COURSE CONTENT

AI SPECIALIST								
VI Semester: COMMON FOR ALL BRANCHES								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACSD44	**Core**	1	0	2	2	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 45**				**Total Classes: 45**		
Prerequisite: Programming for Problem Solving Laboratory								

I. COURSE OVERVIEW:

This course provides in-depth training on modern AI paradigms including numerical learning, human cognition modeling, machine-driven creativity, generative modeling, and autonomous intelligent agents. Students gain hands-on experience in designing predictive models, building reasoning systems, generating creative artifacts, and developing single and multi-agent architectures using LLMs and embodied robotics. The course combines theory, practical labs, and real-world problem-solving projects, leveraging tools such as TensorFlow, PyTorch, and OpenAI. By the end, learners are prepared to architect adaptive AI systems for healthcare, smart infrastructure, security, and creative industries.

II. COURSES OBJECTIVES:

The students will try to learn

I. The core AI paradigms: machine learning, cognitive modeling, creativity simulation, and agent autonomy.
II. Implementation of supervised, unsupervised, and reinforcement learning models for real-world datasets.
III. Generative systems and prompt-driven AI solutions using large language models and creative algorithms.
IV. Reactive, deliberative, learning, tool-using, multi-agent, and embodied robotic agents.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Apply statistical and learning algorithms to derive actionable decisions from numerical data.
CO2 Construct neural architectures like CNNs, RNNs, and probabilistic reasoning models for prediction and classification.
CO3 Model cognitive behaviors such as speech evolution, bias awareness, attention, moral, and theory-of-mind reasoning.
CO4 Generate creative artifacts using prompt-driven generative models for storytelling, sound, UX copy, design and idea incubation.
CO5 Architect and deploy autonomous AI agents using reasoning, memory, and external tool integration.
CO6 Design and evaluate embodied robotic agents including drone-rover hybrids, swarm systems, and inspection or assistance robots.

AI SPECIALIST

CONTENTS

Type of AI	UNIQUE EXPERTISE IN
Numerical AI	It uses statistical & machine learning algorithms and numerical AI focuses on **data-driven learning.** **Turning numerical data into actionable decisions** • Machine Learning: supervised, unsupervised, and reinforcement learning techniques. • Neural Networks: deep learning, CNNs, RNNs. • Probabilistic models: Bayesian networks, Markov models. • Learns patterns automatically from data. • Handles complexity, uncertainty, and non-linear relationships. • Used extensively in prediction, classification, pattern recognition, and control systems.
Cognitive AI	Cognitive AI aims to replicate human-like thinking, learning, and reasoning by modeling the cognitive processes seen in natural intelligence**.** **Human and animal cognition, evolution of speech** • Models human-like thinking and reasoning in machines. • Integrates insights from psychology, neuroscience, and linguistics. • Enables AI to understand context and adapt to new situations. • Supports interpretable and explainable decision-making. • Aims to create more natural, human-aligned intelligent systems.
Computational Creativity	Computational Creativity focuses on enabling machines to generate novel and meaningful creative outputs by modeling or simulating human creative processes. **Simulation of intelligent and creative human activities on computers** • Focuses on enabling machines to produce creative outputs like art, music, or stories. • Uses algorithms and generative models to simulate human-like creativity. • Explores novelty, imagination, and idea generation in computational systems. • Supports human–AI collaboration in creative and design-oriented tasks. • Helps analyze and model the cognitive processes behind creativity.
Evolutionary and Hybrid AI	Evolutionary and Hybrid AI combines evolution-inspired optimization with neural and symbolic methods to create adaptive, self-improving, and interpretable intelligent systems. **Emergent communication and computational grammar**

- Combines evolutionary algorithms with symbolic and neural methods for adaptive learning.
- Uses evolutionary principles like mutation and selection to discover strategies or representations.
- Supports the emergence of communication, behaviors, or computational grammars among agents.
- Integrates multiple AI paradigms to balance flexibility and interpretability.
- Enables systems to self-organize and improve in dynamic or complex environments.

Generative AI

Generative AI refers to models that learn patterns from data and create new content such as text, images, audio, or code based on that learned knowledge.

Turing data into creativity

- Excels at recognizing patterns in training data and generating coherent variations.
- Relies on human prompts to initiate generation processes.
- Primarily focused on producing creative or content-driven outputs.
- Operates mostly through single-turn, request–response interactions.

Agentic AI

Agentic AI refers to autonomous systems that can plan, reason, make decisions, and take actions to achieve goals with minimal human intervention.

Multiple interacting learning agents

- Focuses on AI systems that can autonomously plan, decide, and take actions.
- Uses reasoning, memory, and tool-use to complete multi-step tasks.
- Integrates perception, planning, and execution into a single intelligent agent.
- Enables adaptive behavior through continuous feedback from the environment.
- Supports collaboration between multiple agents for complex, real-world problem solving.

