Vidya Pratishthan's Kamalnayan Bajaj Institute of Engineering and Technology, Baramati

(An Autonomous Institute)

Department of Artificial Intelligence and Data Science

T.Y. B. Tech Syllabus A.Y.2025-26

(As per NEP 2020)

ABOUT DEPARTMENT

- Involvement of Experts from IITs, Govt. Colleges, Reputed Industries, Alumni and Students in development of curriculum.

- Automatic Bank Credit System (ABC)

- Choice of Electives

- Remedial Teaching

- Sponsorship for Publications and IPR

- Research Mentorship

- Industry Internship

- Provision of Credit Transfer Scheme (CTS)

- Peer Teaching Scheme

- Teacher Guardian Scheme (TGS)

- Proficiency Courses

- MOUs with Industries

INSTITUTE VISION AND MISSION

VISION

To achieve Academic Excellence through Persistent and Synergic Collaborations amongst all Stakeholders.

MISSION

1. To ensure holistic development of students as lifelong learners and problem solvers through value-based quality education.

2. To motivate faculty to attain the state-of-the-art knowledge and wisdom in their domain and be a facilitator towards co creation of knowledge.

3. To frame and deploy conducive and empowering policies for multifaceted growth of students, faculty and staff to make them contributors towards excellence.

4. To partner with industry for mutually beneficial relations to generate employable and deployable workforce.

5. To fulfill the aspirations of alumni, parents, society, region and nation at large by generating technically competent and contributing manpower.

DEPARTMENT VISION AND MISSION

VISION

Imparting quality education to develop skillful, dynamic and creative workforce

in the domain of Artificial Intelligence and Data Science

MISSION

1. To provide skill-based and state-of-the-art knowledge and induce

   problem solving skills to the graduates.

2. To associate with the industry and institutes of repute for experiences in the

   domain of Artificial Intelligence and Data Science.

3. To encourage the students for the solutions to the societal problems using the

   skills and knowledge of Artificial Intelligence & Data Science.

4. To undertake cross-disciplinary work for the experience based learning and

   collaborative research.

PROGRAM OUTCOMES (POS)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus: Third Year (TY B. Tech.) Artificial Intelligence and Data Science w.e.f. T.Y: 2025-26

SEMESTER-V

Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks							Credits			
		TH	PR	TUT	Activity	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
AI23301	AI and Neural Networks	3	2	-	10	30	60	-	30	-	130	3	1	-	**4**
AI23302	Machine Learning	3	2	-	10	30	60	-	30	-	130	3	1	-	**4**
AI23303	Programme Elective Course I	3	2	-	10	30	60	-	30	-	130	3	1	-	**4**
AI230XX	Multi-Disciplinary minor	2	2	-	20	20	50	20	-	-	110	2	1	-	**3**
HS23301	Universal Human Values	2	-	-	10	-	60	-	-	-	70	2	-	-	**2**
OE230XX	Open Elective	2	-	-	-	-	50	-	-	-	50	2	-	-	**2**
AI23304	Community Engagement Project	-	4	-	10	-	-	30	-	30	70	-	2	-	**2**
HS23302	Constitution of India											**Grade**			
	Total	15	12	-	70	110	340	50	90	30	690	15	06	-	**21**

Programme Elective List:

AI23303	Elective Programme Course-I
AI23303A	Big Data Fundamentals & Applications
AI23303B	Introduction to Web Development with AI
AI23303C	Cybersecurity for Artificial Intelligence

Syllabus: Third Year (TY B. Tech.) Artificial Intelligence and Data Science w.e.f. TY:2025-26

SEMESTER-VI

Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks							Credits			
		TH	PR	TUT	Activity	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
AI23311	Natural Language Processing	3	2	-	10	30	60	-	30	-	130	3	1	-	**4**
AI23312	Programme Elective Course II	3	2	-	10	30	60	-	30	-	130	3	1	-	**4**
AI23313	Programme Elective Course III	3	2	-	10	30	60	-	30	-	130	3	1	-	**4**
AI230XX	Multi-Disciplinary Minor	2	2	-	20	20	50	20	-	-	110	2	1	-	**3**
HS23311	Environment Studies	2	-	-	10	-	60	-	-	-	70	2	-	-	**2**
OE230XX	Open Elective	2	-	-	-	-	50	-	-	-	50	2	-	-	**2**
AI23315	Vocational and Skill Enhancement Course (VSEC)	-	4	-	10	-	-	30	30	-	70	-	2	-	**2**
HS23312	Democracy, Election, and Governance														**Grade**
Total		**15**	**12**	**-**	**70**	**110**	**340**	**50**	**120**	**-**	**690**	**15**	**6**	**-**	**21**

Programme Elective List:

AI23312	Programme Elective Course-II
AI23312A	Advanced Big Data Analytics and Applications
AI23312B	AI Powered Web Development
AI23312C	AI-Driven Business Intelligence

AI23313	Programme Elective Course-III
AI23313A	Federated Learning
AI23313B	AI-based Innovation and Product Development
AI23313C	Industrial AI-powered intelligence(IndusAI)

