

**Chapter 1 : Introduction to AI****1-1 to 1-23**

Syllabus : Introduction of Artificial Intelligence, Historical backdrop, AI Problems, AI technique, production systems, problem characteristics, production systems characteristics.

1.1	Introduction to Artificial Intelligence.....	1-1
1.1.1	AI Approaches.....	1-2
1.1.1(A)	Acting Humanly : The Turing Test Approach.....	1-2
1.1.1(B)	Thinking Humanly : The Cognitive Modelling Approach.....	1-3
1.1.1(C)	Thinking Rationally : The “Laws of Thought” Approach.....	1-4
1.1.1(D)	Acting Rationally : The Rational Agent Approach.....	1-5
1.1.2	Task Domains of AI.....	1-6
1.2	Historical Backdrop	1-6
1.3	AI Problems.....	1-8
1.3.1	Classic Artificial Intelligence Search Problems.....	1-8
1.4	AI Techniques.....	1-11
1.5	Production Systems.....	1-17
1.5.1	Four Classes of Production Systems.....	1-17
1.6	Problem Characteristics	1-18
1.7	Production System Characteristics.....	1-21

Chapter 2 : Problem Solving**2-1 to 2-57**

Syllabus : Problem Solving by Searching, State-space Search techniques : Breadth first search, Depth first search and Iterative deepening DFS. Heuristic search Techniques : Hill Climbing, Best-first search, Problem reduction, Constraint satisfaction.

2.1	Solving Problems by Searching.....	2-1
2.1.1	Formulating Problems.....	2-2
2.1.2	Components of Problems Formulation.....	2-2



2.1.3	Example of 8-Puzzle Problem	2-3
2.1.4	Example of Missionaries and Cannibals Problem	2-4
2.1.5	Vacuum-Cleaner Problem.....	2-5
2.1.6	Example of Real Time Problems.....	2-6
2.2	Measuring Performance of Problem Solving Algorithm / Agent	2-7
2.3	Node Representation in Search Tree	2-7
2.4	Uninformed Search.....	2-8
2.4.1	Breadth First Search (BFS)	2-8
2.4.2	Uniform Cost Search (UCS)	2-10
2.4.3	Depth First Search (DFS)	2-11
2.4.4	Depth Limited Search (DLS).....	2-14
2.4.5	Iterative Deepening DFS (IDDFS).....	2-16
2.4.6	Difference between BFS and DFS	2-20
2.5	Informed Search Techniques.....	2-21
2.5.1	Heuristic Function	2-21
2.5.2	Example of 8-puzzle Problem	2-23
2.5.3	Example of Block World Problem	2-24
2.5.4	Properties of Good Heuristic Function	2-26
2.6	Local Search Algorithms and Optimization Problems.....	2-27
2.6.1	Hill Climbing.....	2-27
2.6.1(A)	Simple Hill Climbing.....	2-29
2.6.1(B)	Steepest Ascent Hill Climbing	2-29
2.6.1(C)	Limitations of Hill Climbing.....	2-30
2.6.1(D)	Solutions on Problems in Hill Climbing	2-33
2.6.2	Simulated Annealing.....	2-33
2.6.2(A)	Comparing Simulated Annealing with Hill Climbing	2-35
2.6.3	Local Beam Search.....	2-35



2.6.4	Best First Search	2-39
2.6.5	Greedy Best First Search	2-42
2.6.6	Difference between Informed and Un-informed Search Techniques	2-43
2.7	Problem Reduction.....	2-44
2.7.1	AO* Algorithm.....	2-47
2.8	Constraint Satisfaction Problem.....	2-48
2.8.1	Constraint Satisfaction Problems (CSPs).....	2-48
2.8.1(A)	Examples of CSPs.....	2-49
2.8.1(B)	Varieties of CSPs	2-50
2.8.1(C)	Varieties of Constraints	2-50
2.8.2	Backtracking in CSPs	2-51
2.8.2(A)	Improving Backtracking Efficiency	2-51

Chapter 3 : Finding Optimal Paths**3-1 to 3-15**

Syllabus : Brute Force, Branch & bound, Algorithm A*, Admissibility of A*, Iterative Deepening A*, Recursive best first search

