



**Vivekanand Education Society's  
College of Arts, Science and Commerce (Autonomous)  
Sindhi Society, Chembur, Mumbai, Maharashtra - 400 071.**

**Accredited by NAAC "A Grade" in 3<sup>rd</sup> Cycle-2017**

**Best College Award- Urban Area, University of  
Mumbai (2012-13) Recipient of FIST Grant  
(DST) and STAR College Grant (DBT)**

**Credit Based System for Holistic Development Syllabus**

**for**

**T. Y. B. Sc. Artificial Intelligence**

**Undergraduate Programme**

**As per NEP 2020**

**With effect from academic year 2026-27**

**VES COLLEGE OF ARTS, SCIENCE AND COMMERCE**

**BSC (ARTIFICIAL INTELLIGENCE)**

**THIRD YEAR SYLLABUS (2025-2026)**

**SEMESTER FIVE**

| Course  | Sem | Course Code | Sr. No. | Name of Course                                                | Type of Course | Credit    | Subject Type | External Exam Marks | Internal Exam Symbols | Total Marks |
|---------|-----|-------------|---------|---------------------------------------------------------------|----------------|-----------|--------------|---------------------|-----------------------|-------------|
| BSc- AI | V   |             | 1       | AI In Autonomous System                                       | MAJOR          | 4         | THEORY       | 60                  | 40                    | 100         |
|         | V   |             | 2       | AI in Geoinformatics                                          | MAJOR          | 4         | THEORY       | 60                  | 40                    | 100         |
|         | V   |             | 3       | Practical of (AI in Autonomous System + AI in Geoinformatics) | MAJOR          | 2         | PRACTICAL    | -                   | 50                    | 50          |
|         | V   |             | 4       | Deep Learning and Its Applications                            | MAJOR ELECTIVE | 4         | THEORY       | 60                  | 40                    | 100         |
|         | V   |             | 5       | AI based Image Detection                                      | MAJOR ELECTIVE | 4         | THEORY       | 60                  | 40                    | 100         |
|         | V   |             | 6       | Cloud Computing in Data science                               | MINOR          | 2         | THEORY       | 30                  | 20                    | 50          |
|         | V   |             | 7       | Cloud Computing in Data science                               | MINOR          | 2         | PRACTICAL    | -                   | 50                    | 50          |
|         | V   |             | 8       | Random Variables                                              | VSC            | 2         | THEORY       | 30                  | 20                    | 50          |
|         | V   |             | 9       | Community Engagement Programme (CEP)/FP/OJT                   | FP/CEP         | 2         |              | -                   | 50                    | 50          |
|         |     |             |         |                                                               |                | <b>22</b> |              |                     |                       |             |

**VES COLLEGE OF ARTS, SCIENCE AND COMMERCE**

**BSC (ARTIFICIAL INTELLIGENCE)**

**THIRD YEAR SYLLABUS (2026-2027)**

**SEMESTER SIX**

| Course  | Sem | Cour<br>se<br>Code | Sr.<br>No. | Name of Course                                                                        | Type of<br>Course | Credit | Subject<br>Type | External<br>Exam<br>Marks | Internal<br>Exam<br>Symbol<br>s | Total<br>Marks |
|---------|-----|--------------------|------------|---------------------------------------------------------------------------------------|-------------------|--------|-----------------|---------------------------|---------------------------------|----------------|
| BSc- AI | VI  |                    | 1          | AI in Information Security & Cyber Security                                           | MAJOR             | 4      | THEORY          | 60                        | 40                              | 100            |
|         | VI  |                    | 2          | Computer Vision for AI                                                                | MAJOR             | 4      | THEORY          | 60                        | 40                              | 100            |
|         | VI  |                    | 3          | Practical of (AI in Information Security & Cyber Security and Computer Vision for AI) | MAJOR             | 2      | PRACTICAL       | -                         | 50                              | 50             |
|         | VI  |                    | 4          | Block Chain                                                                           | MAJOR ELECTIVE    | 4      | THEORY          | 60                        | 40                              | 100            |
|         | VI  |                    | 5          | Natural language Processing (NLP)                                                     | MAJOR ELECTIVE    | 4      | THEORY          | 60                        | 40                              | 100            |
|         | VI  |                    | 6          | Big Data Analytics                                                                    | MINOR             | 2      | THEORY          | 30                        | 20                              | 50             |
|         | VI  |                    | 7          | Big Data Analytics                                                                    | MINOR             | 2      | PRACTICAL       | -                         | 50                              | 50             |
|         | VI  |                    | 8          | On Job Training (OJT)                                                                 | OJT               | 4      | PRACTICAL       | -                         | 50                              | 50             |

|  |  |  |  |  |  |    |  |  |  |  |
|--|--|--|--|--|--|----|--|--|--|--|
|  |  |  |  |  |  | 22 |  |  |  |  |
|--|--|--|--|--|--|----|--|--|--|--|

# **SEMESTER**

# **FIVE**

**T. Y. B. Sc. Artificial Intelligence**

**SEMESTER V**

**Major / Core Course- I**

**COURSE TITLE: AI In Autonomous System**

**Course Code:**

**[CREDITS - 04]**

**Course Learning Objectives**

**The objective of this course is:**

The objective of the **AI in Autonomous Systems** course is to equip students with a comprehensive understanding of the integration of AI technologies in autonomous systems, focusing on key areas such as perception, decision-making, path planning, and motion control. Through a combination of theoretical concepts and hands-on experience, students will explore AI techniques like machine learning, computer vision, sensor fusion, and reinforcement learning, while also addressing ethical, legal, and safety concerns. The course prepares students to design, implement, and test AI-driven autonomous systems, with applications in domains such as self-driving cars, drones, and robotics, while anticipating future trends and challenges in the field.

**Course Learning Outcomes**

**The objective of this course is:**

**CO1:** Understand the fundamentals of autonomous systems, key concepts of perception, decision-making, and control, and their real-world applications.

**CO2:** Apply computer vision, sensor fusion, and SLAM techniques for perception and localization in autonomous systems.

**CO3:** Analyze decision-making, path planning, and motion control algorithms along with AI techniques for autonomous navigation.

**CO4:** Evaluate AI-driven drone and autonomous vehicle systems, including simulation, safety, and real-world deployment aspects.

| Module | 1. Name of Module                                                                                                                                                                                                                                                                                                    | Lectures |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1      | <b>Unit 1: Introduction to AI In Autonomous Systems.</b><br>1.1 Definition and Types of Autonomous Systems<br>1.2 Overview of Autonomous Systems<br>1.3 AI vs. Traditional Automation<br>1.4 Key Concepts in Autonomy, Perception, Decision-Making, Control<br>1.5 Applications: Drones, Self-Driving Cars, Robotics | 15       |
| 2      | <b>Unit2: Perception, Sensor Fusion, and Localization Techniques</b><br>2.1 Computer Vision Basics:                                                                                                                                                                                                                  | 15       |

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |    |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|               | <p>Object Detection (YOLO, Faster R-CNN), Semantic Segmentation (U-Net, DeepLab), Depth Estimation (Stereo Vision, LiDAR)</p> <p>2.2 Introduction to Sensor Technologies:<br/>LiDAR, RADAR, IMU, GPS, Cameras, Fusion Techniques: Kalman Filter, Extended Kalman Filter (EKF), Particle Filter, Combining Multiple Sensor Inputs for Robust Perception</p> <p>2.3 Introduction to SLAM and its Importance in Autonomous Systems</p> <p>2.4 Visual SLAM (ORB-SLAM, LSD-SLAM), LiDAR-Based SLAM (Cartographer, LOAM), GPS-Denied Navigation Techniques</p> |    |
| 3             | <p><b>Unit3:-Decision Making, Path Planning, Motion Control, and Future Trends</b></p> <p>3.1 Path Planning Algorithms:<br/>A*, Dijkstra, RRT, PRM, Behavior Planning: Finite State Machines, Decision Trees, Motion Control: PID Controller, Model Predictive Control (MPC), Trajectory Optimization</p> <p>3.2 CNNs for Object Detection and Scene Understanding, Reinforcement Learning for Autonomous Driving (DQN, PPO, SAC), Imitation Learning &amp; End-to-End Driving Models (Behavior Cloning)</p>                                             | 15 |
| 4             | <p><b>Unit4:- Drone intelligence and Autonomous mobility</b></p> <p>4.1 Drone Dynamics, Control, and AI-Powered Navigation, Swarm Intelligence in Drones and Mission Planning, Autonomous Driving Stack: Perception</p> <p>4.2 Planning, Control (Tesla, Waymo, NVIDIA)<br/>.Autonomous Driving Simulators (CARLA, AirSim, LGSVL), Safety and Explainability in AI Models, Testing &amp; Validation of AI Algorithms ,Real-World Scenarios</p>                                                                                                           | 15 |
| Referenc<br>e | <p>Textbook:</p> <ol style="list-style-type: none"> <li>1. Artificial Intelligence: A Modern Approach by Stuart Russell &amp; Peter Norvig</li> <li>2. Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms by Nikolaus Correll, Bradley Hayes</li> </ol>                                                                                                                                                                                                                                                                   |    |

|  |                                                                                                                                                                                                                     |  |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | 3. Autonomous Driving: How the Driverless Revolution will Change the World by Andreas Herrmann, Walter Brenner, and Rupert Stadler<br>4. Probabilistic Robotics by Sebastian Thrun, Wolfram Burgard, and Dieter Fox |  |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

### **Modality of Assessment**

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40 marks in the first part & by conducting the Semester End Examinations with 60 marks in the second part.

Students will have to score 40% of marks in the Internal Assessment as well as Semester End Examination to pass the course.

**Internal Assessment:** It is defined as the assessment of the learners on the basis of internal evaluation as envisaged in the Credit & Choice Based System by way of participation of learners in various academic and correlated activities in the given semester of the programme.

**Semester End Assessment:** It is defined as the assessment of the learners on the basis of Performance in the semester end Theory/ Written examination.

