APAI SUBJECT : APPLIED ARTIFICIAL INTELLIGENCE

Course Objectives :

The objectives of this course are:

- To impart knowledge about basic computer fundamentals and Python programming required for implementing Artificial Intelligence (AI) and Machine Learning (ML) applications.
- To enable the students to understand the history of AI and the basic principles of modern AI.
- To enable the students to understand the basics of Machine Learning(ML), Artificial Neural Networks, and Deep Learning(DL)
- To enable the students to understand the uses of AI and ML/DL in various applications including Natural Language Processing(NLP), Speech Recognition, Image Processing & Computer Vision, Weather Predictions, Medicine and Health Care, Economics, eCommerce, Government law and policy-making, Environmental Sustainability, Chatbots and ChatGPT
- To enable the student to understand ethics in AI
- To gain practical experience in handling various AI and ML tools and implementing real-world applications using those tools.

Course Outcomes :

Upon successful completion of this course, the student shall be able to:

- Demonstrate an understanding of the history of AI and its foundations.
- Demonstrate awareness and a fundamental understanding of various applications of AI and Machine Learning in real-world applications including Natural Language Processing(NLP), Speech Recognition, Image Processing & Computer Vision, Weather Predictions, Medicine and Health care, Economics, e-commerce, Government law and policy-making, Environmental Sustainability, Chatbots and ChatGPT
- Demonstrate proficiency in developing various real-world AI and ML applications using existing Python-based tools
- Demonstrate an ability to share in discussions of AI and ML, its current scope and limitations, and its impact on society.

CLASS - XI

SUBJECT: APPLIED ARTIFICIAL INTELLIGENCE (APAI)

SEMESTER – I

FULL MARKS : 35 **CONTACT HOURS : 60 Hours**

COURSE CODE : THEORY

UNIT	TOPICS	CONTACT HOURS	MARKS
Unit 1 : Computer Fundamental (15)	**Classification of computers :** Micro, mini, mainframe and supercomputers **1a) Computer architecture:** (Block diagram-based): important units like CPU, Memory, Input and Output units of a computer, interaction of computer units via system bus. Data flow between CPU, Memory, and I/O devices. Different parts of the CPU and their functions (in brief). Types of memory (examples). Cache memory. Information transfer from Memory to Processor (a block diagram with a brief description). Mention Different types of I/O devices with examples, Processor to I/O Devices communication (a block diagram with brief description).	10	05
	1b) Number systems and Logic gates: How a computer manipulates or stores numbers. Decimal number system, conversion of Decimal to binary, Octal, and Hexadecimal number system. Logic gates - basic logic gates: AND gate, OR gate, NOT gate, and XOR gate. Laws of Boolean algebra. An example of a small logic circuit containing AND gates, OR gates, and/or NOT gates.	08	05
	1c) Computer Network : Definition, various types of networks - LAN, WAN, Internet (brief introduction with suitable figures). Very short introduction (with diagrams/figures) to network devices - Network Interface Card, Hub, Repeater, Switch, Bridge, Router, Gateway.	06	05

UNIT	TOPICS	CONTACT HOURS	MARKS
	2a) Software: Difference between software and hardware, Classification of Software with examples. Basic Concepts of Operating Systems (OS) - functions of OS, Types of OS, Windows operating system - desktop, icons, menu, taskbar. File System- creating files/folders, deleting files/folders, copying files/folders from one drive to another.	08	05
Unit 2 : Software & Languages (10)	**2b)** Basics of Computer Programming (three levels: high-level language, assembly language, machine language, definition, and block diagrams), Overview of Compiler and Interpreter (definition and mention name of major compiled (e.g., C, C++) and interpreted languages (e.g., Python), Overview of procedural and object-oriented programming (key features and just the basic differences, mention names of some popular procedural (e.g., BASIC, FORTRAN, C) and object-oriented programming languages (e.g., C++, Java, Python).Concept of Algorithm and Flowchart. Basic programming concepts, What is programming language ? Classification of programming languages with examples. What is a computer program ?	10	05
Unit 3 : Python Programming (10)	**3)** Features of Python programming language, Applications of Python, Installing Jupyter using Anaconda, Steps to open Python Shell in interactive mode, Steps to create Python file. Variables, data types, operators, different types of expressions, input and output built-in functions, Python comment, Lists - accessing list element, updating list, deleting list, List *vs* tuple. Control structures - conditional statements with small examples, While loop, For loop. Arrays - searching in an array (a simple example). Defining user-defined functions(with simple examples). Some important Python libraries- Numpy, OpenCV, Matplotlib, NLTK, Pandas((very short description for each library).	18	10