Dept. Autonomy Coordinator
Mrs. R. S. Naik

Dept. Academic Coordinator
Mr. P. N. Shendage

HOD, AI&DS
Dr. C. S. Kulkarni

Dean Autonomy
Dr. G. B. Nayak

Dean Academics
Dr. S. M. Bhosle

Principal
Dr. S. B. Lande
Principal
Vidya Pratishthan's
Kamalnayan Bajaj Institute of
Engineering & Technology, Baramati
Vidyanagari, Baramati-413133

BUCKET OF MULTIDISCIPLINARY MINOR COURSE

Multidisciplinary Minor Subjects	
Subject Code	**Subject Name**
AI23051	Data Processing and Analysis

BUCKET OF OPEN ELECTIVES

Open Elective Subjects	
Subject Code	**Subject Name**
OE23001	Digital Marketing
OE23012	International Relations
OE23014	Education Technology

HONORS DEGREE
(only for students having CGPA >= 7.5)
Honor: Computational Intelligence

DOUBLE MINOR DEGREE
(only for students having CGPA >= 7.5)
Double Minor: Artificial Intelligence and Data Science

SEMESTER I

	Vidya Pratishthan's **Kamalnayan Bajaj Institute of Engineering and Technology, Baramati** **(Autonomous Institute)**

AI23301- Artificial Intelligence and Neural Networks

Teaching Scheme: Theory: 3 Hours/Week Practical: 2 Hour/Week	Credits 04	Examination Scheme: Activity Marks:10 Marks In Sem: 30 Marks End Sem: 60 Marks Practical: 30 Marks

Prerequisites: Programming and Problem Solving, Data Structures and Algorithms

Course Objectives:
- To understand the fundamental concepts of Artificial Intelligence (AI) and Artificial Neural Networks (ANN).
- To explore problem-solving techniques, search strategies, knowledge representation, and logical reasoning for intelligent decision-making.
- To achieve goal-oriented AI systems analyze multi-agent environments, adversarial search, and automated planning.
- To study learning algorithms such as supervised, associative, and competitive learning, along with deep learning models.
- To apply AI and ANN techniques in solving complex real-world problems.

Course Outcomes (COs): The students will be able to:

CO1: Apply and evaluate problem-solving and search strategies to effectively address real-time challenges.

CO2: Analyze and apply first-order logic for model assessment and inference understanding in AI systems.

CO3: Evaluate and integrate AI ethics and automated planning principles in the design of AI-based applications for responsible and efficient decision-making.

CO4: Implement and analyze the training of neural networks using various learning rules to enhance model performance.

CO5: Analyze and apply the principles of Associative and Competitive Learning Neural Networks to solve classification and pattern recognition problems.

CO6: Apply and evaluate new tools and techniques to solve a wide variety of real-world problems efficiently.

Course Contents

Unit I: Problem-Solving and Search Strategies (07 Hours)
Problem-Solving by Searching: Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Local Search and Optimization Problems.
Adversarial Search and Games: Game Theory, Optimal Decisions in Games, Heuristic Alpha–Beta Tree Search, Monte Carlo Tree Search, Stochastic Games, Partially Observable Games, and Limitations of Game Search Algorithms. Constraint Satisfaction Problems (CSP).

Unit II: Knowledge Representation and Reasoning (07 Hours)
Logical and Knowledge-Based Agents: Logical Agents, Knowledge-Based Agents, The Wumpus

World, Propositional Logic: Propositional Theorem Proving, Effective Propositional Model Checking, Agents.

First Order Logic and Inference: First-Order Logic, Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic, Propositional vs. First-Order Inference, Unification and First-Order Inference, Forward Chaining, Backward Chaining, Resolution, Knowledge Representation.

Unit III: Planning, AI Ethics (07 Hours)
Automated Planning: Classical Planning, Algorithms for Classical Planning, Heuristics for Planning, Hierarchical Planning.

AI Ethics & Future of AI: Limits of AI, Ethics of AI, Future of AI, AI Components, AI Architectures.

Unit IV: Learning Algorithms and Neural Network Fundamentals (07 Hours)
Learning and Memory, Learning Algorithms, Number of Hidden Nodes, Error Correction and Gradient Descent Rules, Perceptron Learning Algorithms, Supervised Learning & Backpropagation: Multilayered Network Architectures, Backpropagation Learning Algorithm. Feedforward and Feedback Neural Networks.

Unit V: Associative and Competitive Learning in Neural Networks (07 Hours)
Associative Learning: Hopfield Network, Error Performance in Hopfield Networks, Simulated Annealing, Boltzmann Machine & Boltzmann Learning, State Transition Diagram & False Minima Problem, Stochastic Update & Simulated Annealing.

Competitive Learning Neural Networks (CLN): Pattern Clustering & Feature Mapping Networks, Adaptive Resonance Theory (ART) Networks, Features of ART Models, Character Recognition using ART Networks.

Self-Organizing Maps (SOM): Two Basic Feature Mapping Models, SOM Algorithm, Properties of Feature Maps.

Unit VI: Deep Learning and Applications of ANN (07 Hours)
Convolutional Neural Networks (CNNs): Building Blocks of CNNs, Convolution / Pooling Layers, Padding & Stride Convolutions, SoftMax Regression, Deep Learning Frameworks, Transfer Learning & Multi-Task Learning.