The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

### **Evaluation Pattern**

**Evaluation Pattern Credits -4**

**Continuous Internal Evaluation Out of 40 marks**

**Semester End Evaluation Out of 60 marks**

**Total Marks 100 marks**

#### **Continuous Internal Evaluation**

- **Class Test: 20 marks**
- **Assignment / Group presentation /Quiz/Project/Role play/Environmental skits/Viva-voce : 20 marks**



## Question Paper Pattern

Maximum Marks: 60

Questions to be set: 04

Duration: 120 mins

Note: All questions are compulsory carrying 10 marks each.

| Q. No. | Particulars                                                    | Marks                      |
|--------|----------------------------------------------------------------|----------------------------|
| 1      | Answer the Following (Any Three)<br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| 2      | Answer the Following (Any Three)<br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| 3      | Answer the Following (Any Three)<br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |

|       |                                  |    |
|-------|----------------------------------|----|
| 4     | Answer the Following (Any Three) |    |
|       | A.                               | 05 |
|       | B.                               | 05 |
|       | C.                               | 05 |
|       | D.                               | 05 |
|       | E.                               | 05 |
| Total |                                  | 60 |

**T. Y. B. Sc. Artificial Intelligence**

**SEMESTER V**

**Major / Core Course**

**COURSE TITLE: AI In Geoinformatics**

**CREDITS [04]**

**Course Learning Objective**

**The objective of this course is:**

This course aims to introduce students to the fundamentals of **Geoinformatics and Artificial Intelligence (AI)** by focusing on how spatial data, remote sensing, GIS, and GPS technologies can be integrated with AI and machine learning techniques. Students will gain practical knowledge in handling geospatial data, performing image analysis, and developing predictive models while exploring real-world applications in areas such as urban planning, agriculture, environmental monitoring, and disaster management. By the end of the course, students will acquire foundational skills to effectively apply geospatial AI tools for problem-solving and informed decision-making across diverse domains.

**Course Learning Outcomes**

- 1.Explain the fundamental concepts of Geoinformatics, including GIS, remote sensing, GPS, and spatial data types..
- 2.Use geospatial tools and techniques to collect, visualize, and analyze spatial data for real-world applications.
- 3.Apply AI and machine learning methods such as classification, clustering, and deep learning to geospatial datasets.
- 4.Integrate and interpret multi source spatial data (e.g., satellite imagery, GPS, sensor data) for decision-making in fields like urban planning, agriculture, and disaster management.
- 5.Evaluate ethical and legal aspects related to geospatial data use, and present practical solutions through case studies and projects.

| Module | Name of Module                                              | Lectures |
|--------|-------------------------------------------------------------|----------|
| 1      | <b>1.Introduction to Geoinformatics and AI Fundamentals</b> | 15       |
|        | <b>1.1 Geoinformatics Overview:-</b>                        |          |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |    |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|   | <p>Introduction to GIS, Remote Sensing, GPS, and Spatial Data, Applications in urban planning, agriculture, and disaster management</p> <p><b>1.2 Remote Sensing Basics:</b> Types of remote sensing: satellite, UAV, aerial, Image interpretation and classification techniques.</p> <p><b>1.3 GIS Fundamentals:</b> Spatial data models (vector, raster), Geospatial data management and analysis tools.</p> <p><b>1.4 AI and Machine Learning Basics:</b> Overview of AI: History, types of AI, Key AI concepts: Supervised vs. unsupervised learning, regression, classification.</p> <p><b>1.5 Data Preprocessing:</b> Handling spatial data, missing data, normalization, Feature extraction from geospatial datasets.</p>                                                                                                                                                                                                                                                        |    |
| 2 | <p><b>AI Applications in Geospatial Data</b></p> <p><b>2.1 Machine Learning in Geospatial Data:</b> Supervised learning for spatial data: Regression, classification, Unsupervised learning: Clustering (K-means, DBSCAN) for spatial data patterns.</p> <p><b>2.2 Deep Learning for Geospatial Analysis:</b> Convolutional Neural Networks (CNNs) for image classification in remote sensing, Object detection and segmentation for land cover mapping.</p> <p><b>2.3 Geospatial Data Fusion:</b> Integrating satellite, sensor, and GPS data, Combining spatial datasets for enhanced decision-making.</p> <p><b>2.4 Spatial Data Analysis and Prediction:</b> Predictive modeling: Land use change, urban growth, Time-series forecasting for environmental monitoring (e.g., climate change, deforestation).</p> <p><b>2.5 Advanced Remote Sensing Techniques:</b> Change detection and land cover classification, AI for monitoring vegetation, water bodies, and urban areas.</p> | 15 |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |    |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 3 | <p><b>Geospatial Data Processing and Management</b></p> <p><b>3.1 Geospatial Data Types and Sources:-</b>Introduction to raster and vector data models,Common data sources: satellite imagery, GPS, drones (UAVs), sensors,Overview of spatial data collection platforms and open datasets</p> <p><b>3.2 Spatial Data Formats and Coordinate System:-</b>Key geospatial formats: Shapefile, GeoTIFF, KML, CSV with coordinates,Understanding geographic and projected coordinate systems (e.g., WGS 84, UTM),Importance of projections and map alignment in GIS</p> <p><b>3.3 Data Preprocessing and Cleaning:-</b>Handling missing or inconsistent spatial data,Reprojection, clipping, merging layers for spatial consistency,Normalization and basic feature extraction using QGIS/Python tools</p> <p><b>3.4 Attribute and Spatial Data Management:-</b>Managing attribute tables: editing fields, joins, and filtering data,Linking external data (e.g., CSV) with spatial layers,Data cleaning: removing duplicates, fixing geometries, standardizing formats.</p> <p><b>3.5 Basic Spatial Analysis Techniques:-</b>Performing buffer, intersection, and overlay analysis,Use cases: proximity analysis, land suitability, hazard mapping,Introduction to spatial queries using tools like QGIS (optional mention of PostGIS for concept awareness)</p> | 15 |
| 4 | <p><b>Advanced Geoinformatics Applications and Emerging Trends</b></p> <p><b>4.1 AI in Environmental Monitoring and Disaster Management:</b> AI for environmental monitoring: Deforestation, pollution tracking,Early warning systems: Floods, wildfires, earthquakes.</p> <p><b>4.2 Smart Cities and Urban Planning with AI:</b> Geospatial AI for traffic optimization, resource management,Urban growth prediction and infrastructure planning using AI.</p> <p><b>4.3 AI in Agriculture and Precision Farming:</b> Remote sensing for crop monitoring and yield prediction,AI-driven solutions for irrigation and pest control.</p> <p><b>4.4 Autonomous Vehicles and Geospatial Data:</b> AI and geospatial data for autonomous navigation (e.g., UAVs, self-</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 15 |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|           | <p>driving cars),Application of spatial data in real-time vehicle routing and logistics.</p> <p><b>4.5 Emerging Trends and Future Directions:</b> Geospatial Big Data: AI techniques for large-scale geospatial data analysis,Blockchain and AI for data security and integrity in geospatial systems,Quantum computing in geospatial AI applications.</p> <p><b>4.6 Ethics and Legal Issues in Geoinformatics:</b> Privacy concerns in geospatial data collection,Legal issues: Data ownership and regulations in geospatial AI applications.</p> |  |
| Reference | <p>Textbook:</p> <ol style="list-style-type: none"> <li>1. <b>Geographic Information Systems and Science</b> by Paul A. Longley, Michael Goodchild, David J. Maguire, and David W. Rhind</li> <li>2. <b>Remote Sensing and Image Interpretation</b> by Thomas M. Lillesand and Ralph W. Kiefer</li> <li>3. <b>Introduction to Machine Learning with Python</b> by Andreas C. Müller and Sarah Guido</li> <li>4. <b>GIS Fundamentals: A First Text on Geographic Information Systems</b> by Paul Bolstad</li> </ol>                                 |  |

### Modality of Assessment

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40 marks in the first part & by conducting the Semester End Examinations with 60 marks in the second part.

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**Evaluation Pattern Credits -4**

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### **Question Paper Pattern**

Maximum Marks: 60

Questions to be set: 04

Duration: 120 mins

Note: All questions are compulsory carrying 10 marks each.

| <b>Q. No.</b> | <b>Particulars</b>                                                                        | <b>Marks</b>                                                                  |
|---------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| <b>1</b>      | <b>Answer the Following (Any Three)</b><br><br>A.<br><br>B.<br><br>C.<br><br>D.<br><br>E. | <b>05</b><br><br><b>05</b><br><br><b>05</b><br><br><b>05</b><br><br><b>05</b> |

|              |                                                                       |                            |
|--------------|-----------------------------------------------------------------------|----------------------------|
| 2            | <b>Answer the Following (Any Three)</b><br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| 3            | <b>Answer the Following (Any Three)</b><br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| 4            | <b>Answer the Following (Any Three)</b><br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| <b>Total</b> |                                                                       | <b>60</b>                  |