NB : Additional 10 hours for Remedial and/or Tutorial classes

CLASS - XI

SUBJECT: APPLIED ARTIFICIAL INTELLIGENCE (APAI)

SEMESTER – II

FULL MARKS : 35 **CONTACT HOURS : 60 HOURS**

COURSE CODE: THEORY

UNIT	TOPICS	CONTACT HOURS	MARKS
Unit 4 : Foundation of AI (10)	**4a)** History of AI, What is natural intelligence ? What is Artificial Intelligence (AI) ? Strong AI *vs*. Weak AI.	06	03
	4b) • AI agent, An architecture of an AI agent (a block diagram and short description of each component). • Relationships between AI, Machine Learning(ML), and Deep Learning (DL). • What is Machine Learning ? Difference between traditional programming and Machine Learning. Different types of Machine Learning. Advantages of ML over DL. • Basic steps of ML system design - problem understanding, data acquisition, features, data representation, modeling using approaches like rule-based, supervised learning, unsupervised learning, and Reinforcement Learning (short description of each modeling approach with simple examples).	18	07
Unit 5 : Concept of Supervised Learning (10)	**5)** • Supervised learning - a block diagram with a short description, • Regression and classification with simple examples. • Common supervised classifiers - K-Nearest Neighbour search algorithm (in detail), • Decision tree classifier (basic idea only, no induction algorithm),	12	10

UNIT	TOPICS	CONTACT HOURS	MARKS
Unit 6 : Concept of Unsupervised Learning (5)	**6)** K-means clustering algorithm. Illustration with an example.	08	05
Unit 7 : Preliminary Concept of Artificial Neural Network (10)	**7)** • Neural Network - biological motivation, comparison between Artificial Neuron and Human Neuron. • Artificial Neuron as a processing unit. Perceptron learning rule for updating weights of an artificial neuron. Limitation of a perceptron in solving XOR problem. • Multilayer feedforward neural network (only a diagram showing interconnections among neurons at multiple layers). • High-level description of Forward pass and Backward pass of the backpropagation (BP) algorithm used for training. • Multilayer feedforward neural network (No mathematical derivation). • How is Deep Learning (DL) related to Artificial Neural Networks? Difference between shallow and deep learning.	16	10

NB : Additional 10 hours for Remedial and/or Tutorial classes

CLASS: XI

SUBJECT : APPLIED ARTIFICIAL INTELLIGENCE (APAI)

COURSE CODE : PRACTICAL

Full Marks : 30 [Project Marks : 10 + Viva : 05 + Practical : 15]

FULL MARKS : 30 **CONTACT HOURS : 60 HOURS**

Sl. NO.	TOPICS	CONTACT HOURS	MARKS
	1. Computer Fundamentals [No marks]		
1.	• Visit to Computer Lab and familiarization with computers and peripherals and different networking devices (e.g., modem, switch, router). • Opening of the CPU box/cabinet and identification of different parts (e.g., Motherboard, CPU/Processor, RAM, Hard Disk, power supply).	10	0
	2. Introduction to Python Programming [15 Marks]		
2a.	• Introduction to installing and running simple python codes and simple access to user inputs from console examples. • Write Python programs i) To convert the temperature from Centigrade to Fahrenheit and vice versa. ii) To calculate the simple and compound interest. iii) To calculate the area of a triangle when three sides are given iv) Calculate the DA, MA, and HRA from a given salary. v) To solve the quadratic equation vi) To check if a given year is a leap year or not. vii) To find the largest among three numbers using the fourth variable & without using the fourth variable.	14	03

Sl. NO.	TOPICS	CONTACT HOURS	MARKS
2b)	1) Develop a menu-driven arithmetic calculator that can perform simple logical and arithmetic operations. 2) Write Python programs for i) Converting a 3-digit number into words (eg: input -123, output- One hundred twenty-three) ii) Printing patterns, iii) Conversion of binary to decimal and vice versa, iv) Computing GCD of two numbers, v) Finding prime numbers in a given interval vi) Generating Fibonacci sequence, vii) Computing factorial of a number. viii) To find the sum of the digits of an integer.	24	07
2c)	Write programs i) to Find the max, min, average, sum, and length of a list ii) to Use of basic string methods like upper(), lower(), count(), find(), join(), replace(), split() Etc. iii) Linear search iv) Bubble sort in an array	12	05

