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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Big Data Analytics **Subject Code: ……**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. Develop a comprehensive understanding of big data technologies, tools, and techniques for processing and analyzing large-scale datasets.
2. Acquire knowledge and skills in utilizing advanced analytics methods tailored for big data to extract meaningful insights.
3. Learn to apply big data analytics techniques to address real-world challenges and opportunities across diverse domains.
4. Gain proficiency in utilizing big data platforms and tools such as Hadoop, Spark, and NoSQL databases for efficient data processing and analysis.
5. Equip students with the capability to leverage big data analytics to make informed decisions and drive innovation in various professional settings.

Course Outcomes

Upon successful completion of the course, students should be able to:

1. Understand the concepts, characteristics, and challenges of big data, including volume, velocity, variety, and veracity.
2. Apply big data processing frameworks, such as Hadoop and Spark, to manage and analyze large-scale datasets efficiently.
3. Design and implement data pre-processing techniques for cleaning, transforming, and preparing big data for analysis.
4. Apply advanced analytics methods, including machine learning, data mining, and predictive modelling, to extract insights and patterns from big data.
5. Develop and deploy scalable big data analytics solutions using cloud-based platforms and distributed computing environments.
6. Evaluate the performance, scalability, and reliability of big data analytics systems in real-world scenarios.

Unit 1: INTRODUCTION TO BIG DATA ANALYTICS

Overview of big data: characteristics, sources, and challenges, Introduction to big data analytics tools and technologies, Big data storage and processing frameworks: Hadoop, Spark, and Flink, Ethical and legal considerations in big data analytics.

Unit 2: DATA PREPROCESSING AND CLEANING

Techniques for data cleaning, transformation, and integration, Handling missing data and outliers in big data, Data reduction and feature selection methods, Scalable data pre-processing work flows using Apache Pig and Apache Hive.

Unit 3: BIG DATA PROCESSING AND ANALYTICS

Map Reduce programming model for distributed data processing, Introduction to Apache Spark: RDDs, Data Frames, and Spark SQL, Machine learning algorithms for big data analytics: classification, regression, clustering, Real-time analytics and stream processing with Apache Flink.

Unit 4: ADVANCED ANALYTICS ON BIG DATA

Deep learning for big data analytics: neural networks, convolutional neural networks (CNNs), recurrent neural networks (RNNs). Text analytics and natural language processing (NLP) on big data, Graph analytics for social network analysis and recommendation systems, Ensemble learning methods and model evaluation techniques.

Unit 5: SCALABLE BIG DATA ANALYTICS PLATFORMS

Cloud-based big data analytics platforms: Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform (GCP), Containerization and orchestration tools: Docker, Kubernetes, Big data deployment and scaling strategies, Case studies and applications of big data analytics in various domains

Textbooks

1. T itle: "Big Data Analytics: Methods and Applications", Authors: J. Bauckhage, R. Srikant, V. Garg, Publisher: CRC Press, Year: 2016
2. Title: "Big Data Analytics: Turning Big Data into Big Money", Authors: Frank Ohlhorst, - Publisher: John Wiley & Sons, Year: 2012

Reference Books

1. Title: "Hadoop: The Definitive Guide", Authors: Tom White, Publisher: O'Reilly Media, Year: 2015

2. Title: "Spark: The Definitive Guide", Authors: Bill Chambers, Matei Zaharia, Publisher: O'Reilly Media, Year: 2018

3. Title: "Big Data Analytics with R and Hadoop", Authors: Vignesh Prajapati, Anil Kumar K M - Publisher: Packt Publishing, Year: 2013

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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Data Wrangling **Subject Code: ……**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objective

1. Equip students with essential skills and techniques for acquiring, cleaning, transforming, and preparing raw data for analysis.
2. Provide students with knowledge and tools to handle diverse data formats efficiently.
3. Enable students to address missing or inconsistent data effectively during the data wrangling process.
4. Teach students how to create structured datasets suitable for analysis and modeling in data science projects.
5. Empower students with the ability to apply data wrangling techniques to real-world datasets, enhancing their proficiency in data preparation for downstream analysis.