**T. Y. B. Sc. Artificial Intelligence**

**SEMESTER V**

**Major / Core Course III**

**COURSE TITLE: Practical of AI In Autonomous Systems and AI In Geinformatics**

**CREDITS [02]**

| <b>Course Code</b> | <b>Course Title</b>                         |
|--------------------|---------------------------------------------|
|                    | <b>Practical of AI in Autonomous System</b> |
| <b>1</b>           | Basic Object Detection with OpenCV          |

|    |                                                            |
|----|------------------------------------------------------------|
| 2  | Path Planning using A Algorithm in a Grid Environment      |
| 3  | Camera Calibration and Depth Estimation with Stereo Images |
| 4  | Basic PID Controller for Simple Robotics Movement          |
| 5  | Implementing a Basic Kalman Filter for Object Tracking     |
| 6  | Simulating Autonomous Car Navigation in a 2D Environment   |
| 7  | Using LiDAR Data for Basic Mapping in ROS                  |
| 8  | Building a Simple Visual SLAM System with OpenCV           |
| 9  | Simulating Path Planning using Dijkstra's Algorithm        |
| 10 | Sensor Fusion with GPS and IMU for Localization in ROS     |
| 11 | Basic Reinforcement Learning for Simple Navigation Task    |
| 12 | Drone Path Following using Basic Control Algorithms        |

| Course Code | Course Title                                                                                                                                                                                    |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <b>Practical of AI in Geo-Informatics</b>                                                                                                                                                       |
| 1           | Implement Basic GIS and Mapping<br>Understand the fundamentals of GIS and create a simple map using tools like QGIS. Use any other GIS software available as an alternative.                    |
| 2           | Explore Satellite Imagery for Land Use Analysis<br>View and analyze different types of land use using satellite imagery on Google Earth. Other online satellite imagery tools may also be used. |



|           |                                                                                                                                                                                                                                                                       |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>3</b>  | <p>Collect and Plot GPS Data Using Mobile Devices</p> <p>Collect your own location data using a mobile GPS app like GPS Essentials, and visualize it with Google My Maps. You may use any other GPS tracking or mapping apps available.</p>                           |
| <b>4</b>  | <p>Perform Vector and Raster Data Exploration</p> <p>Understand and analyze the differences between vector and raster data formats using QGIS. Alternative GIS tools can also be used for data exploration.</p>                                                       |
| <b>5</b>  | <p>Apply Visual Land Use Classification Techniques</p> <p>Visually classify land use types (urban, water, vegetation, etc.) using satellite images in Google Earth or QGIS. You may use any other satellite imagery viewer.</p>                                       |
| <b>6</b>  | <p>Conduct Image Classification Using QGIS Plugin</p> <p>Perform basic supervised classification (2–3 classes) on satellite imagery using the Semi-Automatic Classification Plugin (SCP) in QGIS. Other semi-automatic classification tools can also be explored.</p> |
| <b>7</b>  | <p>Prepare and Normalize Geospatial Data</p> <p>Clean and normalize geospatial attribute data using Microsoft Excel or Google Sheets. Any spreadsheet software may be used.</p>                                                                                       |
| <b>8</b>  | <p>Introduce Image Classification with Pre-trained Machine Learning Models</p> <p>Experiment with basic image classification using pre-trained ML tools such as Teachable Machine (by Google). Other beginner-friendly ML tools are welcome.</p>                      |
| <b>9</b>  | <p>Visualize Clusters of Spatial Points</p> <p>Perform spatial clustering and visualize point data clusters using QGIS. Other mapping or spatial analysis tools may also be used.</p>                                                                                 |
| <b>10</b> | <p>Detect Urban Growth through Visual Comparison</p> <p>Compare historical and recent satellite images to detect urban growth changes using Google Earth. Any other satellite imagery comparison tools can be used.</p>                                               |
| <b>11</b> | <p>Monitor Crops Using NDVI Analysis</p> <p>Analyze vegetation health using NDVI (Normalized Difference Vegetation Index) through QGIS or online tools like Sentinel Hub EO Browser. Alternative remote sensing platforms can be explored.</p>                        |
| <b>12</b> | <p>Case Study: Geospatial AI for Urban Flood Risk Assessment. Apply geoinformatics and AI techniques to assess flood-prone areas in a city using Tools: QGIS, satellite imagery (e.g., from Sentinel Hub), elevation data (DEM).</p>                                  |

**T. Y. B. Sc. Artificial Intelligence**

**SEMESTER V**

**Major Elective I**

**COURSE TITLE: Deep Learning and Its Applications**

**COURSE CODE:**

**[CREDITS - 04]**

**Course Learning Objective**

The objective of this course is to provide a comprehensive understanding of deep learning concepts, including Artificial Neural Networks (ANNs) and optimization techniques, and to enable students to implement various neural network architectures such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs). The course further aims to develop the ability to analyze advanced deep learning models including transformers and Generative Adversarial Networks (GANs), and apply them to real-world problems in domains like Computer Vision (CV) and Natural Language Processing (NLP). Additionally, it emphasizes exploring practical case studies and understanding ethical considerations in AI systems.

**Course Learning Outcome**

**CO1:** Understand fundamentals of deep learning, neural networks, and optimization techniques.

**CO2:** Apply CNNs, RNNs, transformers, and generative models for AI tasks.

**CO3:** Analyze applications of AI in computer vision and NLP.

**CO4:** Evaluate real-world AI applications and ethical issues in deep learning.

| Module | Name of Module                                                                                                                                                                                                                                                                                                                                                                                                      | Lectures |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1      | <b>Unit - I: Introduction to Deep Learning and Neural Networks</b><br><br>1.1 Fundamentals of Deep Learning : History and Evolution, Differences Between Machine Learning (ML) and Deep Learning (DL)<br><br>1.2 Artificial Neural Networks (ANNs) : Neurons and Activation Functions, Feedforward Networks<br><br>1.3 Backpropagation and Optimization : Gradient Descent, Learning Rate Schedulers, Adam, RMSprop | 15       |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |    |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|           | <p>1.4 Loss Functions and Regularization : Cross-Entropy, Mean Squared Error (MSE), L1/L2 Regularization, Dropout</p> <p>1.5 Deep Learning Frameworks : Basics of TensorFlow, PyTorch, Keras</p>                                                                                                                                                                                                                                                                                                                                                                                                                |    |
| 2         | <p><b>Unit – II: Convolutional and Recurrent Neural Networks</b></p> <p>2.1 Convolutional Neural Networks (CNNs): Filters, Pooling, CNN architecture.</p> <p>2.2 Transfer Learning with AI-powered Models: ResNet, VGG, Inception, MobileNet. Use of HuggingFace &amp; pretrained APIs.</p> <p>2.3 Recurrent Neural Networks (RNNs) and LSTM/GRUs: Time Series &amp; Sequential Modeling.</p> <p>2.4 Transformers and Attention-based Architectures: Multi-head Attention, GPT, BERT.</p> <p>2.5 Generative Models: Autoencoders, VAEs, GANs — Use of generative AI tools (e.g., DALL·E, Stable Diffusion).</p> | 15 |
| 3         | <p><b>Unit – III: Applications, AI Tools &amp; Ethical Perspectives</b></p> <p>3.1 AI in Computer Vision: Image Classification, Object Detection (YOLO), Segmentation (U-Net).</p> <p>3.2 AI in NLP: Sentiment Analysis, NER, Text Generation, Chatbots using Large Language Models (LLMs).</p>                                                                                                                                                                                                                                                                                                                 | 15 |
| 4         | <p><b>Unit – IV: AI Applications using Deep Learning</b></p> <p>4.1 AI for Reinforcement Learning: DQN, Policy Gradients with real-world applications.</p> <p>4.2 AI in the Real World: Healthcare AI (X-ray analysis), Autonomous Driving (Perception systems), Finance (Fraud Detection).</p> <p>4.3 Ethics in Deep Learning: Bias, Explainability (LIME, SHAP), Adversarial Examples, Model Interpretability.</p>                                                                                                                                                                                            | 15 |
|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |    |
| Reference | <p>Textbooks:</p> <p>Deep Learning – Ian Goodfellow, Yoshua Bengio, Aaron Courville.</p> <p>Neural Networks and Deep Learning – Michael Nielsen.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |

|           |                                                                                                                                                                                                                                                                                                                                                                                          |  |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|           | Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow – Aurélien Géron.<br><br>Deep Learning for Computer Vision – Rajalingappaa Shanmugamani.<br><br>Deep Reinforcement Learning Hands-On – Maxim Lapan.                                                                                                                                                                      |  |
| Reference | Website:<br><br>1. <a href="https://www.tensorflow.org/">https://www.tensorflow.org/</a><br>2. <a href="https://pytorch.org/">https://pytorch.org/</a><br>3. <a href="https://www.coursera.org/">https://www.coursera.org/</a><br>4. <a href="https://arxiv.org/abs/1810.04805">https://arxiv.org/abs/1810.04805</a><br>5. <a href="https://huggingface.co/">https://huggingface.co/</a> |  |

**T. Y. B. Sc. Artificial Intelligence**

**SEMESTER V**

**Major Elective Course**

**COURSE TITLE: AI based Image Detection**

**[CREDITS - 04]**

**Course Learning Objective**

The objective of this course is:

This course aims to provide students with a fundamental understanding of image processing techniques, including digital image representation, enhancement, segmentation, compression, object recognition, and specialized applications in medical and satellite imaging. Students will gain hands-on experience with image processing algorithms, OpenCV, and Python for AI-driven image analysis.

**Course Learning Outcome**

After completion of this course learner will be able to:

**CO1:** Apply fundamental concepts of digital image processing, including image acquisition, representation, and enhancement techniques, and implement basic operations using OpenCV in Python.

**CO2:** Analyze and implement image segmentation, compression, and object recognition techniques, including AI-based detection using TensorFlow and OpenCV.

**CO3:** Apply image processing and AI techniques to analyze medical images for disease detection and classification.

**CO4:** Apply satellite image processing and AI methods for land classification, disaster detection, and real-world problem-solving using Python and OpenCV.

| Module | Name of the Module                                                                                                                                                                                                                                                  | [30L] |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1      | <b>Module 1: Fundamentals of Digital Image Processing</b><br>1.1 Introduction to Digital Image Processing: Components, Image Representation, Visual Perception, and Color Models<br>1.2 Image Acquisition and Sampling: Image Types, File Formats, and Quantization | 15    |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|     | 1.3 Image Enhancement Techniques: Spatial Domain and Frequency Domain Enhancement<br>1.4 Introduction to OpenCV: Displaying and Manipulating Images Using Python<br>1.5 Case Studies: Implementing Image Enhancement Using Histogram Equalization, Smoothing, and Sharpening                                                                                                                                                                                                                                                                                                                                                                                               |    |
| 2   | <b>Module 2: Image Segmentation, Compression, and Object Recognition</b><br>2.1 Image Segmentation Techniques: Thresholding, Edge Detection, Hough Transform, Clustering, Watershed Transform<br>2.2 Image Compression: Lossless and Lossy Compression Techniques (JPEG, MPEG, Huffman Coding)<br>2.3 Object Recognition: Computer Vision, Feature Extraction, and Classification Algorithms<br>2.4 AI-Based Object Detection: TensorFlow, OpenCV for Object Tracking<br>2.5 Case Studies: Implementing Image Segmentation and Object Detection Algorithms                                                                                                                 | 15 |
| 3   | <b>Module 3: Advanced Applications of Image Processing</b><br>3.1 Medical Image Processing: MRI, CT, and X-ray Image Analysis<br>3.2 AI Applications in Healthcare Imaging: Disease Detection and Image Classification.                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 15 |
| 4   | <b>Module 4: Satellite Image Processing</b><br>4.1 Satellite Image Processing: Remote Sensing, Photogrammetry, and Multispectral Imaging<br>4.2 AI in Satellite Image Analysis: Land Classification, Disaster Detection<br>4.3 Case Studies: Implementing AI-Based Medical and Satellite Image Processing Techniques Using OpenCV and Python                                                                                                                                                                                                                                                                                                                               | 15 |
| Ref | <b>Textbooks:</b><br>1. Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, Pearson. ISBN: 978-0133356724<br>2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall. ISBN: 978-0133361650<br>3. S. Sridhar, Digital Image Processing, Oxford University Press. ISBN: 978-0199484235<br><br><b>Additional References websites:</b><br>OpenCV Documentation: <a href="https://docs.opencv.org">https://docs.opencv.org</a><br>AI-Based Medical Imaging Research: <a href="https://pubmed.ncbi.nlm.nih.gov">https://pubmed.ncbi.nlm.nih.gov</a><br>Remote Sensing and GIS: <a href="https://earthdata.nasa.gov">https://earthdata.nasa.gov</a> | '' |

### Modality of Assessment

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40 marks in the first part & by conducting the Semester End Examinations with 60 marks in the second part.

