📘Formal Language and Automata Theory (FLAT) – 5th Sem CS

📌 1. Syllabus Overview 1. Mathematical Foundations - Sets, relations, functions - Proof techniques: induction, contradiction - Strings, alphabets, and languages

1. Finite Automata (FA)
2. Deterministic Finite Automata (DFA)
3. Non-Deterministic Finite Automata (NFA)
4. Equivalence of DFA & NFA
5. Regular expressions & conversion to FA
6. DFA minimization
7. Regular Languages
8. Closure properties
9. Pumping Lemma
10. Applications
11. Context-Free Grammar (CFG) & Pushdown Automata (PDA)
12. CFG definitions, derivations, parse trees, ambiguity
13. Normal forms: Chomsky Normal Form (CNF), Greibach Normal Form (GNF)
14. PDA: acceptance by final state/empty stack
15. Equivalence of PDA & CFG
16. Turing Machines (TM)
17. Definition & simple examples
18. Variants: multi-tape, universal TM
19. Recursive & recursively enumerable languages
20. Computability & Complexity
21. Decidability and undecidability
22. Introduction to NP, NP-Complete problems

📌2. Step-by-Step Study Roadmap

Phase 1: Basics (Weeks 1–2) - Learn alphabets, strings, and languages - Practice simple problems: reversing a string, checking palindromes - Understand DFA & NFA with examples

Phase 2: Finite Automata & Regular Languages (Weeks 3–4) - Draw DFA/NFA for simple languages: even number of 1's, divisible by 3, etc. - Convert NFA → DFA → Regex → Minimized DFA - Solve Pumping Lemma problems

Phase 3: CFG & PDA (Weeks 5–6) - Write CFG for arithmetic expressions, palindromes, balanced parentheses - Learn CNF & GNF conversions - Design PDA for simple languages

Phase 4: Turing Machines & Computability (Weeks 7–8) - Construct simple Turing Machines: binary addition, palindrome checker - Study decidable vs undecidable problems - Introduction to P vs NP

📌3. Books & Resources - Introduction to Automata Theory, Languages, and Computation – Hopcroft & Ullman - Theory of Computation – Mishra & Chandrasekaran - GeeksforGeeks – Theory of Computation section - NPTEL lectures – Prof. Kamala Krithivasan, IIT Madras - YouTube: Gate Smashers, Knowledge Gate (FLAT tutorials)

📌4. Exam Preparation Strategy - Focus on DFA, NFA, and Regex conversions - Pumping Lemma proofs (common in theory questions) - CFG construction (palindromes, balanced parentheses) - Practice Turing Machine design problems - Prepare short notes for closure properties, normal forms, and definitions