Course Outcomes

Upon successful completion of the course, students should be able to:

1. Understand the importance of data wrangling in the data science workflow and its role in ensuring data quality.
2. Acquire data from various sources, including databases, web APIs, and file formats such as CSV, JSON, and XML.
3. Clean and pre-process raw data to address issues such as missing values, outliers, and inconsistencies.
4. Transform and reshape data using techniques such as filtering, aggregation, and normalization.
5. Merge, join, and concatenate datasets to create unified datasets suitable for analysis.
6. Document data wrangling processes and workflows to ensure reproducibility and transparency in data science projects.

Unit 1: INTRODUCTION TO DATA WRANGLING

Overview of data wrangling: importance, challenges, and best practices, Data acquisition techniques: accessing databases, web scraping, and file I/O, Exploratory data analysis (EDA) for understanding data quality issues, Data cleaning techniques: handling missing values, outliers, and duplicates.

Unit 2: DATA TRANSFORMATION AND RESHAPING

Techniques for data transformation: normalization, scaling, and encoding, Reshaping data using pivot tables, stack, and unstack operations, Extracting features from text and categorical data, Data aggregation and summarization techniques.

Unit 3: MERGING AND JOINING DATASETS

Combining datasets using concatenation, merging, and joining operations, Handling different types of joins: inner, outer, left, and right joins, Dealing with duplicate and mismatched keys during data merging, Advanced merging techniques: fuzzy matching and approximate string matching.

Unit 4: HANDLING TIME SERIES AND SPATIAL DATA

Preprocessing time series data: resampling, interpolation, and rolling windows, Spatial data wrangling techniques: geocoding, spatial joins, and spatial queries, Handling special data types: images, audio, and video data, Integrating external datasets with geographic information systems (GIS).

Unit 5: DOCUMENTING AND REPRODUCING DATA WRANGLING WORKFLOWS

Documenting data wrangling processes: code comments, markdown files, and Jupyter notebooks,Version control and collaboration using Git and GitHub, Automation and reproducibility using scripting and workflow management tools, Best practices for organizing and managing data wrangling projects.

Textbooks

1. Title: "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", Author: Wes McKinney, Publisher: O'Reilly Media, Year: 2017
2. Title: "R for Data Science: Import, Tidy, Transform, Visualize, and Model Data", Authors: Hadley Wickham, Garrett Grolemund, Publisher: O'Reilly Media, Year: 2017

Reference Books

1. Title: "Data Wrangling with Python: Tips and Tools to Make Your Life Easier", Author: Jacqueline Kazil, Katharine Jarmul, Publisher: O'Reilly Media, Year: 2016
2. Title: "Data Wrangling with R", Author: Bradley Boehmke, Jaynal Abedin, Publisher: Springer, Year: 2016
3. Title: "The Art of Data Science: A Guide for Anyone Who Works with Data", Authors: Roger D. Peng, Elizabeth Matsui, Jeff Leek, Publisher: Leanpub, Year: 2015

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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Software Engineering **Subject Code: ……**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. Develop a comprehensive understanding of software development principles, methodologies, and practices.
2. Acquire knowledge and skills essential for designing, developing, and maintaining high-quality software systems.
3. Emphasize the application of software engineering best practices within the realm of artificial intelligence (AI) applications.
4. Gain proficiency in implementing software engineering techniques tailored for AI-centric projects.
5. Prepare students to effectively design, develop, and manage software solutions by integrating software engineering principles with AI technologies.

Course Outcomes

Upon successful completion of the course, students should be able to:

1. Understand the fundamental concepts and principles of software engineering, including requirements engineering, software design, and testing.
2. Apply software development methodologies, such as agile, iterative, and incremental approaches, to plan and manage software projects effectively.
3. Design and implement software systems using appropriate programming languages, frameworks, and tools, with a focus on AI applications.
4. Apply software engineering best practices for ensuring software quality, reliability, and maintainability in AI systems.
5. Collaborate effectively in software development teams, practicing communication, teamwork, and project management skills.
6. Demonstrate ethical and professional responsibility in software development, adhering to legal and ethical standards and considering societal impacts.

