Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (VIII Sem)**	Branch: **Artificial Intelligence and Machine Learning**
Subject: **Advance Data Science**	Course Code: **D109811(022)**
Total / Minimum-Pass Marks (End Semester Exam): 100 / 35	**L: 3 T: 1 P: 0** Credits: **4**
Class Tests & Assignments to be conducted: **2 each**	**Duration (End Semester Exam): 03 Hours**

Course Objectives:

- Develop advanced expertise in machine learning and deep learning, including the ability to apply ensemble methods, neural networks, and AI-driven techniques to solve complex data problems.
- Gain proficiency in automating data science workflows using AutoML tools, pipeline automation frameworks, and feature engineering for scalable solutions.
- Master time series analysis techniques, leveraging both classical statistical models and modern machine learning methods for accurate forecasting.
- Understand and implement ethical AI practices, focusing on fairness, accountability, transparency, and addressing bias in machine learning models.
- Explore cutting-edge topics like Explainable AI, Federated Learning, and Quantum Machine Learning, and assess their potential impact on future data science applications.

UNIT-I: Advanced Machine Learning:

- **Supervised Learning:**
  - Advanced regression techniques: Ridge, Lasso, ElasticNet
  - Ensemble methods: Bagging, Boosting (XGBoost, AdaBoost), Random Forest
  - Support Vector Machines (SVM), Kernel methods
  - Advanced classification techniques: k-Nearest Neighbors, Naive Bayes, Decision Trees
  - Practical implementation using Scikit-learn, TensorFlow, or PyTorch
- **Unsupervised Learning:**
  - Clustering techniques: K-means, DBSCAN, Hierarchical clustering
  - Dimensionality reduction: PCA, t-SNE, LDA
  - Gaussian Mixture Models, Hidden Markov Models
  - Anomaly detection techniques
  - Implementation and evaluation of unsupervised models
- **Reinforcement Learning:**
  - Markov Decision Processes (MDP)
  - Q-learning, Deep Q-Networks (DQN)
  - Policy gradients, Actor-Critic methods
  - Applications in game AI, robotics, and recommendation systems

UNIT-II: Deep Learning and Neural Networks:

- **Fundamentals of Neural Networks:**
  - Perceptron, Backpropagation, Gradient Descent
  - Activation functions: ReLU, Sigmoid, Tanh
  - Optimization techniques: Adam, RMSprop, SGD
- **Advanced Deep Learning Architectures:**
  - Convolutional Neural Networks (CNNs) for image data
  - Recurrent Neural Networks (RNNs), LSTM, GRU for sequential data
  - Generative Adversarial Networks (GANs)
  - Autoencoders and Variational Autoencoders (VAEs)
- **Transfer Learning:**
  - Pre-trained models: ResNet, VGG, BERT
  - Fine-tuning and feature extraction
  - Applications in computer vision, natural language processing

UNIT-III: AI-ML Driven Data Science and Automation:

- **AI Techniques in Data Science:**
  - Natural Language Processing (NLP): Text mining, Sentiment analysis, Named Entity Recognition (NER)
  - AI in recommendation systems: Collaborative filtering, Content-based filtering
- **Automation in Data Science:**
  - AutoML frameworks: Google AutoML, H2O.ai, Auto-sklearn
  - Automated feature engineering: Featuretools, Feature-engine
  - Pipeline automation with Apache Airflow, Prefect

UNIT-VI: Time Series Analysis:

1. **Introduction to Time Series**: Concepts of stationarity, seasonality, trends, and autocorrelation.
2. **Time Series Data Preprocessing**: Handling missing data, outliers, and transformations for stationarity.
3. **Classical Models**: Autoregressive (AR), Moving Average (MA), ARIMA, and Seasonal ARIMA (SARIMA).
4. **Exponential Smoothing**: Holt-Winters and other smoothing techniques for trend and seasonality.
5. **Advanced Models**: Vector Autoregression (VAR) and GARCH models for multivariate and volatility analysis.
6. **Model Evaluation and Forecasting**: Cross-validation, error metrics (RMSE, MAE), and uncertainty estimation.

