Marks	CO	BL
a.	Design a Turing machine For the $L=\{a^n b^n c^n \mid n>=1\}$.	5	CO5	L5
b.	State PCP problem. Find at least 3 solution to PCP defined by the dominoes: 1 | 10 | 10111 111 | 0 | 10	5	CO5	L5
c.	Convert the following CFG into its equivalent CNF form: S→ a | baAB | BCD A→ BCad | bb B→ b| bad C→ a D→ dd	5	CO5	L3