Students will have to score 40% of marks in the Internal Assessment as well as Semester End Examination to pass the course.

**Internal Assessment:** It is defined as the assessment of the learners on the basis of internal evaluation as envisaged in the Credit & Choice Based System by way of participation of learners in various academic and correlated activities in the given semester of the programme.

**Semester End Assessment:** It is defined as the assessment of the learners on the basis of Performance in the semester end Theory/ Written examination.

The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

## **Evaluation Pattern**

**Evaluation Pattern Credits -4**

**Continuous Internal Evaluation Out of 40 marks**

**Semester End Evaluation Out of 60 marks**

**Total Marks 100 marks**

### **Continuous Internal Evaluation**

- **Class Test: 20 marks**
- **Assignment / Group presentation /Quiz/Project/Role play/Environmental skits/Viva-voce : 20 marks**

### **Question Paper Pattern**

Maximum Marks: 60

Questions to be set: 04

Duration: 120 mins

Note: All questions are compulsory carrying 10 marks each.

| Q. No. | Particulars                                                    | Marks                      |
|--------|----------------------------------------------------------------|----------------------------|
| 1      | Answer the Following (Any Three)<br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| 2      | Answer the Following (Any Three)<br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| 3      | Answer the Following (Any Three)<br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| 4      | Answer the Following (Any Three)<br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| Total  |                                                                | 60                         |

**T. Y. B. Sc. Artificial Intelligence**

**SEMESTER V**

**Minor Course**

**COURSE TITLE: Cloud Computing In Data Science**

**[CREDITS - 02]**

**Course Learning Objective**

**The objective of this course is:**

To provide a comprehensive understanding of cloud computing concepts, architectures, and service models, along with virtualization techniques and deployment strategies. The course aims to develop knowledge of cloud storage systems and platforms such as OpenStack, enabling students to design, manage, and deploy scalable cloud-based solutions for modern computing and data-driven applications.

**Course Learning Outcomes**

After completion of this course learner will be able to:

**CO1:** Explain the fundamental concepts, architecture, characteristics, and service models of cloud computing, including the role of SOA and modern cloud service delivery mechanisms.

**CO2:** Analyze virtualization techniques and cloud deployment models, and evaluate their role in enabling scalable cloud infrastructures and supporting data science and machine learning applications.

**CO3:** Apply cloud storage architectures and implement cloud infrastructure solutions using OpenStack for deployment and orchestration .

| Module | Name of Module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Lectures |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1      | <p><b>Unit I – Fundamentals of Cloud Computing</b></p> <p><b>1.1 Introduction to Cloud Computing</b><br/>Definition and evolution of cloud computing; transition from mainframe computing to distributed and cloud environments; concepts of Service-Oriented Architecture (SOA), Web Services, Grid Computing, and Utility Computing.</p> <p><b>1.2 Characteristics and Benefits of Cloud Computing</b><br/>Essential characteristics such as on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service; advantages including scalability, cost efficiency, flexibility, and high availability.</p> <p><b>1.3 Cloud Computing Architecture</b><br/>Architecture of cloud computing including front-end client interface, back-end infrastructure, virtualization layer, network components, and cloud-based service delivery mechanisms.</p> <p><b>1.4 Cloud Service Models</b><br/>Overview of Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS); service provisioning</p> | 10       |



|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |    |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|   | mechanisms and continuous integration and continuous delivery (CI/CD) using PaaS platforms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |    |
| 2 | <p><b>Unit II – Virtualization and Cloud Deployment</b></p> <p>2.1 Fundamentals of Virtualization<br/>Concept and significance of virtualization in cloud computing; types of virtualization including server, storage, network, desktop, application, and data virtualization; characteristics of virtualized environments.</p> <p>2.2 Virtualization Techniques and Performance Considerations<br/>Taxonomy of virtualization techniques such as full virtualization, para-virtualization, and hardware-assisted virtualization; benefits and limitations of virtualization in distributed systems.</p> <p>2.3 Cloud Deployment Models<br/>Deployment architectures including Public Cloud, Private Cloud, Community Cloud, and Hybrid Cloud; comparison based on security, scalability, and management control.</p> <p>2.4 Role of Cloud Computing in Data Science and Machine Learning<br/>Utilization of cloud platforms for large-scale data storage, distributed processing, model training, and deployment of machine learning workflows.</p>                 | 10 |
| 3 | <p><b>Unit III – Cloud Storage and OpenStack Platforms</b></p> <p>3.1 Cloud Storage Concepts and Applications<br/>Introduction to cloud storage architecture; advantages such as scalability, reliability, and accessibility; practical applications including data backup, archiving, disaster recovery, big data processing, and content delivery networks (CDNs).</p> <p>3.2 Cloud Storage Architectures<br/>Types of storage systems used in cloud environments: block storage, file storage, and object storage; architecture, features, and use cases of each storage model.</p> <p>3.3 OpenStack Cloud Platform<br/>Introduction to OpenStack architecture and components; overview of OpenStack CLI, APIs, tenant management, resource quotas, and private cloud infrastructure building blocks.</p> <p>3.4 OpenStack Deployment and Orchestration<br/>Deployment of OpenStack services including controller, compute, networking, and block storage nodes; configuration for production environments and application orchestration using OpenStack Heat.</p> | 10 |

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|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
| Reference | Textbook:<br>11) Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi, Tata McGraw Hill Education Private Limited, 2013<br>2) OpenStack in Action, V. K. CODY BUMGARDNER, Manning Publications Co, 2016<br>3) OpenStack Essentials, Dan Radez, PACKT Publishing, 2015<br>4) OpenStack Operations Guide, Tom Fifield, Diane Fleming, Anne Gentle, Lorin Hochstein, Jonathan Proulx, Everett Toews, and Joe Topjian, O'Reilly Media, Inc., 2014 |  |
| Reference | Website:<br>1) <a href="https://www.openstack.org">https://www.openstack.org</a>                                                                                                                                                                                                                                                                                                                                                                                          |  |

### **Modality of Assessment**

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 20 marks in the first part & by conducting the Semester End Examinations with 30 marks in the second part.

Students will have to score 40% of marks in the Internal Assessment as well as Semester End Examination to pass the course.

Internal Assessment: It is defined as the assessment of the learners based on internal evaluation as envisaged in the Credit & Choice Based System by way of participation of learners in various academic and correlated activities in the given semester of the programme.

Semester End Assessment: It is defined as the assessment of the learners based on Performance in the semester end Theory/ Written examination.

The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

**Evaluation Pattern**

| <b>Evaluation Pattern</b>      | <b>Credits -2</b> |
|--------------------------------|-------------------|
| Continuous Internal Evaluation | Out of 20 marks   |
| Semester End Evaluation        | Out of 30 marks   |
| Total Marks                    | 50 marks          |

**Continuous Internal Evaluation**

**Internal 1:** Class Test: 10 marks

**Internal 2:** Assignment / Group presentation /Quiz/ Project/ Role play/  
Environmental skits/ Viva-voce/ Field reports: 10 marks

**T. Y. B. Sc. Artificial Intelligence**

**SEMESTER V**

**Minor Course**

**COURSE TITLE: Cloud Computing In Data Science (Practical)**

**[CREDITS - 02]**

|                    | <b>Practical of Cloud Computing</b>                                                           |                |
|--------------------|-----------------------------------------------------------------------------------------------|----------------|
| <b>Course Code</b> | <b>Course Title</b>                                                                           | <b>Credits</b> |
| 1                  | Program to demonstrate cloud service models (SaaS, PaaS, IaaS) using public cloud platforms   |                |
| 2                  | Write a program that calculates cost based on resource usage (CPU hours, storage, bandwidth). |                |
| 3                  | Exploring the AWS Global Infrastructure Overview                                              |                |
| 4                  | Demonstration of how to launch AWS Academy Learner Lab.                                       |                |
| 5                  | Setting up a virtual machine (VM) on AWS EC2                                                  |                |
| 6                  | Using cloud storage on Google drive                                                           |                |
| 7                  | Using cloud storage on AWS s3                                                                 |                |
| 8                  | Working on serverless Computing (AWS Lambda)                                                  |                |
| 9                  | Deploy simple website using AWS s3                                                            |                |
| 10                 | Monitoring cloud resources using CloudWatch                                                   |                |
| 11                 | Implement deletion of instances, volumes, networks, to free up resources                      |                |
| 12                 | Identification of symbols to operate cloud storage                                            |                |
| 13                 | Connecting to a cloud Database (AWS RDS)                                                      |                |
| 14                 | To Find default and paid plan storage space for various cloud services                        |                |
| 15                 | AI tools study for cloud computing                                                            |                |
| 16                 | Creating a Chatbot using DialogFlow                                                           |                |
| 17                 | Integrating chatbot into your webpage                                                         |                |
| 18                 | Connecting to a BigQuery in Google drive                                                      |                |
| 19                 | Exploring the open stack cloud with its components                                            |                |
| 20                 | Deploying OpenStack in production environments                                                |                |

**T. Y. B. Sc. Artificial Intelligence**

**SEMESTER V**

**Vocational Skill Course**

**COURSE TITLE: Random Variables**

**[CREDITS - 02]**

**Course Learning Objective**

The objective of this course is to equip learners with a strong foundation in stochastic processes and their applications in Artificial Intelligence (AI). It covers fundamental concepts such as random processes, Markov chains, ergodicity, and queueing theory, with emphasis on their mathematical properties and practical relevance in real-world systems. Through this course, learners will develop the ability to model, analyze, and apply stochastic techniques to AI-driven systems, including applications in probabilistic modeling, reinforcement learning, and performance optimization in cloud computing and resource management.