Unit 1: INTRODUCTION TO SOFTWARE ENGINEERING

Overview of software engineering: concepts, principles, and software development life cycle, Software processes and methodologies: waterfall, agile, scrum, and kanban, Requirements engineering: elicitation, analysis, specification, and validation, Ethical and professional considerations in software engineering.

Unit 2: SOFTWARE DESIGN AND ARCHITECTURE

Principles of software design: abstraction, modularity, cohesion, and coupling,
Architectural styles and patterns: client-server, layered architecture, and microservices,
Design principles for AI systems: modifiability, scalability, and adaptability, Software

modeling techniques: UML diagrams, entity-relationship diagrams, and data flow diagrams.

Unit 3: IMPLEMENTATION AND TESTING

Programming paradigms and languages for software development, Coding standards, conventions, and best practices, Unit testing, integration testing, and system testing techniques, Test-driven development (TDD) and behavior-driven development (BDD) practices.

Unit 4: SOFTWARE MAINTENANCE AND EVOLUTION

Software maintenance activities: corrective, adaptive, and perfective maintenance, Version control systems and configuration management, Software refactoring and code quality improvement techniques, Legacy system modernization and migration strategies.

Unit 5: SOFTWARE PROJECT MANAGEMENT

Project planning and estimation techniques: work breakdown structure (WBS), effort estimation models, Agile project management frameworks: scrum, kanban, and extreme programming (XP), Risk management and mitigation strategies in software projects, Software documentation and knowledge management practices

Textbooks

1. Title: "Software Engineering: A Practitioner's Approach", Author: Roger S. Pressman, Publisher: McGraw-Hill Education, Year: 2020.

2. Title: "Clean Code: A Handbook of Agile Software Craftsmanship", Author: Robert C. Martin, Publisher: Prentice Hall, Year: 2008.

Reference Books

1. Title: "Agile Software Development: Principles, Patterns, and Practices", Author: Robert C. Martin, Publisher: Prentice Hall, Year: 2002.
2. Title: "Introduction to the Art of Programming Using Scala", Author: Mark C. Lewis, Publisher: CRC Press, Year: 2012.
3. Title: "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation", Authors: Jez Humble, David Farley, Publisher: Addison-Wesley Professional, Year: 2010.

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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Big Data Analytics Lab **Subject Code:**

Maximum Marks in ESE: 40

LIST OF EXPERIMENTS -:

1. Data Exploration with Hadoop: Use Hadoop to explore large-scale datasets stored in the Hadoop Distributed File System (HDFS), and performs basic operations such as listing files, reading data, and calculating summary statistics.
2. Word Count with Map Reduce: Implement the classic Map Reduce word count algorithm to count the frequency of words in a large text corpus stored in HDFS.
3. Data Analysis with Spark: Use Apache Spark to analyze large datasets by loading them into Spark RDDs (Resilient Distributed Datasets) and performing operations such as filtering, mapping, and aggregation.
4. Streaming Analytics with Kafka and Spark: Set up a data streaming pipeline using Apache Kafka to ingest real-time data and process it using Apache Spark Streaming for real-time analytics.
5. Data Visualization with Python and Matplotlib: Use Python and Matplotlib library to visualize insights extracted from large datasets, such as plotting histograms, scatter plots, or time series data.
6. Machine Learning Model Training with Spark MLlib: Train machine learning models on large datasets using Spark's MLlib library, and evaluate model performance using techniques such as cross-validation and model selection.
7. Graph Analytics with GraphX: Explore graph-structured data using Apache Spark's GraphX library, and perform graph analytics tasks such as computing centrality measures or detecting communities.
8. SQL Queries with Hive: Write and execute SQL queries using Apache Hive to analyze structured data stored in HDFS, and perform operations such as filtering, joining, and aggregating data.
9. Data Sampling and Stratification: Implement data sampling techniques to generate representative subsets of large datasets, and stratify the data based on specific criteria for balanced sampling.
10. Data Cleaning and Preprocessing with Pandas: Use the Pandas library in Python to clean and preprocess large datasets, addressing issues such as missing values, outliers, and inconsistent data.