Introduction to CNN Models: LeNet-5, AlexNet, VGG-16, Residual Networks.

Applications of ANN: Pattern Classification – Recognition of Olympic Games Symbols, Recognition of Printed Characters, Neocognitron – Recognition of Handwritten Characters, NET Talk – English Text to Speech Conversion.

Text Books:
1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third edition, Pearson, 2003, ISBN :10: 0136042597
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN: 978-1-25-902998-1
3. Elaine Rich, Kevin Knight and Nair, "Artificial Intelligence", TMH, ISBN-978-0-07-008770-5.
4. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.
5. Laurene Fausett: Fundamentals of Neural Networks: Architectures, Algorithms & Apps, Pearson, 2004.

6. An introduction to neural networks, Gurney, Kevin, CRC press.

Reference Books:
1. Nilsson Nils J, "Artificial Intelligence: A new Synthesis", Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4.
2. 2.Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley Publishing Company, ISBN: 0-201-53377-4.
3. Dr. Lavika Goel, "Artificial Intelligence: Concepts and Applications", Wiley publication, ISBN: 9788126519934.
4. 4.Artificial Neural Networks - B. Vegnanarayana Prentice Hall of India P Ltd ,2005
5. 5.Neural Networks in Computer Intelligence- Li Min Fu, MC GRAW HILL EDUCATION, 2003
6. 6.Neural Networks -James A Freeman David M S Kapura, Pearson Education, 2004.

7. 7.Introduction to Artificial Neural Systems- Jacek M. Zurada, JAICO Publishing House Ed.,2006.

E-Resources:

- https://nptel.ac.in/courses/106/102/106102220/

- https://nptel.ac.in/courses/106/105/106105077/

- https://nptel.ac.in/courses/106/105/106105078/

- https://nptel.ac.in/courses/106/105/106105079/

- https://nptel.ac.in/courses/117105084.

- https://www.coursera.org/projects/predicting-weather-artificial-neural-networks

List of Assignments

1. Given a 2D grid maze, where some cells are blocked (obstacles) and others are free paths, implement a pathfinding AI that finds the shortest route from a start position (S) to a goal position (G) using:

   a. A* Algorithm

   b. Greedy Best-First Search (GBFS)

2. Develop a Python program to solve a CSP-based Sudoku Solver and a Map Coloring Problem using Backtracking Search with heuristics.

3. Develop a medical diagnosis system using First-Order Logic (FOL) that can infer diseases based on symptoms and conditions.

4. Given Knowledge Base (KB) in FOL:

   a. $\forall x$ (Fever(x) $\wedge$ Cough(x) $\rightarrow$ Flu(x))

   b. $\forall x$ (Flu(x) $\rightarrow$ NeedsRest(x))

   c. $\forall x$ (SevereCough(x) $\wedge$ ShortnessOfBreath(x) $\rightarrow$ Pneumonia(x))

   d. Fever(John)

   e. Cough(John)

5. Implement Linear Regression using Batch Gradient Descent (BGD), Stochastic Gradient Descent (SGD), and Mini-Batch Gradient Descent (MBGD).

   a. Given a dataset of house prices (features: size, number of rooms), use Gradient Descent to optimize model parameters.

   b. Compare the convergence rates of BGD, SGD, and MBGD.

6. Handwritten Digit Recognition (MNIST Dataset)-Implement a 3-layer neural network (Input → Hidden → Output) using Backpropagation.

    a. Use Sigmoid, ReLU, or Tanh activation functions.

    b. Train the network on the MNIST dataset to classify handwritten digits (0-9).

    c. Optimize using Gradient Descent with Momentum or Adam Optimizer.

7. Clustering 2D Data Using ART1-

    a. Implement the ART1 algorithm for binary input data.

    b. Given a set of binary vectors, cluster them into categories based on similarity.

    c. Use vigilance parameter (ρ) to control cluster formation. Clustering 2D Data using Winner-Takes-All (WTA) Network Implement a Winner-Takes-All (WTA) neural network to cluster 2D data points.

    d. Each neuron represents a cluster center, and only the winning neuron (closest to input) updates its weights.

    e. Train the network on randomly generated 2D points and visualize the clusters.

8. Object Recognition using CNN (CIFAR-10 Dataset)

    a. Train a CNN model to classify CIFAR-10 images into 10 object categories (airplane, cat, car, dog, etc.).

    b. Use data augmentation to improve model generalization.

    c. Compare model performance with and without Batch Normalization and Dropout.

9. Implementing Self-Organizing Maps (SOM) for Image Compression-

    a. Implement Kohonen's Self-Organizing Map (SOM) for image compression.

    b. Train SOM to reduce the number of colors in an image.

    c. Display the original and compressed images to analyze quality loss.

10. Implementing Self-Organizing Maps (SOM) for Image Compression-

    a. Implement Kohonen's Self-Organizing Map (SOM) for image compression.

    b. Train SOM to reduce the number of colors in an image.

    c. Display the original and compressed images to analyze quality loss.