UNIT-V: Advanced Topics in Data Science:

1. **Explainable AI (XAI):** Techniques like LIME, SHAP, and interpretability in machine learning models.
2. **Federated Learning**: Privacy-preserving machine learning and decentralized data processing.
3. **Quantum Machine Learning**: Introduction to quantum algorithms and their potential in data science.
4. **AI Ethics and Fairness**: Addressing bias, fairness, and ethical considerations in AI systems.
5. **Emerging Trends**: Sustainable AI, AI for social good, and edge AI deployment for IoT applications.

Text Books/Reference Books:

1. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
2. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
3. "Pattern Recognition and Machine Learning" by Christopher M. Bishop
4. "Time Series Analysis and Its Applications: With R Examples" by Robert H. Shumway and David S. Stoffer
5. "The Elements of Statistical Learning: Data Mining, Inference, and Prediction" by Trevor Hastie, Robert Tibshirani, and Jerome Friedman
6. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig
7. "Python for Data Analysis" by Wes McKinney

Course Outcomes:

After completing the course, students will be able to:

- Apply advanced machine learning techniques, including ensemble methods and reinforcement learning, to complex datasets for real-world problem-solving.
- Design, implement, and optimize deep learning models using neural network architectures like CNNs, RNNs, and GANs for various applications.
- Automate and scale data science workflows using AI-driven techniques, AutoML frameworks, and ethical AI practices to deliver robust solutions.
- Analyze and forecast time series data using classical models like ARIMA, advanced models like GARCH, and deep learning-based approaches.
- Explore and apply cutting-edge topics like Explainable AI, Federated Learning, and Quantum Machine Learning to innovate and advance data science applications.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (VIII Sem)**	Branch: **Artificial Intelligence and Machine Learning**
Subject: **Introduction to Game Theory** ***(Professional Elective–IV)***	Course Code: **D109831(022)**
Total / Minimum-Pass Marks (End Semester Exam): 100 / 35	**L: 2 T: 1 P: 0** Credits: **3**
Class Tests & Assignments to be conducted: **2 each**	**Duration (End Semester Exam): 03 Hours**

Course Objectives:

- The objective of this course is to understand the various architecture of game Theory and Game engine design, their support system and human interface.

UNIT-I: Introduction: Modeling the real world, Evolutionary Game Theory, Linear and Non Linear Dynamical Systems, 2- Player & 2-Stratey (2 x 2) Games, Dynamics Analysis of the 2 x 2 Game, Multi-player Games, Structure of a Typical Game Team, What Is a Game?, What Is a Game Engine?, Engine Differences Across Genres, Game Engine Survey, Runtime Engine Architecture, Tools and the Asset Pipeline, Tools of the Trade: Version Control, Microsoft Visual Studio, Profiling Tools, Contents.

UNIT-II: Fundamentals of Software Engineering for Games, C++ Review and Best Practices, Data, Code, and Memory in C/C++, Catching and Handling Errors, 3D Math for Games , Solving 3D Problems in 2D, Points and Vectors , Matrices, Quaternions, Comparison of Rotational Representations.

UNIT-III: Low-Level Engine Systems, Engine Support Systems, Subsystem Start-Up and Shut-Down, Memory Management, Containers, Strings, Engine Configuration, Resources and the File System, File System, The Resource Manager, The Game Loop and Real-Time Simulation, The Rendering Loop, The Game Loop, Game Loop Architectural Styles.

UNIT-IV: Human Interface Devices, Types of Human Interface Devices, Interfacing with a HID, Types of Inputs, Types of Outputs, Game Engine HID Systems, Tools for Debugging and Development, Logging and Tracing, Debug Drawing Facilities, In-Game Menus & Console, Debug Cameras and Pausing the Game, Cheats, Screenshots and Movie Capture, In-Game Profiling.

UNIT-V: The Rendering Engine, Animation system: types, poses skeleton, clips, post processing, Action state machine, Rigid body dynamics, Mathematics of Sound and Audio engine architectures, Data driven game engine.