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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Data Wrangling Lab **Subject Code:**

Maximum Marks in ESE: 40

LIST OF EXPERIMENTS -:

1. Handling Missing Values: Identify and fill missing values in a dataset using methods such as mean imputation or forward/backward filling.

2. Data Filtering: Filter rows or columns based on specified criteria, such as removing outliers or selecting data within a certain range.

3. Data Aggregation: Aggregate data by grouping rows based on a specific attribute and computing summary statistics, such as mean, median, or count.

4. Data Concatenation: Concatenate multiple datasets along rows or columns to create a unified dataset.

5. Data Reshaping: Reshape data by pivoting, stacking, or unstacking to convert between wide and long formats.

6. Data Sampling: Randomly sample rows or columns from a dataset to create a smaller subset for analysis.

7. Data Conversion: Convert data types of columns, such as converting categorical variables to numerical or vice versa.

8. Text Data Processing: Clean and preprocess text data by removing punctuation, stopwords, and performing tokenization.

9. Date-Time Processing: Extract date or time components from datetime columns and perform operations such as calculating time differences or aggregating by time intervals.

10. Data Merging: Merge two or more datasets based on common keys or indices to combine information from different sources.

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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Software Engineering Lab **Subject Code:**

Maximum Marks in ESE: 40

LIST OF EXPERIMENTS -:

1. Version Control with Git: Practice basic Git operations such as repository creation, file addition, committing changes, and pushing to a remote repository.
2. Code Review Simulation: Conduct a simulated code review session where students provide feedback on each other's code, focusing on readability, maintainability, and adherence to coding standards.
3. Unit Testing with pytest: Write and execute unit tests for Python functions using the pytest framework, covering different test cases and assertions.
4. Continuous Integration Setup: Set up a basic continuous integration (CI) pipeline using tools like GitHub Actions or Travis CI to automatically build and test code changes on every commit.
5. Code Refactoring Exercise: Identify and refactor code snippets to improve code quality, readability, and performance, focusing on techniques such as extracting methods, removing duplication, and improving naming conventions.
6. Agile Sprint Planning: Conduct a simulated sprint planning session following agile principles, where students break down user stories into tasks, estimate their effort, and allocate them for a sprint.
7. Pair Programming Activity: Pair up students to work on a programming task collaboratively, taking turns as the driver and navigator, and switch roles periodically to promote teamwork and knowledge sharing.
8. Code Documentation Practice: Write and document Python functions and classes using docstrings and generate HTML documentation using tools like Sphinx or MkDocs.
9. Mocking and Dependency Injection: Practice mocking and dependency injection techniques in Python using libraries like unittest.mock or dependency-injector to isolate and test individual components of a software system.
10. Code Review Automation: Integrate a code quality analysis tool like CodeFactor or Codacy with GitHub to automatically analyze code changes and provide feedback on code style, complexity, and potential issues.

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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Technical Communication and Soft Skill **Subject Code: ……**

Maximum Marks (TA): 20

1. **Effective Communication in Data Science**
   Principles of effective technical communication. Written and verbal communication skills. Presentation techniques for conveying data science concepts.

2. **Teamwork and Collaboration**
   Importance of teamwork in data science projects. Collaboration tools and techniques.
   Case Study: Team dynamics in a data science project team.

3. **Problem-Solving Skills**
   Critical thinking and problem-solving strategies. Analytical skills for data analysis and interpretation.
   Case Study: Problem-solving approach in analyzing real-world datasets.

4. **Time Management and Productivity**
   Time management techniques for project completion. Prioritization and task management skills.
   Case Study: Managing time effectively in data science project deadlines.

5. **Professional Ethics and Integrity**
   Ethical considerations in data science research and analysis. Maintaining integrity and professionalism in data handling.
   Case Study: Ethical dilemmas in data collection and analysis processes.