**Course Learning Outcome**

After completion of this course learner will be able to:

**CO1:** Understand stochastic processes and their applications in AI.

**CO2:** Analyze Markov chains and stochastic models for decision-making in AI.

**CO3:** Apply queueing theory and optimization techniques in AI systems.

| <b>Module</b> | <b>Name of the Module</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>[30L]</b> |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1             | <b>Module 1: Fundamentals of Stochastic and Random Processes</b><br><br>1.1 Random Processes-Introduction to Random Processes, Definitions, Examples, and Classification First & Second Order Statistics.Deterministic vs. Non-Deterministic Random Processes<br>Stationary and Evolutionary Processes,Auto-correlation and Cross-correlation Functions,Some Standard Random Processes<br><br>1.2 Poisson Process and its Properties-Mean, Variance, Autocorrelation, and Correlation Coefficients,Joint Probability Density Functions,Gaussian Random Processes<br><br>1.3 AI Applications:Probabilistic modeling in AI,Stochastic processes in deep learning,Time-series forecasting | 10           |
| 2             | <b>Module 2: Markov Chains and Stochastic Decision Processes</b><br><br>2.1 Markov Chains-Introduction and Definition,Transition Probability Matrix & Transition Diagram,Homogeneous Markov Chains,Chapman-Kolmogorov Equation,Classification of States<br>Semi-Markov Chains,Markov Processes with Continuous State Space & Time<br><br>2.2 Ergodicity and Linear Systems-Introduction to Ergodicity                                                                                                                                                                                                                                                                                  | 10           |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |    |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|     | <p>Mean-Ergodic Processes &amp; Theorems, Power Spectral Density<br/>Cross Spectral Density Functions, Systems with Stochastic Inputs<br/>Linear Time Invariant (LTI) Systems</p> <p>2.3 AI Applications:, Hidden Markov Models (HMMs) in speech &amp; NLP, Markov Decision Processes (MDPs) in reinforcement learning<br/>Time-series modeling for AI predictions</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |    |
| 3   | <p><b>Unit 3: Queueing Theory and AI Performance Optimization</b></p> <p>3.1 Queueing Theory-Introduction to Queueing Systems<br/>Performance Measures, Little's Formula &amp; Probability Relations<br/><b>M/M/1/∞, M/M/∞, M/M/1/k, M/M/s/k Systems</b></p> <p>3.2 AI Applications:, Resource allocation in AI systems, AI-driven cloud computing optimization, Queue-based reinforcement learning for system efficiency</p> <p>3.3 Optimization- Partial derivatives, Gradient, Gradient descent</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 10 |
| Ref | <p><b>Textbooks:</b><br/>T. Veerarajan, — “Probability, Statistics and Random Processes” ISBN: 978-1-25-902994-3, Tata McGraw Hill Publications.<br/>P. K. Vishwakarma, — “Probability and Random Processes” ISBN: 978-81-203-5083-7, PHI Learning Pvt. Ltd.<br/>Kanti Swarup, P. K. Gupta, Man Mohan, — “Operations Research” ISBN: 978-81-203-2989-5, Sultan Chand &amp; Sons.<br/>G. Kumbhojkar, — “Probability and Random Processes” ISBN: 978-81-92883-89-2, Nirali Prakashan.</p> <p><b>Additional References websites:</b><br/><a href="https://ocw.mit.edu/courses/mathematics/18-445-introduction-to-stochastic-processes-fall-2015/">https://ocw.mit.edu/courses/mathematics/18-445-introduction-to-stochastic-processes-fall-2015/</a><br/><a href="https://nptel.ac.in/courses/111/106/111106112/">https://nptel.ac.in/courses/111/106/111106112/</a><br/><a href="https://nptel.ac.in/courses/111/105/111105098/">https://nptel.ac.in/courses/111/105/111105098/</a><br/><a href="https://www.khanacademy.org/math/statistics-probability">https://www.khanacademy.org/math/statistics-probability</a><br/><a href="https://www.brilliant.org/courses/probability/">https://www.brilliant.org/courses/probability/</a><br/><a href="https://math.stackexchange.com/">https://math.stackexchange.com/</a><br/><a href="https://ai.stackexchange.com/">https://ai.stackexchange.com/</a></p> |    |

### Modality of Assessment

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**Evaluation Pattern**

| <b>Evaluation Pattern</b>      | <b>Credits -2</b> |
|--------------------------------|-------------------|
| Continuous Internal Evaluation | Out of 20 marks   |
| Semester End Evaluation        | Out of 30 marks   |
| Total Marks                    | 50 marks          |

**Continuous Internal Evaluation**

**Internal 1:** Class Test: 10 marks

**Internal 2:** Assignment / Group presentation /Quiz/ Project/ Role play/  
Environmental skits/ Viva-voce/ Field reports: 10 marks

# **SEMESTER SIX**



**T. Y. B. Sc. Artificial Intelligence**

**SEMESTER VI**

**Major / Core Course I**

**COURSE TITLE: AI in Information Security and Cyber Security**

**[CREDITS - 04]**

**Course Learning Objective**

The objective of this course is to provide students with an understanding of Information Security (InfoSec) and Cybersecurity so that they can protect sensitive data, prevent cyber threats, and ensure secure digital operations. The course also aims to make students aware of various security issues, risks, and technologies involved in safeguarding information systems, thereby ensuring data safety, privacy, and secure communication in digital environments.

**Course Learning Outcomes**

After completion of this course learner will be able to:

1. Classify different types of attacks which causes threat to Information Security, also understand the concept of cryptography
2. Apply user authentication and access control mechanisms on different objects, also studying the encryption and decryption techniques
3. Implement security techniques to prevent internet threats.
4. Apply different ML algorithms for cyber security

| Module | Name of Module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Lectures |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1      | <b>Unit - I Introduction to Information Security</b><br>1.1 Definition and Importance of Information security, Principles of information security.<br><br>1.2 Type of Attacks: Active and Passive attacks, Denial of Service, DDOS, Backdoors and Trapdoors, Sniffing, phishing, Spoofing, Man in the Middle, Replay, TCP/IP Hacking, Encryption attacks, Social Engineering<br><br>1.3 Types of Malwares and their impact on security and prevention:<br>- Virus, Worms, Trojan horse, Spyware, Adware, Ransomware, Logic Bombs, Rootkits, Backdoors, Keyloggers<br><br>1.4 Threat and Risk Analysis: Introduction to assets, vulnerability, threats, risks, relation between: threat, vulnerability, risks<br><br>1.5 Cryptography- Plain text, Cipher text, Cryptography, Cryptanalysis, Cryptology, Encryption, Decryption<br><br>1.6 Symmetric and Asymmetric cryptography : Introduction, working, key management, asymmetric cryptography -public key distribution<br><br>1.7 Steganography : Introduction and working of steganography | 15       |
| 2      | <b>Unit - II Authentication and Access Control</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 15       |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |    |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|   | <p>2.1 Identification and Authentication methods : Electronic user authentication, username and password, multi-factor authentication, token-based authentication, biometrics</p> <p>2.2 Guessing password, Password attacks : Piggybacking, Shoulder surfing, Dumpster diving</p> <p>2.3 Biometrics : Finger prints, Hand prints, Retina scan patterns, Voice patterns</p> <p>2.4 Authorization : Introduction to authorization, goals of authorization</p> <p>2.5 Access controls : Access control principles, Access rights and permission, Access control policies : Discretionary access control (DAC), Mandatory access control (MAC)</p> <p>2.6 Encryption Algorithms- DES (Data Encryption Standard) algorithm, AES (Advanced Encryption Standard) algorithm, RSA algorithm</p> <p>2.7 Hash Function : Introduction, Features of Hash Functions, MD5 and SHA algorithm</p> <p>2.8 Digital Signature : Introduction and working of digital signature</p> |    |
| 3 | <p><b>Unit - III Internet Security and Cyber Security</b></p> <p>3.1 Firewall : Need of firewall, Types of firewalls : Packet filters, Stateful packet filters, Application gateways, Circuit gateways</p> <p>3.2 Firewall policies, Configuration, E-mail security : Simple mail transfer protocol (SMTP), Pretty good privacy (PGP), S/MIME</p> <p>3.3 Cyber security- Definition, Importance, Cybersecurity vs. Information Security, Historical evolution of Cybersecurity</p> <p>3.4 Types of Cybersecurity Threats (Malware, Phishing, Ransomware, etc.)</p> <p>3.5 IDS and IPS</p> <p>3.6 Working of Kerberos</p>                                                                                                                                                                                                                                                                                                                                        | 15 |
| 4 | <p><b>Unit – IV AI in Cyber Security</b></p> <p>4.1 Cyber crime: Introduction, Hacking, Digital forgery, Cyber stalking/Harassment, Cyber pornography, Identity theft &amp; fraud, Cyber terrorism, Cyber defamation, OS fingerprinting</p> <p>4.2 Cyber Laws: Introduction, Need, Cybercrime Laws, Data Protection &amp; Privacy Laws, Intellectual Property (IP) Laws in Cyberspace</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 15 |

|               |                                                                                                                                                                                                                                                                                                                                                    |  |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|               | 4.3 Cyber Security requirement for AI system<br>4.4 ML algorithms for Cyber Security<br>4.5 AI Tools for Cyber Security (Darktrace, Forcepoint)                                                                                                                                                                                                    |  |
| Referenc<br>e | Textbook:<br>1)Nina Godbole,Information Systems Security Second Edition,John Wiley ISBN-13: 978-8126564057<br>2)William Stallings, Lawrie Brown,Computer Security Principles and Practice, Third Edition,Pearson. ISBN-13: 978-0-13-377392-7<br>3)V. K. Pachghare,Cryptography and Information Security,Prentice Hall India ISBN:978-81-203-5082-3 |  |

### **Modality of Assessment**

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40 marks in the first part & by conducting the Semester End Examinations with 60 marks in the second part.