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AI23302- Machine Learning		
Teaching Scheme: **Theory: 3 Hours/Week** **Practical: 2 Hour/Week**	**Credits** **04**	**Examination Scheme:** **Activity Marks: 10 Marks** **In Sem: 30 Marks** **End Sem: 60 Marks** **Practical: 30 Marks**

Prerequisites: Data Science , Python Programming Language

Course Objectives:
- Describe various learning paradigms and machine learning models.
- Utilize regression techniques to make predictions across different applications.
- Implement classification algorithms to categorize data with suitable labels.
- Employ clustering algorithms to group unlabeled data based on similarities.
- Explore and incorporate advanced ensemble models.
- Explain reinforcement learning concepts and associated algorithms.

Course Outcomes COs): The students will be able to learn:

CO1: Explain and differentiate various Machine Learning Models.

CO2: Develop ML models for predictive tasks using linear, non-linear, and logistic regression techniques.

CO3: Apply classification techniques to solve binary and multi-class problems.

CO4: Utilize clustering methods to organize and analyze unlabeled data.

CO5: Combine multiple machine learning algorithms through ensemble learning.

CO6: Implement reinforcement learning techniques for diverse applications.

Course Contents

Unit No. I: Introduction to Machine Learning (07 Hours)
Introduction: Machine Learning, Definition of Learning, Life Cycle, ML Vs AI, Classification, Regression, Clustering, Types, Applications. Feature Transformation: Dimensionality Reduction Techniques- PCA and LDA.

Unit No. II: Regression (07 Hours)
Introduction: Regression, Types of Regression: Univariate vs. Multivariate, Linear vs. Nonlinear, Bias-Variance tradeoff, Overfitting, Underfitting. Regression Techniques: Polynomial, Stepwise, Decision Tree, Random Forest , Support Vector, Ridge, Lasso, Evaluation Metrics: Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE),R-squared, Adjusted R squared ,Mean Absolute Percentage Error (MAPE).

Unit No. III: Classification (07 Hours)
Introduction: Importance of classification, Types (Binary and Multiclass), Challenges in balanced vs. imbalanced classification problems. Binary Classification: Linear classification models, Performance metrics – Confusion matrix, Accuracy, Precision, Recall, F-measure, ROC and AUC-ROC and MCC. Multiclass Classification: Classification strategies – one-vs-one, one-vs-all approaches, Classification algorithms: K-Nearest Neighbor (KNN), linear support vector machines (SVM), and Multinomial Naïve Bayes.

Unit No. IV: Clustering (07 Hours)

Introduction: Clustering, Types of Clustering, Hierarchical clustering algorithms and its types, Centroid-based clustering algorithms: K-Means clustering algorithm, Elbow method, The Silhouette method, K-Medoids. Density-based clustering algorithms: DBSCAN algorithm and it's working.

Unit No. V: Ensemble Learning (07 Hours)

Introduction to Ensemble Learning and Its Applications, Types of Ensemble Methods: Bagging, Boosting, Stacking, Voting Ensemble: Max Voting, Averaging, Weighted Average, Advanced Techniques: AdaBoost, Gradient Boosting, XGBoost, Random Forest, Advantages of Ensemble Methods.

Unit No. VI: Reinforcement Learning (07 Hours)

Introduction: Reinforcement Learning, Supervised vs Unsupervised Vs Reinforcement Learning, Types of Reinforcement, Elements of Reinforcement Learning, Real time applications of Reinforcement learning. Markov's Decision Process: Markov property, Markov chain/process, Markov reward process (MRP), Markov decision process (MDP), Return, Policy, Value functions, Introduction of Q-Learning.

Text Books:

1. Ethem Alpaydin., "Introduction to Machine Learning" by The MIT Press ISBN: 978-0262043793, Fourth Edition (April 2020),
2. Peter Flach., "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012.
3. Bishop M., C., "Pattern Recognition and Machine Learning", Springer-Verlag (2011) 2nd Edition.
4. Alpaydin E. "Introduction to Machine Learning", MIT Press (2014) 3rd Edition.

Reference Books:

1. McKinney., "Python for Data Analysis" Second Edition (2017) O'Reilly Media ISBN: 978-1-491-95766-0.
2. H. Witten, Eibe Frank, Mark A. Hall, and Christopher J. Pal. "Data Mining: Practical Machine Learning Tools and Techniques" The fourth edition was published in 2016.
3. Shalev-Shwartz, Shai, and Shai Ben-David, "Understanding machine learning: From theory to algorithms", Cambridge university press, 2014.
4. Jiawei Han, Micheline Kamber, and Jian Pei. "Data Mining: Concepts and Techniques" The third edition was published in 2011.

E-Resources:

- Introduction to Machine Learning (IIT kharagpur) : https://nptel.ac.in/courses/106105152
- Introduction to Machine Learning: https://onlinecourses.nptel.ac.in/noc23_cs18/preview

List of Assignments

1. Apply PCA on the Wine dataset to reduce dimensionality and visualize principal components for distinguishing between red and white wine. Dataset Link: https://media.geeksforgeeks.org/wp-content/uploads/Wine.csv

2. Develop a Ridge and Lasso regression model to predict the number of bike rentals based on weather conditions and time. Dataset: Bike Sharing Dataset (UCI)

3. Create a multiclass classification model to predict wine quality based on chemical properties. Dataset: Wine Quality Dataset (UCI)

4. Develop a Support Vector Machine (SVM) classification model to predict whether a tumor is malignant or benign based on various features derived from digitized images of fine needle

aspirate (FNA) of breast mass. Dataset: Breast Cancer Wisconsin (Diagnostic) Dataset (UCI Machine Learning Repository).