AI Agent

An AI agent is a software or physical entity that can perceive its environment, make decisions, and take actions to achieve specific goals autonomously.

AI based System Development using LLMs

AI-based system development using LLMs refers to building intelligent applications that leverage large language models to understand, generate, and reason with natural language for automated and human-centered tasks.

Numerical AI

Type of Learning	Domain and Title of the Project
Supervised Learning	1. Chronic Kidney Disease (CKD) Prediction 2. Stroke Prediction using Clinical & Lifestyle Features 3. Parkinson's Disease Prediction from Biomedical Voice Data 4. Autism Spectrum Disorder (ASD) Early Detection 5. Arrhythmia and ECG Signal Classification 6. Smart Grid Cyber–Physical Attack Detection 7. IoT Botnet and Intrusion Detection 8. Cyberbullying Detection in Social Media Posts 9. Electrical Load Forecasting for Smart Buildings 10. Breast Cancer Prediction from Diagnostic Measurements
Unsupervised Learning	1. Climate Pattern Clustering for Extreme Weather Identification 2. Gene Expression Clustering for Disease Biomarker Discovery 3. Movie Embedding Clustering for Content-Based Recommendation 4. Urban Air Quality Pattern Detection 5. Human Activity Pattern Mining Using Smartphone Sensors 6. Music Genre Clustering Using Audio Features 7. Urban Traffic Flow Pattern Clustering 8. Image Clustering for Medical Imaging (MRI/CT) 9. Patient Health Pattern Clustering for Clinical Insights 10. Document Topic Extraction for Research Paper Corpora
Reinforcement Learning	1. Autonomous Drone Navigation in Obstacle-Rich Environments 2. Conversational Dialogue Management 3. Personalized E-Learning Tutor 4. Stock Portfolio Optimization 5. Game AI Agent for Real-Time Strategy (RTS) Environments 6. Navigation Policy Learning for Self-Driving Cars in Simulation 7. Elevator Scheduling Optimization 8. Dynamic Resource Allocation in Cloud Computing 9. Adaptive Healthcare Treatment Recommendation 10. Intelligent HVAC Control for Energy-Efficient Buildings

Cognitive AI

Type of Learning	Domain and Title of the Project
Cognitive AI	1. Shopping Behavior Simulator 2. Human-Like Negotiation Agent 3. Pedestrian Theory-of-Mind Predictor 4. Human Bias-Aware Investment Advisor 5. Human Panic Behaviou Simulator 6. Migration Pattern Predictor 7. Human-Like Debate Coach 8. Cyber Threat Detection 9. Eye-Tracking Attention Analyzer 10. Moral Reasoning AI for Legal Scenarios

Computational Creativity

Type of Learning	Domain and Title of the Project
Cognitive AI	1. Magazine Layout Designer 2. Comic Strip Creator 3. Procedural Game World Builder 4. Storyboard Panel Generator for Animators 5. Generative Recipe Creator with Ingredients Constraints 6. Sound Effect Synthesizer for Game Developers 7. AD Campaign Composer 8. Home Renovation Visualizer 9. Game Puzzle Designer 10. Startup Idea Incubator

Evolutionary and Hybrid AI

Type of Learning	Domain and Title of the Project
Cognitive AI	1. Pest-Response Strategy 2. Workforce Optimization 3. Emergency Response Planner 4. Spacecraft Fault Diagnosis System

5. Drug Molecule Designer
6. Team Formation Strategy Engine
7. Collision-Avoidance Simulator
8. Genome Editing Strategy Planner
9. Pollution Control Planner
10. Destination Demand Predictor

Generative AI

Type of Learning	Domain and Title of the Project
Cognitive AI	1. Historical Civilization Reconstructor 2. Legal Case Argument Generator 3. Adaptive UX Copywriter for Neurodiverse Users 4. Financial Scenario World- Builder 5. Personalized Documentary Script Generator 6. Multi-Layer Soundscape Composer for Therapy 7. Aviation Safety Briefing Generator 8. Investor Pitch Deck Auto-Composer 9. Crisis Communication Generator for PR Teams 10. Virtual Cityscape Generator for Urban Simulators

Agentic AI

Type of Agentic AI	Title of the Project
Reactive Agents	A **Reactive Agent** is an intelligent agent that reacts instantly to perceptions from the environment using predefined rules or behaviors, without relying on internal models or complex planning. 1. Smart Home Intrusion Detection 2. Autonomous Obstacle Avoidance Robot 3. Stock Market Buy-Sell Reactive Agent 4. Weather-Based Clothing Recommendation Agent 5. Spam Email Classifier Reactive Agent
Deliberative (Planning) Agents	**Deliberative (Planning) Agent** is an intelligent agent that uses symbolic reasoning, internal models, and planning algorithms to decide the best sequence of actions needed to achieve a goal. 1. Intelligent Cyberbullying Detection System 2. Credit Risk Assessment and Loan Approval Planner