Students will have to score 40% of marks in the Internal Assessment as well as Semester End Examination to pass the course.

**Internal Assessment:** It is defined as the assessment of the learners on the basis of internal evaluation as envisaged in the Credit & Choice Based System by way of participation of learners in various academic and correlated activities in the given semester of the programme.

**Semester End Assessment:** It is defined as the assessment of the learners on the basis of Performance in the semester end Theory/ Written examination.

The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

### **Evaluation Pattern**

**Evaluation Pattern Credits -4**

**Continuous Internal Evaluation Out of 40 marks**

**Semester End Evaluation Out of 60 marks**

**Total Marks 100 marks**

**Continuous Internal Evaluation**

- **Class Test: 20 marks**
- **Assignment / Group presentation /Quiz/Project/Role play/Environmental skits/Viva-voce : 20 marks**

**Question Paper Pattern**

Maximum Marks: 60

Questions to be set: 04

Duration: 120 mins

Note: All questions are compulsory carrying 10 marks each.

| <b>Q. No.</b> | <b>Particulars</b>                                                                        | <b>Marks</b>                                                                  |
|---------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| <b>1</b>      | <b>Answer the Following (Any Three)</b><br><br>A.<br><br>B.<br><br>C.<br><br>D.<br><br>E. | <b>05</b><br><br><b>05</b><br><br><b>05</b><br><br><b>05</b><br><br><b>05</b> |
| <b>2</b>      | <b>Answer the Following (Any Three)</b><br><br>A.<br><br>B.<br><br>C.<br><br>D.<br><br>E. | <b>05</b><br><br><b>05</b><br><br><b>05</b><br><br><b>05</b><br><br><b>05</b> |

|       |                                  |    |
|-------|----------------------------------|----|
| 3     | Answer the Following (Any Three) |    |
|       | A.                               | 05 |
|       | B.                               | 05 |
|       | C.                               | 05 |
|       | D.                               | 05 |
|       | E.                               | 05 |
| 4     | Answer the Following (Any Three) |    |
|       | A.                               | 05 |
|       | B.                               | 05 |
|       | C.                               | 05 |
|       | D.                               | 05 |
|       | E.                               | 05 |
| Total |                                  | 60 |

**T. Y. B. Sc. Artificial Intelligence**

**SEMESTER VI**

**Major / Core Course II**

**COURSE TITLE: Computer Vision for AI**

**[CREDITS - 04]**

### **Course Learning Objective**

The objective of this course is:

This course aims to equip learners with a fundamental understanding of computer vision and image processing techniques, including concepts such as feature extraction, image segmentation, motion analysis, and deep learning-based vision models. By the end of the course, learners will be able to implement computer vision algorithms, analyze image data, and develop AI-driven applications in areas such as object detection, image recognition, and image enhancement.

### **Course Learning Outcome**

After completion of this course learner will be able to:

1. Explain, analyze, and implement fundamental concepts of computer vision, including image representation, enhancement techniques, filtering, convolution, transformations, and restoration methods.

2. Analyze, evaluate, and interpret image segmentation, edge detection, texture analysis, and motion estimation techniques for extracting meaningful visual information
3. Analyze, design, and evaluate feature extraction, feature representation, and classification techniques using machine learning approaches.
4. Design, develop, and assess deep learning architectures for image classification, object detection, segmentation, and real-world AI applications.

| Module | Name of the Module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | [30L<br>1] |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 1      | <b>Module 1: Fundamentals of Computer Vision and Image Processing</b><br><br>1.1 Introduction to Computer Vision<br>Introduction to computer vision and its applications, Image representation, image processing operations, Image filtering and convolution<br><br>1.2 Image Enhancement and Filtering<br>Contrast stretching, Histogram specification, Adaptive Histogram Equalization (AHE), Wavelet-based enhancement, Smoothing filters: Linear (Box filter, Gaussian filter), Non-linear filters: Median, Min, and Max Sharpening: Laplacian filter<br><br>1.3 Image Transformation and Restoration<br>DFT, DCT, DST, Walsh-Hadamard Transform, Slant Transform, Haar Transform Noise models and types (Gaussian, Rayleigh, Exponential, Uniform, Salt & Pepper noise) Restoration filtering: Mean filter (Arithmetic, Geometric, Harmonic, Contraharmonic), Median filter, Midpoint filter | 15         |
| 2      | <b>Module 2: Image Analysis and Feature Extraction</b><br><br>2.1 Segmentation and Texture Analysis<br>Edge detection (Prewitt, Sobel, Canny) Optimum edge detection and thresholding techniques Region-based segmentation Texture analysis: GLCM, LBP, Gabor filters, Laws' texture energy measures<br>Texture-based segmentation<br>2.2 Motion Analysis<br>Optical flow estimation (Lucas-Kanade, Horn-Schunck) Background subtraction Dense optical flow using deep learning (FlowNet) Motion-based segmentation                                                                                                                                                                                                                                                                                                                                                                               | 15         |
| 3      | <b>Module 3: Image Analysis and Feature Extraction</b><br><br>3.1 Feature Matching and Classification<br>3.2 Feature extraction: SIFT, SURF, BRISK<br>3.3 Feature representation: Bag-of-words, Vector quantization<br>3.4 Feature classification: SVM, KNN, Random Forest                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 15         |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |    |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 4   | <b>Module 4: Deep Learning for Computer Vision</b><br><br>4.1 Image Classification with Deep Learning CNN architectures<br>Attention models Vision transformation<br>4.2 Object Detection and Generative Models Generative models: GANs<br>Object detection: Regions with CNN, Fast R-CNN, Faster R-CNN, Mask R-CNN, SSD, YOLO<br>4.3 Semantic Segmentation and AI Applications U-Net for semantic segmentation Centroid-based object tracking, Real-world AI applications in medical imaging, autonomous systems, and robotics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 15 |
| Ref | <b>Textbooks:</b><br>R. C. Gonzalez, R. E. Woods – "Digital Image Processing," Pearson Education. ISBN: 978-0133356724<br>D. A. Forsyth, J. Ponce – "Computer Vision: A Modern Approach," Pearson. ISBN: 978-0136085928<br>S. Szeliski – "Computer Vision: Algorithms and Applications," Springer. ISBN: 978-1848829343<br><br><b>Additional References websites:</b><br><a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-869-advances-in-computer-vision-fall-2015/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-869-advances-in-computer-vision-fall-2015/</a><br><a href="https://www.coursera.org/specializations/deep-learning">https://www.coursera.org/specializations/deep-learning</a><br><a href="https://www.khanacademy.org/computing/computer-science/algorithms">https://www.khanacademy.org/computing/computer-science/algorithms</a><br><a href="https://github.com/openai/openai">https://github.com/openai/openai</a><br><a href="https://ai.stackexchange.com/">https://ai.stackexchange.com/</a> |    |

### Modality of Assessment

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40 marks in the first part & by conducting the Semester End Examinations with 60 marks in the second part.

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**Semester End Assessment:** It is defined as the assessment of the learners on the basis of Performance in the semester end Theory/ Written examination.

The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

## **Evaluation Pattern**

**Evaluation Pattern Credits -4**

**Continuous Internal Evaluation Out of 40 marks**

**Semester End Evaluation Out of 60 marks**

**Total Marks 100 marks**

### **Continuous Internal Evaluation**

- **Class Test: 20 marks**
- **Assignment / Group presentation /Quiz/Project/Role play/Environmental skits/Viva-voce : 20 marks**

### **Question Paper Pattern**

Maximum Marks: 60

Questions to be set: 04

Duration: 120 mins

Note: All questions are compulsory carrying 10 marks each.

| <b>Q. No.</b> | <b>Particulars</b>                                                                        | <b>Marks</b>                                                                  |
|---------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| <b>1</b>      | <b>Answer the Following (Any Three)</b><br><br>A.<br><br>B.<br><br>C.<br><br>D.<br><br>E. | <b>05</b><br><br><b>05</b><br><br><b>05</b><br><br><b>05</b><br><br><b>05</b> |



|              |                                                                       |                            |
|--------------|-----------------------------------------------------------------------|----------------------------|
| 2            | <b>Answer the Following (Any Three)</b><br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| 3            | <b>Answer the Following (Any Three)</b><br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| 4            | <b>Answer the Following (Any Three)</b><br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| <b>Total</b> |                                                                       | <b>60</b>                  |

## SEMESTER VI

### Major / Core Course II

**COURSE TITLE: Practical of (AI in Information Security & Cyber Security and Computer Vision for AI)**

**[CREDITS - 02]**

|                    | <b>Practical for AI in Information Security and Cyber Security</b>                                  |  |
|--------------------|-----------------------------------------------------------------------------------------------------|--|
| <b>Course Code</b> | <b>Course Title</b>                                                                                 |  |
| <b>1</b>           | Creating a Strong Password ,use online tool to check its strength,and compare it with weak password |  |
| <b>2</b>           | Configure firewall settings on any operating system                                                 |  |
| <b>3</b>           | Implement caesar cipher encryption technique.                                                       |  |
| <b>4</b>           | Implement Deiffie Hellman Algorithm                                                                 |  |

|    |                                                    |
|----|----------------------------------------------------|
| 5  | Implement DES Algorithm                            |
| 6  | Implement AES Algorithm                            |
| 7  | Implement MD5 Algorithm                            |
| 8  | Implement SHA Algorithm                            |
| 9  | Implement RSA Algorithm                            |
| 10 | Implement Digital Signature                        |
| 11 | Implement IDS using KNN Algorithm                  |
| 12 | Implement Packet Filtering using K-Means Algorithm |

|                    | <b>Practical of Computer Vision for AI</b>                                                               |
|--------------------|----------------------------------------------------------------------------------------------------------|
| <b>Course Code</b> | <b>Course Title</b>                                                                                      |
| 1                  | Improve the contrast of an image using Histogram Equalization and Adaptive Histogram Equalization (AHE). |
| 2                  | Apply different filters (Gaussian, Median, Laplacian) to smooth and sharpen an image.                    |
| 3                  | Perform scaling and rotation transformations on an image.                                                |
| 4                  | Add Salt and Pepper noise to an image and remove it using Median and Mean filters.                       |
| 5                  | Detect edges in an image using different operators.                                                      |
| 6                  | Extract texture features from an image using GLCM.                                                       |
| 7                  | Track the motion of an object in a video using the Lucas-Kanade optical flow algorithm.                  |
| 8                  | Use a pre-trained CNN (such as MobileNet or ResNet) to classify images.                                  |
| 9                  | Detect objects in an image using the YOLO (You Only Look Once) model.                                    |
| 10                 | Perform semantic segmentation on an image using the U-Net model.                                         |

