FORMAL LANGUAGES AND AUTOMATA THEORY (23CY503)

UNIT III – Context-Free Grammars and Pushdown Automata

Part-A: Short Answer Questions

1. Define Context-Free Grammar (CFG).
2. What is a Derivation?
3. Define Leftmost Derivation.
4. Define Rightmost Derivation.
5. What is a Parse Tree?
6. Define Sentential Form.
7. What is Ambiguity in CFG?
8. Define Pushdown Automaton (PDA).
9. What is Acceptance by Final State?
10. Define Deterministic PDA.

Part-B: Descriptive Questions

1. Explain the components of a CFG.
2. Discuss leftmost and rightmost derivations with examples.
3. Explain parse trees and their significance.
4. Describe ambiguity in context-free grammars.
5. Explain the formal definition of PDA.
6. Discuss the equivalence between PDA and CFG.

Tutorial Assignment:
Design a CFG and PDA for $L=\{a^n b^n \mid n \geq 1\}$.

Part C: MCQs

1.A Context-Free Grammar consists of:

- A) Variables, Terminals, Productions, Start Symbol ✅
- B) States and Inputs
- C) States and Stack
- D) None

2.A variable in CFG is also called:

- A) Non-terminal ✅
- B) Terminal
- C) Alphabet
- D) Symbol

3.The leaf nodes of a parse tree contain:

- A) Terminals ✅
- B) Non-terminals
- C) States
- D) Productions

4.The root of a parse tree is:

- A) Start Symbol ✅
- B) Terminal
- C) State
- D) Input

5.A grammar is ambiguous if:

- A) More than one parse tree exists ✅
- B) One parse tree exists
- C) No parse tree exists
- D) Infinite states exist

6.CFGs are used in:

- A) Programming Language Design ✅
- B) Networking
- C) Databases
- D) Operating Systems

7.PDA stands for:

- A) Pushdown Automata ✅
- B) Program Driven Automata
- C) Push Driven Automata
- D) None

8.The additional memory in PDA is:

- A) Stack ✅
- B) Queue
- C) Tape
- D) Register

9.PDA accepts:

- A) Context-Free Languages ✅
- B) Regular Languages only
- C) Recursive Languages
- D) None

10. The stack follows:

- A) LIFO ✅
- B) FIFO
- C) Circular
- D) Random

11. Acceptance by empty stack means:

- A) Stack becomes empty ✅
- B) Final state reached
- C) Input rejected
- D) No transition

12.DPDA stands for:

- A) Deterministic Pushdown Automata ✅
- B) Dynamic PDA
- C) Direct PDA
- D) None

13.NPDA stands for:

- A) Non-Deterministic PDA ✅
- B) New PDA
- C) Nested PDA
- D) None

14.CFGs generate:

- A) Context-Free Languages ✅
- B) Regular Languages only
- C) Recursive Languages
- D) CSL

15.A derivation begins with:

- A) Start Symbol ✅
- B) Terminal
- C) State
- D) Input

16. The language $\{a^n b^n\}$ is:

- A) Context-Free ✅
- B) Regular
- C) Finite
- D) None

17.PDA is more powerful than:

- A) DFA ✅
- B) Turing Machine
- C) CFG
- D) None

18.A parse tree represents:

- A) Derivation ✅
- B) Transition
- C) State Diagram
- D) Input

19.A PDA may have:

- A) ε-transitions ✅
- B) Infinite tape
- C) Registers
- D) Queue

20.CFG and PDA are:

- A) Equivalent in power ✅
- B) Different
- C) Unrelated
- D) None

Part-D: Fill in the Blanks

1. CFG stands for _____ Grammar.
   Answer: Context-Free
2. A variable in CFG is called a _____.
   Answer: Non-terminal
3. A derivation starts from the _____ symbol.
   Answer: Start
4. The leaf nodes of a parse tree are _____.
   Answer: Terminals
5. A grammar with multiple parse trees is called _____.
   Answer: Ambiguous
6. PDA stands for _____ Automata.
   Answer: Pushdown

7. PDA uses a _____ for storage.
   Answer: Stack
8. Stack follows the _____ principle.
   Answer: LIFO
9. CFG generates _____ languages.
   Answer: Context-Free
10. PDA accepts _____ languages.
    Answer: Context-Free
11. The root of a parse tree is the _____ symbol.
    Answer: Start
12. Acceptance by empty stack requires the stack to become _____.
    Answer: Empty
13. Acceptance by final state requires reaching a _____ state.
    Answer: Final
14. DPDA stands for _____ Pushdown Automata.
    Answer: Deterministic
15. NPDA stands for _____ Pushdown Automata.
    Answer: Non-Deterministic
16. CFG and PDA are _____ in computational power.
    Answer: Equivalent
17. A sentential form contains terminals and _____.
    Answer: Non-terminals
18. Parse trees help identify grammar _____.
    Answer: Ambiguity
19. PDA is more powerful than _____ Automata.
    Answer: Finite
20. The language $\{a^n b^n\}$ is a _____ language.
    Answer: Context-Free