Reference Books:

1. Jun Tanimoto, Fundamentals of evolutionary game theory and its applications Fundamentals of evolutionary game theory and its applications, Vol-6, Springer.
2. Jason Gregory, The Game Engine Architecture, 3rd edition CRC press, Tylor & Francis group.
3. David H. Eberly, 3D Game Engine Architecture Engineering Real-Time Applications with Wild Magic, Magic Software, Inc.

Course Outcomes [After undergoing the course, students will be able to:]

- To Structure of Game Theory and Game engine and various tools.
- Understand fundamentals of software engineering form games and 3D maths for game.
- To understand Engine system and game loop and real time simulation.
- To study Human interface device, Cameras and pausing of games.
- To provide a knowledge rendering engine, Action state machine, rigid body dynamics, Mathematics of Sound and audio engine architecture.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (VIII Sem)**	Branch: **Artificial Intelligence and Machine Learning**
Subject: **Multimedia and Computer Vision** ***(Professional Elective–IV)***	Course Code: **D109832(022)**
Total / Minimum-Pass Marks (End Semester Exam): 100 / 35	**L: 2 T: 1 P: 0** Credits: **3**
Class Tests & Assignments to be conducted: **2 each**	**Duration (End Semester Exam): 03 Hours**

Course Objective:

- To understand the fundamental issues and problems in the representation, manipulation, and delivery of multimedia content particularly in a networked environment.
- To understand the concepts of multimedia components.
- To understand the basic concepts of Computer vision.

UNIT-I: Introduction

Concept of Multimedia, media & data stream, Main properties of multimedia system, Data stream characteristics of continuous evolution. media, multimedia Applications, Hardware and software requirements, Multimedia Products & its evolution.

UNIT-II: Components of Multimedia

Text, Basic sound concepts, MIDI, Speech, Basic concept of Images, Graphics format, Overview of image processing, Basic concepts of Video & animation, Conventional system, Transmission, Enhanced system, High Definition system, Computer based animation, Design & authoring Tools, Categories of Authority Tools, Types of products.

UNIT-III: Data Compression

Coding requirement, Source, entropy, hybrid coding, JPEG, MPEG, Text compression using static Huffmann technique, Dynamic Huffmann Technique, Statistical coding techniques.

UNIT-IV: Optical Storage Media

Videodisk and other WORMS, Compact Disk digital audio, Advantage of CD-DA Frames tracks blocks of CD-DA, CD-ROM, and Further CD-ROM based developments, Principles of CDWO, Prospects of CD technologies.

UNIT-V: Introduction to Computer Vision

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis, feature detection, image classification.

Text Books:

1. Multimedia System Design, Andleigh and Thakarar, PHI, 2003.
2. Multimedia Technology & Application, David Hillman, Galgotia Publications.
3. Computer Vision: A modern approach, Forsyth & Ponce, 2nd Ed., Pearson 2011.

Reference Books:

1. Multimedia Computing Communication and Application, Steinmetz, Pearson Edn.
2. Fundamentals of Computer Graphics and Multimedia, D.P. Mukherjee, PHI.

Course Outcomes : After completion of this course the students will be able to:

- To know the fundamental video, audio, image, text processing techniques.
- Acquire the basic skill of designing video compression, audio compression, image compression, text compression.
- To know the basic techniques in designing video transmission systems: error control and rate control.
- To identify basic concepts, terminology, theories, models and methods in the field of computer vision.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (VIII Sem)**	Branch: **Artificial Intelligence and Machine Learning**
Subject: **Digital Image Processing** ***(Professional Elective–IV)***	Course Code: **D109833(022)**
Total / Minimum-Pass Marks (End Semester Exam): 100 / 35	**L: 2 T: 1 P: 0** Credits: **3**
Class Tests & Assignments to be conducted: **2 each**	**Duration (End Semester Exam): 03 Hours**

Course Objectives:

- To understand the basics of the human visual system as they relate to image processing including spatial frequency resolution and brightness adaptation.
- To teach the students about various image enhancement techniques and transformation of images.
- To have an illustrative idea about various edge detection techniques and the need of thresholding and types of thresholding techniques.
- To have a brief idea about approaches to restoration and image compressions.

UNIT–I: Introduction to Image Processing: Applications and Fields of Image Processing, Fundamental steps in Digital Image Processing, Elements of Visual Perception, Image Sensing and Acquisition, Basic Concepts in Sampling and Quantization, Representing Digital Images.