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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Computer Vision (Professional Elective II) **Subject Code: ……**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. To provide students with a comprehensive understanding of computer vision fundamentals and techniques.
2. To enable students to apply computer vision algorithms to solve real-world problems in various domains.
3. To familiarize students with state-of-the-art methodologies and advancements in computer vision research.
4. To develop practical skills in image processing, feature extraction, object detection, and recognition.
5. To encourage students to critically evaluate and analyze the ethical and societal implications of computer vision applications.

Course Outcomes

1. Understand the principles and theoretical foundations of computer vision.
2. Apply various computer vision algorithms for tasks such as image classification, object detection, and image segmentation.
3. Implement computer vision techniques using programming languages and frameworks such as Python and Open CV.
4. Analyze and evaluate the performance of computer vision models using appropriate metrics.
5. Demonstrate an understanding of ethical considerations and potential biases in computer vision applications.

Unit 1: INTRODUCTION TO COMPUTER VISION

Overview of computer vision concepts and applications. Image formation and representation. Colour spaces and image enhancement techniques. Image filtering and convolution operations.

Unit 2: IMAGE PROCESSING AND FEATURE EXTRACTION

Image transformation and geometric operations. Image segmentation techniques (e.g., thresholding, edge detection). Feature extraction methods (e.g., corner detection, scale-invariant feature transform).

Unit 3: OBJECT DETECTION AND RECOGNITION

Introduction to object detection and localization.Popular object detection algorithms (e.g., Haar cascades, YOLO, SSD). Object recognition techniques using deep learning approaches (e.g., Convolutional Neural Networks).

Unit 4: DEEP LEARNING FOR COMPUTER VISION

Fundamentals of deep learning and neural networks. Convolutional Neural Networks (CNNs) architecture and applications in computer vision.

Transfer learning and fine-tuning pre-trained CNN models for specific tasks.

Unit 5: ADVANCED TOPICS AND APPLICATIONS

Advanced topics in computer vision (e.g., image registration, motion analysis). Applications of computer vision in fields such as healthcare, autonomous vehicles, and surveillance. Ethical considerations and societal implications of computer vision technologies.

TEXTBOOKS:

1. Title: "Computer Vision: Algorithms and Applications" Author: Richard Szeliski, Publication Details: Springer, 2010

2. Title: "Learning OpenCV 4 Computer Vision with Python 3: Get to grips with tools, techniques, and algorithms for computer vision and machine learning", Author: Joseph Howse, Joe Minichino, Prateek Joshi, Publication Details: Packt Publishing, 2018

REFERENCE BOOKS:

1. Title: "Computer Vision: A Modern Approach", Author: David A. Forsyth, Jean Ponce, Publication Details: Prentice Hall, 2002

2. Title: "Deep Learning for Computer Vision", Author: Rajalingappaa Shanmugamani, Publication Details: Packt Publishing, 2018

3. Title: "Python Deep Learning: Exploring deep learning techniques, neural network architectures and GANs with PyTorch, Keras and TensorFlow", Author: Ivan Vasilev, Daniel Slater, Gianmario Spacagna, Peter Roelants, Valentino Zocca, Publication Details: Packt Publishing, 2019

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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Multimedia System and Application **Subject Code: ……**

(Professional Elective II)

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. To introduce students to the fundamental concepts and principles of multimedia systems.
2. To provide an understanding of multimedia data representation, compression, and transmission techniques.
3. To familiarize students with multimedia applications and their real-world implementations.
4. To develop practical skills in designing and developing multimedia systems and applications.
5. To encourage students to analyze and evaluate the performance of multimedia systems in various contexts.

Course Outcomes

1. Understand the components and architecture of multimedia systems.
2. Apply multimedia data compression techniques to optimize storage and transmission.
3. Design and develop multimedia applications using appropriate tools and technologies.
4. Analyze and evaluate the performance of multimedia systems based on quality metrics and user experience.
5. Demonstrate an understanding of ethical and legal considerations in multimedia content creation and distribution.

Unit 1: INTRODUCTION TO MULTIMEDIA SYSTEMS

Overview of multimedia concepts, components, and applications. Multimedia data types and formats. Multimedia system architecture and components.