**T. Y. B. Sc. Artificial Intelligence**

**SEMESTER VI**

**Major Elective**

**COURSE TITLE: Blockchain**

**[CREDITS - 04]**

### **Course Learning Objective**

The objective of this course is to provide learners with a comprehensive understanding of Blockchain and Distributed Ledger Technology (DLT), including their fundamental concepts

and working principles. The course enables students to understand the Bitcoin network, nodes, cryptographic keys, wallets, and transaction mechanisms. It also focuses on developing practical skills to implement smart contracts on the Ethereum platform using various development frameworks and to build applications on permissioned blockchain networks such as Hyperledger Fabric. Additionally, the course introduces different crypto assets and cryptocurrencies and analyzes the integration of blockchain with emerging technologies such as Artificial Intelligence, Internet of Things (IoT), and Cybersecurity through relevant case studies.

### Course Learning Outcomes

1. Explain the fundamental concepts of Blockchain and Distributed Ledger Technology (DLT) and the working of the Bitcoin network, including nodes, cryptographic keys, wallets, and transactions.
2. Develop and deploy smart contracts on the Ethereum platform using appropriate development frameworks.
3. Build and manage applications on permissioned blockchain networks such as Hyperledger Fabric.
4. Analyze and differentiate various crypto assets and cryptocurrencies.
5. Evaluate the integration of blockchain with emerging technologies such as Artificial Intelligence (AI), Internet of Things (IoT), and Cybersecurity through case studies.

| Module | Name of Module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Lectures |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1      | <b>1. Introduction to DLT and Blockchain</b><br><br>1.1 Distributed Ledger Technologies (DLTs) Introduction, Types of Blockchains.<br><br>1.2 Blockchain: Origin, Phases, Components Block in a Blockchain: Structure of a Block,<br>1.3 Block Header Hash and Block Height, The Genesis Block, Linking Blocks in the Blockchain, Merkle Tree.<br>1.4 What are Bitcoin and the history of Bitcoin, Bitcoin Transactions, Bitcoin Concepts: keys, addresses and wallets, Bitcoin Transactions, validation of transactions, PoW consensus | 15       |
| 2      | <b>2. Consensus and Mining and Permissionless Blockchain: Ethereum</b><br><br>2.1 Bitcoin Network: Peer-to-Peer Network Architecture, Node Types and Roles, Incentive-based Engineering, The Extended Bitcoin Network, Bitcoin Relay Networks, Network Discovery, Full Nodes, Exchanging "Inventory" "simplified Payment Verification (SPV) Nodes, SPV Nodes and Privacy, Transaction Pools, Blockchain Forks                                                                                                                           | 15       |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |    |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|           | <p>2.2 Components, Architecture of Ethereum, Miner and mining node, Ethereum virtual machine, Ether, Gas, Transactions, Accounts, Patricia Merkle Tree, Swarm, Whisper and IPFS, Ethash, End to end transaction in Ethereum</p> <p>2.3 Smart Contracts: Smart Contract programming using solidity, Metamask (Ethereum Wallet), Setting up the development environment, Use cases of Smart Contract, Smart Contracts: Opportunities and Risk.</p> <p>2.4 Smart Contract Deployment: Introduction to Truffle, Use of Remix, and test networks for deployment.</p> <p>2.5 Smart contract development using Java or Python.</p> |    |
| 3         | <p><b>Permissioned Blockchain: Hyperledger Fabric</b></p> <p>3.1 Introduction to Framework, Tools, and Architecture of Hyperledger Fabric Blockchain.</p> <p>3.2 Components: Certificate Authority, Nodes, Chain codes, Channels, Consensus: Solo, Kafka, RAFT Designing Hyperledger Blockchain</p>                                                                                                                                                                                                                                                                                                                         | 15 |
| 4         | <p><b>Crypto assets and Cryptocurrencies</b></p> <p>4.1 Fundamentals of Hyperledger Composer</p> <p>4.2 ERC20 and ERC721 Tokens, comparison between ERC20 &amp; ERC721, ICO, STO, Different Crypto currencies.</p> <p>4.3 Blockchain in IoT, AI, Cyber Security</p>                                                                                                                                                                                                                                                                                                                                                         | 15 |
|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |    |
| Reference | <p>Textbook:</p> <p>1.“Mastering Bitcoin, PROGRAMMING THE OPEN BLOCKCHAIN”, 2nd Edition by Andreas M. Antonopoulos, June 2017, Publisher(s): O'Reilly Media, Inc. ISBN: 9781491954386.</p> <p>2. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'Reilly.</p> <p>3. Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhillash K. A and Meena Karthikeyan, Universities press.</p> <p>4. Hyperledger Fabric In-Depth: Learn, Build and Deploy Blockchain Applications Using Hyperledger Fabric, Ashwani Kumar, BPB publications</p>                          |    |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|           | <p>5. Solidity Programming Essentials: A beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, Ritesh Modi, Packt publication</p> <p>6. Cryptoassets: The Innovative Investor's Guide to Bitcoin and Beyond, Chris Burniske &amp; Jack Tatar.</p>                                                                                                                                                                                                                                                                                      |  |
| Reference | <p>Website:</p> <p>1. <a href="http://www.coursera.org">www.coursera.org</a></p> <p>2. <a href="https://ethereum.org/en/">https://ethereum.org/en/</a></p> <p>3. <a href="https://www.trufflesuite.com/tutorials">https://www.trufflesuite.com/tutorials</a></p> <p>4. <a href="https://hyperledger-fabric.readthedocs.io/en/release-2.2/whatis.h">https://hyperledger-fabric.readthedocs.io/en/release-2.2/whatis.h</a></p> <p>5. <a href="https://andersbrownworth.com/blockchain/">https://andersbrownworth.com/blockchain/</a> Blockchain demo:</p> |  |

## T. Y. B. Sc. Artificial Intelligence

### SEMESTER VI

### Major Elective II

### COURSE TITLE: Natural Language Processing

### COURSE CODE:

[CREDITS - 04]

#### Course Learning Objective

To provide a comprehensive understanding of Natural Language Processing (NLP) concepts, techniques, and tools, including text preprocessing, classical NLP algorithms, and deep learning approaches. The course aims to develop skills in implementing NLP tasks using libraries such as NLTK and spaCy, applying machine learning and deep learning models for language understanding, and exploring advanced topics like transformers, large language models, and real-world NLP applications while addressing ethical concerns such as bias and explainability.

#### Course Learning Outcomes:

**The objective of this course is:**

**CO1:** Understand basics of NLP and text preprocessing.

**CO2:** Apply classical NLP techniques.

**CO3:** Implement deep learning models for NLP tasks.

**CO4:** Evaluate transformer-based NLP models and applications.

| Module | Name of Module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Lectures |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1      | <b>1. Introduction to NLP and Text Processing</b><br>1.1 What is NLP? Applications and Challenges<br><br>1.2 Text Preprocessing: Tokenization, Stopword Removal, Lemmatization, Stemming<br><br>1.3 Text Representation: Bag-of-Words, TF-IDF, Word Embeddings (Word2Vec, GloVe)<br><br>1.4 Language Models: N-grams, Perplexity<br><br>1.5 Introduction to spaCy and NLTK<br><br>1.6 Implementation of : <ul style="list-style-type: none"><li>● NLTK to tokenize a sample paragraph into words and sentences.</li><li>● Remove stopwords from the tokenized words using NLTK stopwords list</li><li>● Remove common suffixes from words using Porters stemmer</li></ul> | 15       |
| 2      | <b>2. Classical NLP Tasks and Algorithms</b><br>2.1 POS Tagging and Named Entity Recognition<br><br>2.2 Chunking and Parsing (Dependency & Constituency)<br><br>2.3 Rule-based vs Statistical NLP<br><br>2.4 Text Classification: Naive Bayes, SVM<br><br>2.5 Topic Modeling: LDA, Non-negative Matrix Factorization (NMF)<br><br>2.6 Implementation of : <ul style="list-style-type: none"><li>● Use NLTK to perform POS tagging and Named Entity. Recognition on given text.</li><li>● SVM</li></ul>                                                                                                                                                                    | 15       |
| 3      | <b>3. Deep Learning for NLP</b><br>3.1 Sequence Modeling: RNN, GRU, LSTM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 15       |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|           | 3.2 Word Embeddings in DL: Word2Vec, FastText, GloVe<br>3.3 Sentiment Analysis using LSTM<br>3.4 Attention Mechanism and Sequence-to-Sequence Models<br>3.5 Introduction to Transformers: Encoder-Decoder Architectures<br>3.6 Implementation of : <ul style="list-style-type: none"> <li>• Sentiment analysis using LSTM</li> <li>• Sentiment analysis using TEXTBlob</li> </ul>                                                                                                                                          |    |
| 4         | <b>4. AI in NLP – Large Language Models &amp; Tools</b><br>4.1 Transfer Learning in NLP: BERT, RoBERTa, GPT<br>4.2 Text Generation: GPT-2, GPT-3, ChatGPT<br>4.3 Fine-Tuning and Prompt Engineering<br>4.4 Explainability and Bias in NLP Models<br>4.5 Hugging Face Transformers, LLM APIs, and Real-world Applications (Chatbots, Summarizers, Sentiment Engines)<br>4.6 Implementation of : <ul style="list-style-type: none"> <li>• Text summarization using Hugging Face Transform.</li> <li>• Bias in NLP</li> </ul> | 15 |
|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |
| Reference | Textbook:<br>1. Multilingual Natural Language Processing Applications: From Theory to Practice–Daniel M. Bikel and Imed Zitouni, Pearson Publication.<br>2. Speech and Natural Language Processing-Daniel Jurafsky & James H Martin, Pearson Publications.<br>3. Natural Language Processing and Information Retrieval: Tanveer Siddiqui, U.S.Tiwary                                                                                                                                                                       |    |
| Reference | Website:<br>1. <a href="http://www.deeplearning.ai">www.deeplearning.ai</a><br>2. <a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a>                                                                                                                                                                                                                                                                                                                                                                         |    |

## **Modality of Assessment**

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40 marks in the first part & by conducting the Semester End Examinations with 60 marks in the second part.