UNIT–II: Image Enhancement in the Spatial Domain: Some basic gray level Transformations, Histogram Processing, Histogram Modification, Image Subtraction, Spatial Filtering, Sharpening Spatial Filters, Use of First and Second Derivatives for Enhancement, Image Enhancement in the Frequency Domain, Gaussian Filters, Homomorphic Filtering, Pseudo colouring: Intensity Slicing, Gray level to Color Transformation.

UNIT–III: Image Segmentation: Some Basic Relationships between Pixels, Point, Line and Edge Detection, Gradient Operators, Canny Edge Detection, Pyramid Edge Detection, Edge Linking and Boundary Detection, Hough Transform, Chain Codes, Boundary Segments, Skeletons, Boundary Descriptors, Fourier Descriptors.

UNIT–IV: Thresholding: The Role of Illumination, Global Thresholding, Adaptive Thresholding, Use of Boundary Characteristics for Histogram Improvement and Local Thresholding, Region based Segmentation, Region Growing, Region Splitting and Merging.

UNIT–V: Image Restoration: Degradation Model, Restoration in Spatial Domain, Geometric Transformation, Spatial Transformation, Approach to Restoration, Inverse & Wiener Filtering, Image Compression: Basics of Image Compression. Text Books: 1. Digital Image Processing by Gonzalez &Woods, Pearson Education. 2. Introduction to Digital Image Processing by Alasdair Mc Andrew, Cengagelearning. 3. Fundamental of Digital Image Processing by A K Jain, PHI.

Text Book:

1. Digital Image Processing by Madhuri A. Joshi, PHI

Reference Books:

1. Image Processing, Analysis and Machine Vision by Milan Sonka, Thomson Learning.
2. Digital Image Processing by Pratt W.K, John Wiley & Sons.

Course Outcomes:

- Students will understand how images are represented; understand image types such as binary images, gray-scale images, color and multi-spectral images.
- Emphasis will be to develop engineering skills and intuitive understanding of the tools used in Image Processing.
- Students will be able to do various operations on images like Image enhancement, transformation, sharpening etc.
- Students can analyze various edge detection techniques and their algorithms.
- Students will be able to use various thresholding techniques and segmentations. 6. Students will be able to visualize approaches used in image restoration.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (VIII Sem)**	Branch: **Artificial Intelligence and Machine Learning**
Subject: **Augmented and Virtual Reality** ***(Professional Elective–IV)***	Course Code: **D109834(022)**
Total / Minimum-Pass Marks (End Semester Exam): 100 / 35	**L: 2 T: 1 P: 0** Credits: **3**
Class Tests & Assignments to be conducted: **2 each**	**Duration (End Semester Exam): 03 Hours**

Course Objectives:

- The objective of this course is to provide a foundation to the fast growing field of AR and make the students aware of the various AR devices.

UNIT-I: Introduction to Augmented Reality: Defining augmented reality, history of augmented reality, The Relationship Between Augmented Reality and Other Technologies-Media, Technologies, Other Ideas Related to the Spectrum Between Real and Virtual Worlds, applications of augmented reality. Concepts Related to Augmented Reality, Ingredients of an Augmented Reality Experience.

UNIT-II: Augmented Reality Hardware: Augmented Reality Hardware – Displays – Audio Displays, Haptic Displays, Visual Displays, Other sensory displays, Visual Perception, Requirements and Characteristics, Spatial Display Model. Processors – Role of Processors, Processor System Architecture, Processor Specifications. Tracking& Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.

UNIT-III: Computer Vision for Augmented Reality & A.R. Software: Computer Vision for Augmented Reality-Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking Augmented Reality Software - Introduction, Major Software Components Application for Augmented Reality Systems, Software used to Create Content for the Augmented Reality

UNIT-IV: AR Techniques- Marker based & Markerless tracking: Marker-based approach- Introduction to marker-based tracking, types of markers, marker camera pose and identification, visual tracking, mathematical representation of matrix multiplication Marker types- Template markers, 2D barcode markers, imperceptible markers. Marker-less approach- Localization based augmentation, real world examples Tracking methods- Visual tracking, feature based tracking, hybrid tracking, and initialisation and recovery.