3. Intelligent Course Timetable Scheduling System
4. Medical Diagnosis and Treatment Recommendation Planner
5. Personalized News Recommendation Planner
6. Smart Agricultural Crop Planning System
7. Indoor Navigation and Wayfinding System
8. Smart Waste Collection and Routing Planner
9. Intelligent Resume Screening & Candidate Ranking
10. Network Intrusion Detection & Threat Response Planner

Learning Agents

A **Learning Agent** is an AI system that uses data and experience to automatically improve its decision-making ability and performance without being explicitly programmed for every situation.

1. Personalized E-Learning Recommendation
2. Adaptive Traffic Signal Control Agent
3. Autonomous Drone Navigation Learning
4. Intelligent Stock Price Prediction and Auto-Trading
5. Adaptive Smart HVAC Energy Optimization
6. Personalized Health Monitoring and Risk Prediction
7. Intelligent Chatbot with Reinforcement Learning Feedback
8. Intelligent Fraud Detection Learning Agent
9. Intelligent Robot Learning Agent for Task Mastery
10. Adaptive Road Accident Risk Prediction and Alerting Agent

Hybrid Agents

A **Hybrid Agent** is an AI agent that integrates both reactive and deliberative behaviors (and often learning capabilities) to perform real-time actions while also planning for long-term goals.

1. Intelligent Traffic Flow Management System
2. Disaster Response and Evacuation Planning System
3. Smart Farming Crop Health and Resource Optimization System
4. Cybersecurity Threat Detection and Automated Response System
5. Intelligent Retail Store Automation and Customer Flow Optimization
6. Intelligent Energy Management System for Smart Buildings
7. Personalized E-Commerce Recommendation and Preference Learning System
8. Autonomous Warehouse Robotics Coordination System
9. Intelligent Healthcare Monitoring and Early Warning System
10. Financial Fraud Detection and Risk Prediction System

Tool-Using Agents (LLM Agents)

Or

A **Tool-Using Agent (LLM Agent)** is an AI system that uses a Large Language Model to understand tasks, plan actions, and then call external tools (APIs, calculators, databases, browsers, code executors, robots, etc.) to complete those tasks.

1. Conversational QA Agent for Domain-Specific Knowledge Retrieval

Single-Agent System

2. Research Paper Summarizer for Academic Literature
3. Real-time Disaster Alert Agent for Emergency Response
4. Automated Code Review Agent for Software Quality Assurance
5. Social Media Sentiment Analysis Agent for Real-Time Trend Monitoring
6. Financial News Classifier Agent for Market Impact Analysis
7. Healthcare Appointment Coordinator for Patient Scheduling Optimization
8. Supply Chain Disruption Detector for Logistics Resilience
9. Intelligent Energy Management System for Smart Buildings
10. Personalized Learning Path Recommender for Adaptive Education

Multi-Agent Systems

A **Multi-Agent Systems (MAS)** is a system in which multiple intelligent agents interact with each other and with their environment to achieve individual and/or shared goals. These agents may cooperate, compete, communicate, negotiate, or coordinate with each other.

1. Patent Intelligence and Technology Transfer System
2. Healthcare Translation and Triage Assistant (IndicTrans)
3. Car Damage Assessment and Insurance Estimation System
4. Scientific Figure Captioning and Knowledge Extraction System
5. Resume-to-Video Automation System
6. RFP Response Automation and Validation Framework
7. Customer Review Intelligence and Auto-Response System
8. Regulatory Compliance Q&A and Validation Assistant
9. Meeting Intelligence, Action Extraction and Follow-Up System
10. Competitive Intelligence Monitoring and Battlecard Generator

Embodied Agents (Robotic Agents)

An **Embodied Agent**, also called a **Robotic Agent**, is an intelligent agent that exists physically in the real world and interacts with its environment through sensors and actuators. Unlike purely software agents, embodied agents have a physical body that allows them to perceive, move, manipulate objects, and perform actions in the real world.

1. Adaptive Terrain Negotiation Robot
2. Human Emotion-Aware Social Companion Robot
3. Autonomous Warehouse Shelf-Climbing Robot
4. Smart Agricultural Drone-Rover Hybrid Agent
5. Self-Learning Home Cleaning Robot
6. Autonomous Elderly Assistance Robotic Agent
7. Multi-Robot Swarm for Debris Clearing
8. Precision Surgical Assistant Micro-Robot
9. Vision-Guided Industrial Welding Robot
10. Autonomous Underwater Structure Inspection Robot