CLASS - XII

SUBJECT: APPLIED ARTIFICIAL INTELLIGENCE (APAI)

SEMESTER – III

FULL MARKS : 35 **CONTACT HOURS : 60 Hours**

COURSE CODE: THEORY

UNIT	TOPICS	CONTACT HOURS	MARKS
Unit 1 : Different Types of Data & Various Application Areas of AI (5)	**1a)** ● Structured data ● Unstructured (Audio, video, and text) data ● Semi-structured data	07	02
	1b) ● Natural Language Processing ● Speech recognition ● Computer vision ● Weather Predictions ● Self-driving cars ● Autonomous systems ● Robotics **(A brief description of each area, focusing on the question: what is it?)**	08	03
Unit 2 : AI in Natural Language Processing (10)	**2)** ● Definition of Natural language processing (NLP) ● Applications of NLP ● Major Natural Language Processing applications - Chatbots, ● Autocomplete in Search Engines ● Voice Assistants (Siri, Alexa, or Google Assistant), ● Machine translation ● Grammar Checkers, Email Classification and Filtering, ● Sentiment analysis, Fake news detection, Hate speech detection. **(Brief explanation of each NLP topic using suitable examples. Roles of AI and ML in the respective application (brief explanation in storytelling fashion with a suitable diagram only . Sophisticated math must be avoided).** ● Use cases: Sentiment analysis, common features extraction using NLTK toolkit (Bag-of-words model, TF-IDF features, n-gram features), classification tools - KNN model, Decision Tree, ANN (in Scikit learn) training sentiment analysis model and testing the learned model (Use block diagram and ML tools, no mathematical description or derivation).	15	10

UNIT	TOPICS	CONTACT HOURS	MARKS
Unit 3 : AI in Speech Recognition (7)	What is a speech signal ? Applications of Speech recognition. How does it differ from text.? Common audio format (.wav,.mp3), description of basic speech features (Frequency, Amplitude, pitch, zero crossing rate, energy, and autocorrelation, MFCC), feature extraction using Python toolbox (no mathematics, only concepts), speech recognition using ANN (in Scikit learn). Roles of AI and ML in speech recognition.	10	07
Unit 4 : AI in Image Processing & Computer Vision (8)	What is computer vision? Applications of Image Analysis and Computer Vision. Common image and video formats (very brief description .jpeg, .tiff, .bmp, .mp4, .avi), Color Model: RGB, image representation in computer, image binarization (Threshold Based) , image features- pixel features, Gray Scale Values as Features, Mean pixel values of channels, Edge features(Prewitt kernel, Sobel kernel,), Texture Feature, Use case: image classification using the Animal dataset(three classes- dogs, cats, and pandas) , image representation with examples, description of the Animal dataset, Using ML tools like k-NN or others for classification (A brief description of the steps: Data collection, Data representation, Split the Dataset into train and test sets, Train the Classifier, Evaluation using Scikit learn tools).	10	08
Unit 5 : AI for Weather Predictions (5)	Problem definition, Features, Time series data (stock market time series analysis), ARIMA Model (briefly) Data representation, Prediction using linear regression (using regression tools, no mathematical derivation).	10	05

NB: Additional 10 hours for Remedial and/or Tutorial classes

CLASS - XII

SUBJECT: APPLIED ARTIFICIAL INTELLIGENCE (APAI)