5. Develop a Random Forest classification model to predict the forest cover type based on cartographic variables. Handle missing data and perform feature scaling. Evaluate the model using accuracy, precision, recall, and F1 score. Dataset: Forest CoverType Dataset (UCI).

6. Utilize the K-Means clustering algorithm to segment customers based on their purchasing behavior. Apply the Elbow Method to determine the optimal number of clusters that best represent distinct customer segments for targeted marketing strategies. Dataset: UCI Machine Learning Repository - Wholesale Customers Data Set

7. Use K-Medoids clustering to segment wholesale customers based on their annual spending on different product categories. Identify the optimal number of clusters to effectively group customers with similar purchasing behaviours. Dataset: Wholesale Customers Dataset (UCI).

8. Develop a Gradient Boosting regression model to predict wine quality based on physicochemical properties. Handle missing values, perform feature scaling, and evaluate the model using MSE, MAE, RMSE, and R-squared. Dataset: Wine Quality Dataset (UCI).

9. Build an XGBoost classification model to predict loan defaults based on borrower information and loan characteristics. Preprocess the data by handling missing values, encoding categorical variables, and addressing class imbalance. Evaluate the model using AUC-ROC and F1 score. Dataset: Lending Club Loan Data (Kaggle).

10. Solve the Taxi problem using reinforcement learning, where an agent acts as a taxi driver to pick up and drop off passengers efficiently.

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Elective – I AI23303 (A) - Big Data Fundamentals & Applications

Teaching Scheme: **Theory: 3 Hours/Week** **Practical: 2 Hour/Week**	**Credits** **04**	**Examination Scheme:** **Activity Marks: 10 Marks** **In Sem: 30 Marks** **End Sem: 60 Marks** **Practical: 30 Marks**

Prerequisites: Database Management System, Data Science.

Course Objectives:

- Introduce students to fundamental concepts, terminology, and applications of big data.
- Develop an understanding of advanced analytical methods in data science.
- Familiarize students with essential tools such as Hadoop, NoSQL, and map reduce for big data management and analysis.
- Implement industry-standard solutions using big data analytics.
- To analyze the applications of big data across industries and understand its impact on real-world problem-solving.

Course Outcomes (COs): Upon completing the course, students will be able to:

CO1: Implement techniques for handling missing data in real-world applications.

CO2: Utilize modern architectures and platforms for big data, particularly hadoop and map reduce.

CO3: Demonstrate analytical methods such as clustering and association rules in big data analytics.

CO4: Apply various operations on distributed storage.

CO5: Distinguish advanced predictive analytics algorithms across domains like retail, finance, and healthcare.

CO6: Able to analyze and evaluate the role of big data in real-world problem-solving.

Course Contents

Unit I: Introduction to Big Data and Analytics: (07 Hours)

Big Data: Key Characteristics, Evolution, Definition, Challenges, Traditional Business Intelligence Vs. Big Data, Current Practices In Analytics, Roles In Big Data Ecosystems, Big Data Analytics**:** Introduction, Classification of Analytics, Challenges, Importance Of Analytics.

Unit II: Big Data Platforms (07 Hours)

Overview of Apache Spark, HDFS, YARN, MapReduce, MapReduce Programming Model with Spark, MapReduce Example: Word Count, Page Rank etc., CAP Theorem, Eventual Consistency, Consistency TradeO-s, ACID and BASE, Zookeeper and Paxos, Cassandra, Cassandra Internals, HBase, HBase Internals.

Unit III: Pattern Discovery and Clustering (07 Hours)

Frequent Itemset Mining: Market Basket Model, Apriori Algorithm, Managing Large Datasets in Main Memory, Limited Pass Algorithm for Efficient Processing, Counting Frequent Itemset in Data Streams Clustering Techniques Overview: Hierarchical Clustering, K-Means Clustering, Frequent Pattern-Based Clustering.

Unit IV: Hadoop Distributed File System (07 Hours)

Distributed System Overview, Distributed File System with NFS, Basic HDFS Architecture: NameNode, Secondary NameNode, DataNode, checkpoint Node. Features of HDFS, HDFS Assumption and Goals: Hardware failure, Streaming data access, Large datasets, coherency model. HDFS Read and Write Operations.

Unit V: Advanced Predictive Analytics Algorithms and Python (07 Hour)

Introduction to Exploratory Data Analysis (EDA): Definition, significance, key steps in data exploration, and various data types. Enhancing Classification Accuracy: Overview of ensemble methods, including Machine Learning, AdaBoost, and Random Forest techniques. Model Evaluation and Selection: Understanding the Confusion Matrix, dataset partitioning strategies such as the Holdout Method and Random Subsampling, and the application of Cross-Validation.

Unit VI: Applications of Big Data (07 Hour)

Introduction To Real-World Use Cases, Key Benefits, And Challenges Case Studies**:** Healthcare, Finance & Banking, E-Commerce & Marketing, Smart Cities & Iot, Ethical & Future Trends In Big Data Applications.