Students will have to score 40% of marks in the Internal Assessment as well as Semester End Examination to pass the course.

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The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

## **Evaluation Pattern**

**Evaluation Pattern Credits -4**

**Continuous Internal Evaluation Out of 40 marks**

**Semester End Evaluation Out of 60 marks**

**Total Marks 100 marks**

### **Continuous Internal Evaluation**

- **Class Test: 20 marks**
- **Assignment / Group presentation /Quiz/Project/Role play/Environmental skits/Viva-voce : 20 marks**

## **Question Paper Pattern**

Maximum Marks: 60

Questions to be set: 04

Duration: 120 mins



Note: All questions are compulsory carrying 10 marks each.

| Q. No.       | Particulars                                                           | Marks                      |
|--------------|-----------------------------------------------------------------------|----------------------------|
| 1            | <b>Answer the Following (Any Three)</b><br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| 2            | <b>Answer the Following (Any Three)</b><br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| 3            | <b>Answer the Following (Any Three)</b><br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| 4            | <b>Answer the Following (Any Three)</b><br>A.<br>B.<br>C.<br>D.<br>E. | 05<br>05<br>05<br>05<br>05 |
| <b>Total</b> |                                                                       | <b>60</b>                  |

**T. Y. B. Sc. Artificial Intelligence**  
**SEMESTER VI**  
**Minor Course**  
**COURSE TITLE: Big Data Analytics**  
**[CREDITS - 02]**

**Course Learning Objective:**

A Big Data Analytics course aims to provide a comprehensive understanding of Big Data concepts, technologies, and processing frameworks, including Hadoop and Spark. The course aims to develop the ability to manage, process, and analyze large-scale data using distributed systems, data warehousing tools, and real-time streaming technologies for practical applications in various domains.

**Course Learning Outcomes:**

**CO1** -Apply fundamental concepts of Big Data by analyzing its characteristics (5Vs), differentiating data types, and evaluating its applications across various domains in comparison with traditional data processing systems.

**CO2**- Design and analyze distributed data processing solutions using the Hadoop ecosystem, including HDFS architecture, MapReduce programming model, and YARN-based resource management.

**CO3**- Implement and evaluate Big Data storage, processing, and analytics solutions using different tools along with real-time data streaming and visualization platforms.

| Module | Name of Module                                                                                                                                  | Lectures |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1      | <b>Unit I – Fundamentals of Big Data</b><br><br>1.1 Introduction to Big Data<br>Definition and evolution of Big Data; characteristics including | 10       |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |    |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|   | <p>Volume, Velocity, Variety, Veracity, and Value; classification of data into structured, semi-structured, and unstructured formats.</p> <p>1.2 Big Data Applications<br/>Use of Big Data technologies in healthcare analytics, financial services, e-commerce recommendation systems, social media analysis, smart cities, and scientific research.</p> <p>1.3 Big Data vs Traditional Data Processing<br/>Comparison between conventional data management systems and Big Data platforms based on scalability, storage architecture, processing capability, and performance.</p> <p>1.4 Big Data Technologies<br/>Concept of Big Data technology; classification into operational systems for real-time processing and analytical systems for large-scale data analysis.</p> |    |
| 2 | <p><b>Unit II – Hadoop Framework and Distributed Processing</b></p> <p>2.1 Hadoop Architecture<br/>Need for Hadoop in distributed computing; key features and architecture of the Hadoop ecosystem.</p> <p>2.2 Hadoop Distributed File System (HDFS)<br/>Architecture of HDFS including NameNode and DataNode components, block-based storage mechanism, data replication strategy, and fault tolerance.</p> <p>2.3 MapReduce Processing Model<br/>Concept of parallel data processing using MapReduce; working of Mapper and Reducer functions and execution workflow.</p> <p>2.4 YARN Resource Management<br/>Role of YARN (Yet Another Resource Negotiator) in cluster management; resource allocation and scheduling mechanisms.</p>                                        | 10 |
| 3 | <p><b>Unit III – Big Data Ecosystem and Processing Tools</b></p> <p>3.1 Data Warehousing and Processing Tools<br/>Introduction to Apache Hive for data warehousing and Apache Pig for large-scale data processing using Pig Latin scripting.</p> <p>3.2 Data Integration and Storage Technologies<br/>Overview of HBase for NoSQL storage, Sqoop for data transfer between relational databases and Hadoop, and Flume for data ingestion from distributed sources.</p> <p>3.3 Apache Spark for Big Data Analytics<br/>Introduction to Apache Spark architecture and components;</p>                                                                                                                                                                                             | 10 |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|           | ecosystem modules including Spark SQL, Spark Streaming, MLlib, and GraphX; concept of Resilient Distributed Datasets (RDDs).                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
|           | 3.4 Real-Time Data Processing and Visualization<br>Introduction to Apache Kafka for real-time data streaming and visualization tools such as Tableau, Microsoft Power BI, Google Data Studio, and OpenHeatMap for Big Data analytics.                                                                                                                                                                                                                                                                                                                                      |  |
| Reference | Textbook:<br>1) M. Vijayalakshmi, Radha Shankarmani, Big Data Analytics, Publication details: Wiley c2017, 2022 N. Delhi Edition: 2nd ed. c2017, ISBN: 9788126565757<br>2) Tom White. Hadoop: The Definitive Guide, 4th Edition, Released April 2015, Publisher(s): O'Reilly Media, Inc. ISBN: 9781491901632.<br>3) Seema Acharya and Subhashini Chellappan "Big data and Analytics" Wiley India Publishers, 2nd Edition, 2019.<br>4. Rajkamal and Preeti Saxena, "Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning", McGraw Hill Publication, 2019. |  |
| Reference | <b>Website:</b><br>1. <a href="https://www.edureka.co/blog/big-data-tutorial">https://www.edureka.co/blog/big-data-tutorial</a><br>2. <a href="https://www.tutorialspoint.com/apache_spark/index.htm">https://www.tutorialspoint.com/apache_spark/index.htm</a><br>3. <a href="https://www.bigdatalearning.com/blog/apache-hive-beginners-guide">https://www.bigdatalearning.com/blog/apache-hive-beginners-guide</a><br>4. <a href="https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset">https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset</a>  |  |

### Modality of Assessment

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 20 marks in the first part & by conducting the Semester End Examinations with 30 marks in the second part.

Students will have to score 40% of marks in the Internal Assessment as well as Semester End Examination to pass the course.

**Internal Assessment:** It is defined as the assessment of the learners based on internal evaluation as envisaged in the Credit & Choice Based System by way of participation of learners in various academic and correlated activities in the given semester of the programme.

**Semester End Assessment:** It is defined as the assessment of the learners based on Performance in the semester end Theory/ Written examination.

The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

### Evaluation Pattern

| <b>Evaluation Pattern</b>      | <b>Credits -2</b> |
|--------------------------------|-------------------|
| Continuous Internal Evaluation | Out of 20 marks   |
| Semester End Evaluation        | Out of 30 marks   |
| Total Marks                    | 50 marks          |

### **Continuous Internal Evaluation**

**Internal 1:** Class Test: 10 marks

**Internal 2:** Assignment / Group presentation /Quiz/ Project/ Role play/  
Environmental skits/ Viva-voce/ Field reports: 10 marks

## **T.Y. B. Sc. Artificial Intelligence**

### **SEMESTER VI**

#### **Minor Course**

### **COURSE TITLE: Big Data Analytics (Practical)**

**[CREDITS - 02]**

|                    | <b>Practical of Cloud Computing</b>                                                   |
|--------------------|---------------------------------------------------------------------------------------|
| <b>Course Code</b> | <b>Course Title</b>                                                                   |
| <b>1</b>           | Demonstration of Hadoop and its need.                                                 |
| <b>2</b>           | Adding files and directories, retrieving files, Deleting files and directories        |
| <b>3</b>           | Find the HDFS file size                                                               |
| <b>4</b>           | Find the replication factor in HDFS                                                   |
| <b>5</b>           | Implement Pig installation, writing simple pig scripts for data processing.           |
| <b>6</b>           | Implementing pig data processing with scripts                                         |
| <b>7</b>           | Implementing pig scripts for large scale data processing                              |
| <b>8</b>           | Implementing DDL and DML statements in sql.                                           |
| <b>9</b>           | Implement program to perform read and write operation on nApache hive using spar      |
| <b>10</b>          | Implementy program to perform read and write operation on Apache HIVE using spark SQL |
| <b>11</b>          | Understanding and installing Tableau software                                         |
| <b>12</b>          | Creating a simple bar chart for students dataset in excel.                            |
| <b>13</b>          | Creating a simple bar chart for students dataset in Tableau                           |
| <b>14</b>          | Creating a simple pie chart for students dataset in excel.                            |
| <b>15</b>          | Creating a simple pie chart for students dataset in Tableau                           |
| <b>16</b>          | Creating a Gantt chart for the project in Tableau                                     |
| <b>17</b>          | Implement waterfall chart using suitable dataset                                      |
| <b>18</b>          | Import data and create charts in Power BI.                                            |

|           |                                                       |
|-----------|-------------------------------------------------------|
| <b>19</b> | Create Calculated Columns and Measures in power BI    |
| <b>20</b> | Create Dashboard with Filters and Slicers in power BI |