Unit 2: MULTIMEDIA DATA REPRESENTATION AND COMPRESSION

Digital audio and video representation. Image and video compression techniques (e.g., JPEG, MPEG). Lossy and lossless compression algorithms.

Unit 3: MULTIMEDIA COMMUNICATION AND STREAMING

Multimedia data transmission over networks. Streaming media protocols and technologies. Quality of Service (QoS) considerations in multimedia communication.

Unit 4: **MULTIMEDIA APPLICATIONS AND DEVELOPMENT**

Multimedia authoring tools and platforms. Design principles for interactive multimedia applications. Case studies of multimedia applications in various domains.

Unit 5: ETHICAL AND LEGAL ASPECTS OF MULTIMEDIA

Ethical considerations in multimedia content creation and distribution. Intellectual property rights and copyright issues in multimedia. Regulatory frameworks and standards for multimedia systems and applications.

TEXTBOOKS

1. Title: "Multimedia Systems and Applications", Author: Ralf Steinmetz, Klara Nahrstedt, Publication Details: Springer, 2004.

2. Title: "Multimedia: Computing, Communications & Applications", Author: Ralf Steinmetz, Klara Nahrstedt, Publication Details: Prentice Hall, 2010.

REFERENCE BOOKS

1. Title: "Multimedia Systems", Author: John F. Koegel Buford, J. Lennox, Publication Details: Springer, 2014.

2. Title: "Introduction to Multimedia Systems", Author: Sugata Mitra, Publication Details: Chapman and Hall/CRC, 2017

3. Title: "Multimedia Systems: Algorithms, Standards, and Industry Practices", Author: Parag Havaldar, Gerard Medioni. Publication Details: Springer, 2014.

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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Image Processing (Professional Elective II) **Subject Code: ……**

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. To introduce students to the fundamental principles and techniques of digital image processing.
2. To provide an understanding of various image enhancement and restoration methods.
3. To familiarize students with image segmentation and feature extraction techniques.
4. To develop practical skills in implementing image processing algorithms using appropriate tools and programming languages.
5. To encourage students to analyze and evaluate the performance of image processing algorithms in real-world applications.

Course Outcomes

1. Understand the theoretical foundations of digital image processing.
2. Apply various image enhancement techniques to improve image quality and visual appearance.
3. Implement image restoration algorithms to remove noise and other artifacts from images.
4. Design and implement image segmentation algorithms for object detection and recognition.
5. Analyze and evaluate the performance of image processing algorithms based on quantitative metrics and visual inspection.

Unit 1: INTRODUCTION TO DIGITAL IMAGE PROCESSING

Overview of digital image processing concepts and applications. Digital image representation and characteristics.Image acquisition and preprocessing techniques.

Unit 2: IMAGE ENHANCEMENT AND RESTORATION

Spatial domain enhancement techniques (e.g., histogram equalization, spatial filtering). Frequency domain enhancement techniques (e.g., Fourier transform, filtering in frequency domain). Image restoration techniques (e.g., image denoising, image deblurring).

Unit 3: IMAGE SEGMENTATION AND FEATURE EXTRACTION

Thresholding and region-based segmentation methods. Edge detection algorithms (e.g., Sobel, Canny). Feature extraction techniques (e.g., corner detection, texture analysis).

Unit 4: MORPHOLOGICAL IMAGE PROCESSING

Mathematical morphology operations (e.g., erosion, dilation, opening, closing). Morphological image processing for noise removal and feature extraction. Applications of morphological operations in image analysis.

Unit 5: ADVANCED TOPICS IN IMAGE PROCESSING

Image compression techniques (e.g., JPEG, wavelet-based compression).Image registration and fusion methods. Case studies and applications of image processing in various domains (e.g., medical imaging, remote sensing).