Text Books:

1. Raj Kamal and Preeti Saxena, "Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning", McGraw Hill Education, 2018 ISBN: 9789353164966, 9353164966.
2. Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1stEdition, Pearson Education, 2016. ISBN13: 978-9332570351.
3. Data Analytics: The Ultimate Beginner's Guide to Data Analytics Paperback – 12 November 2017by Edward Mize.
4. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques", Elsevier Publishers, ISBN:9780123814791, 9780123814807.

Reference Books:

1.Professional Hadoop, Benoy Antony et al, July 2016, Wiley.
2.Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Michael Minelli et al Wiley, 2013.
3.Raj, Pethuru, "Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGI Global, 2014.
4.Wajid Khattak, Paul Buhler, Thomas Erl, "Big Data Fundamentals: Concepts, Drivers & Techniques", John Wiley & Sons, ISBN: 13: 9780134291079.

E-Resources:

- https://archive.nptel.ac.in/courses/106/104/106104189/

List of Assignments

1. Setup and Configuration of a Single-Node Hadoop System.
2. Develop a MapReduce Program for Word Frequency Analysis.
3. Implement Matrix Multiplication Using MapReduce.
4. Create a MapReduce Program to Determine Student Grades.
5. Develop and Implement Applications Using Apache Spark.
6. To implement and analyze frequent itemset mining and clustering techniques on a real-world dataset using Python.
7. To perform Exploratory Data Analysis (EDA), enhance classification accuracy using ensemble methods, and evaluate model performance using appropriate validation techniques in Python.
8. Analyze Titanic Disaster Data Using MapReduce.

     I. Calculate the average age of deceased males.

     II. Determine the number of deceased females in each class.

9. Hive: Introduction Creation of Database and Table, Hive Partition, Hive Built in Function and Operators, Hive View and Index.

10. Visualization: Connect to data, Build Charts and Analyze Data, Create Dashboard, Create Stories using Tableau/PowerBI.

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Elective – I AI23303 (B) - Introduction to Web Development with AI		
Teaching Scheme: **Theory: 3 Hours/Week** **Practical: 2 Hour/Week**	**Credits** **04**	**Examination Scheme:** **Activity Marks:10 Marks** **In Sem: 30 Marks** **End Sem: 60 Marks** **Practical: 30 Marks**

Prerequisites: Basics of JavaScript, Fundamentals of Machine Learning.

Course Objectives:
- To introduce the fundamentals of web development using HTML, CSS, and JavaScript.
- To provide an understanding of integrating AI into web applications for tasks like image classification and NLP.
- To equip students with the skills to build simple AI-based models in the browser using TensorFlow.js.
- To explore the creation and deployment of AI models on the web, including back-end integration.
- To provide hands-on experience with creating basic web applications that use AI for personalization and security.
- To teach the basics of web security, with a focus on integrating AI for fraud and anomaly detection.

Course Outcomes (COs): The students will be able to:

CO1: Recall basic web development concepts and tools used in AI integration.

CO2: Explain the role of AI in front-end and back-end web development.

CO3: Implement AI models in web applications to perform tasks like image classification and text analysis.

CO4: Analyze user behavior to personalize web application features.

CO5: Evaluate security and privacy risks associated with implementing AI in web applications.

CO6: Design and develop a fully functional web application that integrates AI features like personalization and security.

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Course Contents

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Unit I: Introduction to Web Development and AI Concepts (07 Hours)
Overview of Web Development: HTML, CSS, and JavaScript basics**,** Introduction to Web APIs and their use in web development.
Basics of machine learning: Supervised vs. unsupervised learning, Introduction to TensorFlow.js and AI for the browser, Setting up a simple web development environment.

Unit II: Basic Front-end Development with AI Features (07 Hours)
Structure of a web page: HTML tags, attributes, and CSS styles, Introduction to JavaScript and its role in web development, Understanding DOM manipulation using JavaScript, Introduction to AI integration in web development with TensorFlow.js, Building interactive web pages with basic AI

features (e.g., text classification, simple image processing), Using TensorFlow.js for image classification in the browser, Basic example of a facial detection model in the browser.

Unit III: Back-end Development for AI-based Web Applications (07 Hours)
Introduction to back-end development: Node.js, Express.js**,** Working with RESTful APIs and integrating AI models (e.g., using Flask/Django for Python), Introduction to databases: MongoDB basics, building simple AI-based APIs for text analysis or image classification, Hosting AI models on a server**.**
Introduction to cloud deployment (Heroku, AWS), Integrating AI with backend to serve real-time predictions.

Unit IV: Basic Natural Language Processing (NLP) in Web Apps (07 Hours)
Introduction to Natural Language Processing (NLP) and its applications in web development**,** building a basic chatbot using Rasa or Dialog Flow, Simple text classification and sentiment analysis. Introduction to Named Entity Recognition (NER) for extracting structured information, Integrating NLP features into web applications (chatbots, sentiment analysis), Using external NLP APIs (e.g., Google NLP API, IBM Watson).