UNIT-V: AR Devices & Components: AR Components – Scene Generator, Tracking system, monitoring system, display, Game scene AR Devices – Optical See- Through HMD, Virtual retinal systems, Monitor bases systems, Projection displays, Video see-through systems. Introduction to mixed reality, Applications of mixed reality, Input and Output in Mixed reality, Computer Vision and Mixed Reality, simultaneous localization and mapping (SLAM).

Text Books:

1. Allan Fowler-AR Game Development, 1st Edition, A press Publications, 2018, ISBN 978-1484236178
2. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First
1. edition (12 October 2016),ISBN-10: 9332578494

Reference Books:

1. Designing for Mixed Reality, Kharis O'Connell Published by O'Reilly Media, Inc., 2016, I
2. Sanni Siltanen- Theory and applications of marker-based augmented reality. Julkaisija – Utgivare Publisher. 2012.

Course Outcomes [After undergoing the course, students will be able to:]

- Describe how AR systems work and list the applications of AR.
- Understand and analyse the hardware requirement of AR.
- Use computer vision concepts for AR and describe AR techniques.
- Analyse and understand the working of various state of the art AR devices.
- Acquire knowledge of mixed reality.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (VIII Sem)**	Branch: **Artificial Intelligence and Machine Learning**
Subject: **Web Development Using Full Stack (Lab)**	Course Code: **D109821(022)**
Total / Minimum-Pass Marks (End Semester Exam): 40 / 20	**L: 0 T: 0 P: 2** Credits: **1**

Lab Objectives:

- Systematic Introduction to Web Designing
- Getting familiar with the front and back end tools
- Creating applications using HTML, CSS, Javascript
- Implementing various applications using JQuery
- Creating Websites

List of Programs:

1. Write a program to create a simple webpage using HTML.
2. Write a program to create a website using HTML CSS and JavaScript.
3. Write a program to build a Chat module using HTML CSS and JavaScript.
4. Write a program to create a simple calculator Application using React JS
5. Write a program to create a voting application using React JS.
6. Write a program to create and Build a Password Strength Check using Jquery.
7. Write a program to create and Build a star rating system using Jquery.
8. Create a Simple Login form using React JS.
9. Create a blog using React JS Using the CMS users must be able to design a web page using the drag and drop method. Users should be able to add textual or media content into placeholders that are attached to locations on the web page using drag and drop method.
10. Create a project on Grocery delivery application Assume this project is for a huge online departmental store. Assume that they have a myriad of grocery items at their godown. All items must be listed on the website, along with their quantities and prices. Users must be able to sign up and purchase groceries. The system should present him with delivery slot options, and the user must be able to choose his preferred slot. Users must then be taken to the payment page where he makes the payment with his favourite method.
11. Connecting our TODO React JS Project with Firebase.

Lab Outcomes:
Students will be able to understand:

- Usage of various front and back end Tools.
- They can understand and create applications on their own.
- Demonstrate and Designing of Websites can be carried out.
- Develop web based application using suitable client side and server side code.
- Implement web based application using effective database access.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Program / Semester: **B.Tech (VIII Sem)**	Branch: **Artificial Intelligence and Machine Learning**
Subject: **Advance AI (Lab) / Linux (Lab)**	Course Code: **D109822(022)**
Total / Minimum-Pass Marks (End Semester Exam): 40 / 20	**L: 0 T: 0 P: 2** Credits: **1**

List of Experiments (to be conducted in python):

1. Write a program to solve constraint satisfaction problems.
2. To Implement Mini-max algorithm for game playing.
3. Write a program to implement simple Chat bot.
4. To implement Naïve Bayes Models.
5. Write a program to Implement of Towers of Hanoi Problem.
6. Write a Program to Implement Breadth First Search.
7. Write a Program to Implement Depth First Search.
8. Write a program to implement Hill Climbing Algorithm.
9. Write a program to implement A* Algorithm.
10. Write a program to implement Tic-Tac-Toe game.
11. Write a program to implement Water Jug Problem.