TEXTBOOKS

1. Title: "Digital Image Processing", Author: Rafael C. Gonzalez, Richard E. Woods, Publication Details: Pearson, 2017

2. Title: "Digital Image Processing Using MATLAB", Author: Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Publication Details: Gatesmark Publishing, 2019

REFERENCE BOOKS

1. Title: "Image Processing, Analysis, and Machine Vision", Author: Milan Sonka, Vaclav Hlavac, Roger Boyle, Publication Details: Cengage Learning, 2014.

2. Title: "Principles of Digital Image Processing: Core Algorithms", Author: Wilhelm Burger, Mark J. Burge, Publication Details: Springer, 2009.

3. Title: "Computer Vision: Algorithms and Applications", Author: Richard Szeliski, Publication Details: Springer, 2010.

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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: High Performance Computing **Subject Code: ……**

(Professional Elective II)

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. To introduce students to the principles and techniques of high-performance computing (HPC)
2. To provide an understanding of parallel computing architectures and programming models.
3. To familiarize students with performance optimization techniques for HPC applications.
4. To develop practical skills in designing and implementing parallel algorithms for various computational tasks.
5. To encourage students to analyze and evaluate the performance of HPC systems and applications.

Course Outcomes

1. Understand the principles of parallel computing and its relevance to high-performance computing.
2. Apply parallel programming models and techniques to solve computationally intensive problems.
3. Design and implement parallel algorithms for tasks such as matrix multiplication, sorting, and numerical simulations.
4. Optimize the performance of parallel applications using profiling, tuning, and scaling techniques.
5. Evaluate the performance and scalability of HPC systems based on metrics such as speedup, efficiency, and scalability.

Unit 1: INTRODUCTION TO HIGH-PERFORMANCE COMPUTING

Overview of high-performance computing concepts, applications, and challenges. Evolution of computing architectures and the need for parallelism. Introduction to parallel computing models (e.g., SIMD, MIMD).

Unit 2: PARALLEL COMPUTING ARCHITECTURES

Classification of parallel computing architectures (e.g., shared-memory, distributed-memory). Multi-core processors, GPUs, and accelerators for parallel computing. Interconnection networks and communication overhead in parallel systems.

Unit 3: PARALLEL PROGRAMMING MODELS

Introduction to parallel programming languages and libraries (e.g., MPI, OpenMP, CUDA). Parallelization techniques for different computational tasks (e.g., data parallelism, task parallelism). Hands-on exercises with parallel programming frameworks.

Unit 4: PERFORMANCE OPTIMIZATION IN HPC

Profiling and performance analysis of parallel applications. Optimization techniques for memory access, communication, and computation.
Scalability analysis and load balancing in parallel computing environments.

Unit 5: ADVANCED TOPICS IN HIGH-PERFORMANCE COMPUTING

Parallel algorithms for specific computational tasks (e.g., numerical simulations, machine learning). High-performance computing in big data analytics and artificial intelligence. Case studies of HPC applications in scientific computing, engineering, and industry.

TEXTBOOKS

1. Title: "Introduction to High Performance Computing for Scientists and Engineers", Author: Georg Hager, Gerhard Wellein, Publication Details: CRC Press, 2010

2. Title: "Parallel Programming: Concepts and Practice", Author: Thomas Rauber, Gudula Rünger, Publication Details: CRC Press, 2010

REFERENCE BOOKS

1. Title: "High Performance Computing", Author: Charles Severance, Kevin Dowd, Publication Details: O'Reilly Media, 2018

2. Title: "Parallel and Distributed Computing: A Survey of Models, Paradigms and Approaches", Author: Claudia Leopold, Wolfgang Karl, Publication Details: Springer, 2012

3. Title: "Programming Massively Parallel Processors: A Hands-on Approach", Author: David B. Kirk, Wen-mei W. Hwu, Publication Details: Morgan Kaufmann, 2012

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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Crypto-currency and Block Chain Technology (Professional Elective II)

Subject Code: ……

Total Theory Periods: 40 **Total Tutorial Periods: 10**

No. of Class tests to: 2 (Minimum) **No. of Assignments to be submitted: One per Unit**

ESE Duration: Three Hours, **Maximum Marks in ESE: 100**

Minimum Marks in ESE: 35

Course Objectives

1. To introduce students to the fundamental concepts and principles of cryptocurrencies and blockchain technology.
2. To provide an understanding of the underlying cryptographic techniques used in cryptocurrencies and blockchain.
3. To familiarize students with the architecture and components of blockchain systems.
4. To explore the applications and use cases of blockchain technology beyond cryptocurrencies.
5. To develop practical skills in designing and implementing blockchain-based solutions.