Unit V: AI for User Personalization in Web Applications (07 Hours)
Introduction to recommendation systems (collaborative filtering, content-based filtering), Basics of building a recommendation system using AI, personalizing web pages based on user behavior and interactions, Simple machine learning model for product recommendations in a web application,
Integration of user interaction data to improve personalization (user preferences, past behavior), AI-driven search and product recommendation in e-commerce websites.

Unit VI: Web Security and Privacy (07 Hours)
Introduction to web security concerns: Cross-site scripting (XSS), SQL injection, etc., Using AI for security features: anomaly detection, fraud detection in web applications, Building AI models for detecting malicious activity on a website, AI-powered testing frameworks for web applications (automated testing using TensorFlow and Jest), Implementing AI-based CAPTCHA systems for user verification, Ethical and privacy concerns in AI implementation.

Text Books:
1.Subramanian, V. (2019). Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node (2nd ed.). Apress. ISBN: 978-1-4842-4390-9.
2. Kanber, B. (2018). Hands-on Machine Learning with JavaScript: Solve Complex Computational Web Problems Using Machine Learning (1st ed.). Packt Publishing. ISBN: 978-1-78899-824-6.
3. Kaehler, A., & Bradski, G. (2018). Learning OpenCV 4: Computer Vision with Python (1st ed.). O'Reilly Media. ISBN: 978-1-4920-5568-1.

Reference Book:
1. Brown, E. (2019). Web Development with Node and Express: Leveraging the JavaScript Stack (2nd ed.). O'Reilly Media. ISBN: 978-1-4920-5351-9.
2. Bird, S., Klein, E., & Loper, E. (2009). Natural Language Processing with Python. O'Reilly Media. ISBN: 978-0-596-51649-9.
3. Bileschi, S., & Pignataro, R. P. (2020). Learning TensorFlow.js: Machine Learning in JavaScript. O'Reilly Media. ISBN: 978-1-4920-7076-9.
4. Fabbri, M. (2020). Artificial Intelligence for Web Development: Machine Learning and AI Concepts for Web Developers. Independently published. ISBN: 979-8-6500-1234-5.

List of Assignments

1. Develop a static webpage using HTML and CSS to display student details.

2. Develop a basic facial detection system using TensorFlow.js to detect faces in an image.

3. Develop a REST API using Node.js and Express.js to handle user authentication.

4. Develop a login authentication system using Node.js and Express.js.

5. Build a sentiment analysis tool to classify user feedback as positive, negative, or neutral.

6. Build a spam detection system that classifies messages using NLP techniques.

7. Create a web-based text-to-speech converter using NLP libraries.

8. Develop a recommendation system that suggests movies based on user preferences.

9. Implement input validation techniques to prevent SQL injection in a web form.

10. Implement a personalized e-commerce webpage that suggests products based on browsing history.

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<p align="center">Elective – I AI23303 (C) - Cybersecurity for Artificial Intelligence</p>

Teaching Scheme: **Theory: 3 Hours/Week** **Practical: 2 Hour/Week**	**Credits** **04**	**Examination Scheme:** **Activity Marks: 10 Marks** **In Sem: 30 Marks** **End Sem: 60 Marks** **Practical: 30 Marks**

Prerequisites: Basic understanding of Artificial Intelligence and Machine Learning.

Course Objectives:
- To introduce the fundamental principles of cybersecurity and their relevance in AI-based systems.
- To explore security vulnerabilities, threats, and attack types specific to AI applications.
- To implement ethical hacking techniques to test AI model security.
- To apply cryptographic methods for protecting AI-based data and models.
- To study privacy-preserving AI techniques and legal compliance frameworks.
- To analyse real-world AI security case studies and develop best practices.

Course Outcomes (COs):

CO 1: Understand the cybersecurity landscape and AI-specific threats.

CO 2: Identify and prevent adversarial attacks on AI models.

CO 3: Apply cryptographic and encryption techniques in AI security.

CO 4: Develop privacy-preserving AI applications.

CO 5: Conduct AI model security testing and ethical hacking.

CO 6: Analyse ethical, legal, and governance challenges in AI security.

<p align="center">Course Contents</p>

Unit I: Introduction to AI Security & Cyber Threats (07 Hours)

Fundamentals of Cybersecurity: CIA Triad (Confidentiality, Integrity, Availability), Cyber Threats in AI: Data Poisoning, Model Evasion, Model Inversion, Backdoor Attacks, Attack Vectors in AI: Adversarial Examples, Model Extraction, Prompt Injection Attacks, Basics of Secure AI Development: Defensive Programming and Risk Mitigation.

Unit II: Adversarial Attacks and Defense in AI (07 Hours)

Adversarial AI and Its Impact, Types of Adversarial Attacks: White-Box, Black-Box, and Grey-Box Attacks Real-World Case Studies: AI Misuse in Cybersecurity and Social Media, Defense Strategies: Adversarial Training, Noise Injection, Robust AI Models.

Unit III: **Cryptography and AI Security (07 Hours)**

Basics of Cryptographic Techniques in AI Security ,Symmetric vs Asymmetric Encryption in AI Data Protection ,Secure Model Sharing: Homomorphic Encryption and Federated Learning ,Blockchain for AI Security: Secure Model Training and Verification

Unit IV: Privacy-Preserving AI Techniques (07 Hours)

Differential Privacy and Secure AI Training, Secure Data Sharing and Federated Learning in AI Models, Data Protection Laws: GDPR, CCPA, AI Act, and their Impact, Ethical Considerations: Bias, Fairness, and Transparency in AI System.