3.1	Brute Force.....	3-1
3.2	Branch & Bound.....	3-1
3.2.1	Implementation.....	3-2
3.3	Algorithm A*	3-4
3.3.1	Implementation.....	3-5
3.3.2	Algorithm (A*).....	3-5
3.3.3	Behaviour of A* Algorithm.....	3-7
3.3.4	Admissibility of A*.....	3-8
3.3.5	Properties of A*.....	3-10
3.3.6	Example : 8 Puzzle Problem using A* Algorithm.....	3-10
3.4	Iterative Deepening A* (IDA*).....	3-11
3.4.1	Recursive Best-First Search (RBFS).....	3-12

**Chapter 4 : Planning****4-1 to 4-45**

Syllabus : Component of a Planning system, Forward state space planning, Backward state space planning, Goal stack planning, Plan space Planning, Hierarchical planning.

4.1	Introduction to Planning	4-1
4.1.1	Simple Planning Agent.....	4-2
4.2	Planning Problem	4-3
4.2.1	Why Planning ?.....	4-4
4.2.1(A)	Problem Solving and Planning.....	4-4
4.3	Goal of Planning	4-5
4.3.1	Major Approaches.....	4-6
4.4	Planning Graphs	4-7
4.5	Planning as State-Space Search	4-10
4.5.1	Examples of State Space Search.....	4-12
4.6	Classification of Planning with State Space Search	4-16
4.6.1	Progression Planners.....	4-16
4.6.2	Regression Planners.....	4-18
4.6.3	Heuristics for State-Space Search	4-19
4.7	Goal Stack Planning	4-19
4.8	Total Order Planning (TOP)	4-24
4.9	Partial Order Planning	4-25
4.9.1	POP as a Search Problem	4-26
4.9.2	Consistent Plan is a Solution for POP Problem.....	4-27
4.10	Hierarchical Planning	4-28
4.10.1	POP One Level Planner	4-28
4.10.2	Hierarchy of Actions	4-29
4.10.3	Planner.....	4-30



4.11	Planning Languages	4-32
4.11.1	Example of Block World Puzzle	4-33
4.11.2	Example of the Spare Tire Problem.....	4-36
4.12	Planning and Acting in the Real World	4-37
4.13	Multi-agent Planning	4-38
4.14	Conditional Planning	4-39
4.15	Planning with Operators	4-41

Chapter 5 : Game Tree Search**5-1 to 5-21**

Syllabus : Minimax, Alpha-beta, Heuristics in game tree search.
--

5.1	What is Adversarial Search?	5-1
5.2	Environment Types	5-2
5.3	AI Game - Features	5-3
5.3.1	Zero Sum Game	5-4
5.3.2	Non-Zero Sum Game	5-4
5.3.2(A)	Positive Sum Game	5-4
5.3.2(B)	Negative Sum Game.....	5-4
5.4	Relevant Aspects of AI Game	5-4
5.5	Game Playing	5-5
5.5.1	Type of Games.....	5-6
5.5.1(A)	Chess	5-7
5.5.1(B)	Checkers	5-8
5.5.2	What is Game Tree?.....	5-9
5.6	MiniMax Algorithm	5-11
5.6.1	Minimax Algorithm.....	5-11
5.6.2	Properties of Minimax Algorithm.....	5-15
5.7	Alpha Beta Pruning	5-15
5.7.1	Example of α - β Pruning.....	5-18
5.7.2	Properties of α - β	5-20

**Chapter 6 : Natural Language Understanding****6-1 to 6-11**

Syllabus : Overview, Mechanical translation, Grammars, Parsing techniques, Text generation, Natural language processing systems.

6.1	Natural Language Processing (NLP)	6-1
6.1.1	Components of NLP	6-1
6.2	The Steps Involved in NLP	6-2
6.3	Formal Grammar	6-3
6.4	Types of Grammars	6-4
6.5	Parsing	6-5
6.6	Techniques used in NLP	6-7
6.7	Natural Language Processing Systems	6-8