SEMESTER – IV

FULL MARKS : 35 **CONTACT HOURS : 60 Hours**

COURSE CODE: THEORY

UNIT	TOPICS	CONTACT HOURS	MARKS
Unit 6 : AI for Medicine and Health Care (7)	**6)** How is AI Changing Medical Science (brief notes). AI for medical disease detection using - Diabetes detection using Machine Learning Algorithm (KNN, ANN), AI for medical diagnostic-disease detection using computer vision (Example-based), AI for Medical Prognosis (example-based). AI for health surveillance (sensor-based examples with flow diagram). Will Clinicians be replaced by AI ? Limitations and Challenges in the Application of Artificially Intelligent Systems in Medical Science (Discussion on each topic should be brief and be example-based).	10	07
Unit 7 : AI for Business (6)	**7a) AI for Economics:** How can AI reshape the future of economics ? AI-powered economic forecasting, Stock market prediction, Regression-based forecasting of economic indicators such as GDP and inflation, a brief description of each use case, and block diagram architecture of the AI model used for forecasting. Challenges and limitations of using AI for economic forecasting.	07	03
	7b) AI for eCommerce: How is AI changing eCommerce ? Recommendation System Steps (Collecting user data, Analyzing data, Filtering, Generating recommendations). Recommendation using user-based k-nearest neighbours, Online shopping, virtual assistants, Chatbots, and voice assistants **(Brief introduction to each use case).**	07	03

UNIT	TOPICS	CONTACT HOURS	MARKS
Unit - 8 : AI for Government Law and Policy-making (3)	**8)** ● Introduction, AI tool-based analysis of the reactions of the common people when a new policy is to be introduced. ● Automatic legal advisers, AI-based methods for legal document retrieval and processing for supporting argumentation (example-based).	07	03
Unit - 9 : AI in Environment Sustainability (5)	**9)** What is meant by environmental sustainability ? GreenHouse Effect, Carbon Footprint. Renewable energy forecasting using Machine Learning (Regression based). How can AI help in environment sustainability ? (brief description with suitable examples).	09	05
Unit - 10 : Chatbots, Large Lanugage Models and ChatGPT (7)	**10)** How does a Chatbot work ? A block-level diagram for a Chatbot. What is a language model ? How does the traditional language model differ from a Large Language Model ? What is ChatGPT ? How is it related to Deep Learning ? How does it function ? Impact of ChatGPT on various sectors like education, health, etc. What is Prompt Engineering? What is its importance ?	10	07
Unit - 11 : Benefits, Risks and Ethics of AI (7)	**11)** ● Positive aspects of AI, negative aspects of AI. ● Short notes on various risks of the misuse of AI - Lethal autonomous weapons, surveillance, and persuasion, biased decision-making, impact on employment, safety-critical applications, and cyber security (example-based discussion). ● AI ethics - Commonly cited principles to be followed while creating or using AI technology, the ethical side of lethal autonomous weapons, Surveillance, security, privacy, fairness and bias, trust and transparency, and robot rights (each topic should be discussed in brief with suitable examples).	10	07

NB: Additional 10 hours for Remedial and/or Tutorial classes

CLASS: XII

SUBJECT : APPLIED ARTIFICIAL INTELLIGENCE (APAI)

COURSE CODE : PRACTICAL

Full Marks : 30 [Project Marks : 10 + Viva : 05 + Practical : 15]

FULL MARKS : 30 **CONTACT HOURS : 60 HOURS**

UNIT	TOPICS Suggested Experiments (at least 3 Experiments must be completed)	CONTACT HOURS	MARKS
	1. Develop a machine learning-based sentiment analysis model (Python-based Scikit Learn tools) 2. a) Write a Python Program to read a .wav audio file and visualize the signal b) Develop spoken numeral recognition using MFCC features and KNN (Python-based Scikit Learn tools) . 3. a) Write a Python Program to read an image and display the image. b) Develop an image classification system using ANN on Animal dataset (Python-based Scikit Learn tools) 4. Develop a simple weather prediction system using a regression tool (Python-based Scikit Learn tools). 5. Develop a Diabetes prediction system using ANN (Python-based Scikit Learn tools) 6. Develop a Chatbot using existing tools 7. Use ChatGPT for various tasks: Writing Essay, Letters, Poem, Coding Assistant, Compose song lyrics, Generate Movie Scripts.	60	15

Suggested Reading :

1	Fundamentals of Computers by E Balagurusamy, McGraw Hill,2009
2	Artificial Intelligence: A modern approach by Stuart Russell, Peter Norvig, Pearson Edition
3	Principles of Artificial Intelligence by Nills J. Nilsson, Springer Berlin, Heidelberg
4	Machine Learning by Peter Flach, Cambridge University Press
5	Machine Learning by Tom Mitchell, McGraw Hill, 1997
6	Introduction to Machine Learning with Python by Andreas C Muller, Sarah Guido, Publisher(s): O'Reilly Media