Course Outcomes

1. Understand the fundamentals of cryptocurrencies, including their history, characteristics, and mechanics.
2. Analyze the cryptographic techniques used in blockchain technology, such as hashing, digital signatures, and consensus mechanisms.
3. Explain the architecture and components of blockchain systems, including blocks, transactions, and distributed ledgers.
4. Identify and evaluate various applications of blockchain technology in industries such as finance, supply chain, and healthcare.
5. Design and implement basic blockchain solutions, including smart contracts and decentralized applications (DApps).

Unit 1: INTRODUCTION TO CRYPTOCURRENCIES

Overview of cryptocurrencies: history, characteristics, and benefits. Cryptographic techniques used in cryptocurrencies: hashing, digital signatures, and cryptographic hash functions. Introduction to blockchain technology and its role in cryptocurrencies.

Unit 2: BLOCKCHAIN ARCHITECTURE AND COMPONENTS

Basic principles of blockchain: decentralized consensus, immutability, and transparency. Blockchain architecture: blocks, transactions, and the structure of a blockchain. Types of blockchain networks: public, private, and consortium.

Unit 3: CRYPTOCURRENCY MECHANICS AND ECONOMICS

Mechanics of cryptocurrency transactions: wallets, addresses, and keys. Cryptocurrency mining: proof-of-work, proof-of-stake, and other consensus mechanisms. Economic aspects of cryptocurrencies: valuation, volatility, and market dynamics.

Unit 4: APPLICATIONS OF BLOCKCHAIN TECHNOLOGY

Beyond cryptocurrencies: use cases of blockchain in finance, supply chain management, healthcare, and more. Smart contracts: definition, execution, and applications. Decentralized applications (DApps) and their potential impact on various industries.

Unit 5: BLOCKCHAIN DEVELOPMENT AND IMPLEMENTATION

Blockchain development platforms and tools: Ethereum, Hyperledger, and others. Hands-on exercises with blockchain development: creating smart contracts, deploying DApps, and interacting with blockchain networks. Challenges and future directions in blockchain technology.

TEXTBOOKS

1. Title: "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", Author: Andreas M. Antonopoulos, Publication Details: O'Reilly Media, 2017

2. Title: "Blockchain Basics: A Non-Technical Introduction in 25 Steps", Author: Daniel Drescher,Publication Details: Apress, 2017

REFERENCE BOOKS

1. Title: "Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World", Author: Don Tapscott, Alex Tapscott, Publication Details: Portfolio, 2016

2. Title: "Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations", Author: Henning Diedrich
Publication Details: CreateSpace Independent Publishing Platform, 2017

3. Title: "Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications", Author: Imran Bashir, Publication Details: Packt Publishing, 2018

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

Branch: B Tech Honours (Data Science) **Semester - VII**

Subject: Technical Communication and Soft Skill **Subject Code: ……**

Maximum Marks (TA): 20

1. Effective Communication in Data Science

Principles of effective technical communication. Written and verbal communication skills. Presentation techniques for conveying data science concepts.

2. Teamwork and Collaboration

Importance of teamwork in data science projects.Collaboration tools and techniques.
Case Study: Team dynamics in a data science project team.

3. Problem-Solving Skills

Critical thinking and problem-solving strategies. Analytical skills for data analysis and interpretation.
Case Study: Problem-solving approach in analyzing real-world datasets.

4. Time Management and Productivity

Time management techniques for project completion. Prioritization and task management skills.
Case Study: Managing time effectively in data science project deadlines.

5. Professional Ethics and Integrity

Ethical considerations in data science research and analysis. Maintaining integrity and professionalism in data handling.
Case Study: Ethical dilemmas in data collection and analysis processes.