Unit V: AI Security Testing and Ethical Hacking (07 Hour)
Ethical Hacking and Penetration Testing for AI Models, Red Team vs Blue Team AI Security Testing, Secure AI Deployment: Access Control, API Security, and Model Integrity, AI in Cyber Threat Detection: AI-Powered IDS and IPS.

Unit VI: Future Trends in AI Security (07 Hours)
AI for Cybersecurity: Threat Intelligence and Attack Detection, Quantum Cryptography and AI Security AI-Generated Deepfakes: Detection and Mitigation Strategies, The Future of AI Cybersecurity: AI-Driven Cyber Defense and Zero-Trust AI.

Text Books:
1. Clarence Chio and David Freeman, "*Machine Learning Security"*, O'Reilly, 2018. ISBN: 9781491979853
2. Mark Stamp, "Artificial Intelligence for cyber-Security", Springer, 2022. ISBN: 9783030970871.
3. Anthony Joseph, "Adversarial Machine Learning", Cambridge University Press, 2019. ISBN: 9781107043466.

Reference Books:
1. Alessandro Parisi, "Hands-On Artificial Intelligence for Cybersecurity", Packt Publishing, 2019. ISBN: 9781789804027.
2. Max Bramer, "Artificial Intelligence in Cyber Security", Springer, 2018. ISBN: 9783319988429.
3. J. Morris, R. Gupta, "Privacy-Preserving Machine Learning", Manning Publications, 2023. ISBN: 9781617298042
4. Hans Delfs, Helmut Knebl, "Introduction to Cryptography", Chapman & Hall/CRC, 2014. ISBN: 9781466570269.
5. Zahid Akhtar, Ajita Rattani, "Cybersecurity for Intelligent Systems", Springer, 2019. ISBN: 9783030075397.

E-Resources:
NPTEL/IBM:
1. NPTEL CourseCyber Security and Privacy:
   https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2. IBM Cybersecurity Analyst Professional Certificate:
   https://www.coursera.org/professional-certificates/ibm-cybersecurity-analyst#courses

List of Assignments

1. Create an image classifier using a traditional machine learning approach Random Forest and analyze how minor modifications (like noise) affect its predictions. (dataset: MNIST (handwritten digits))
2. Train a Decision Tree or Logistic Regression model on basic URL features (e.g., presence of "https", number of subdomains) to classify phishing websites.
3. Use Naïve Bayes or TF-IDF + SVM to classify emails as phishing or legitimate based on word patterns.
4. Build a simple Rule-based Classifier or Random Forest Model to evaluate password strength based on length, special characters, and dictionary words.
5. Develop a machine learning model using Support Vector Machine (SVM) to classify real vs. fake images using a small dataset of real and AI-generated faces.
6. Develop a chatbot using Dialogflow or Rasa with basic encryption techniques (e.g., hashing user inputs).
7. Test a simple AI-based API (like an image classifier) for basic security flaws, such as model prediction leaks.

8. Train a basic Federated Learning model using TensorFlow Federated on small datasets stored on different devices.
9. Building a Basic K-Means Clustering Model to Detect Unusual Network Traffic Patterns patterns using an open-access dataset.
10. Create a simple text-based CAPTCHA and try breaking it using OCR tools (like Tesseract) to understand AI-based attacks.

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HS23301- Universal Human Values and Professional Ethics

Teaching Scheme: Theory: 2 Hours/Week	Credits 02	Examination Scheme: Activity Marks: 10 Marks End Sem: 60 Marks

Prerequisites:

Course Objectives:

- To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.

- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

- This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

Course Outcomes (COs):

CO 1: To become more aware of themselves, aspirations in life, happiness and prosperity.

CO 2: To handle problems with sustainable solutions, while keeping human relationships and human nature in mind.

CO3: To become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

CO4: To develop harmony with nature.

CO5: To apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

CO5: To follow professional Ethical human conduct.

Course Contents

Unit I: Introduction to Value Education (05 Hours)

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.

Unit II: Harmony in the Human Being (05 Hours)
Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

Unit III: Harmony in the Family and Society (05 Hours)
Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order

Unit IV: Harmony in the Nature/Existence (05 Hours)
Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

Unit V: Implications of the Holistic Understanding – a Look at Professional Ethics (06 Hour)
Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

Text Books:
1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1
2. The Teacher‟s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G
3. Professional Ethics and Human Values, Premvir Kapoor, Khanna Book Publishing.

Reference Books:
1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Rediscovering India - by Dharampal
9. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
10. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972
11. Limits to Growth – Club of Rome's report, Universe Books.
12. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
13. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
14. A N Tripathy, 2003, Human Values, New Age International Publishers.
15. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
16. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
17. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
18. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
19. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

E-Resources:

- Value Education websites,
- https://www.uhv.org.in/uhv-ii,
- http://uhv.ac.in,
- http://www.uptu.ac.in
- Story of Stuff,
- http://www.storyofstuff.com
- Al Gore, An Inconvenient Truth, Paramount Classics, USA
- Charlie Chaplin, Modern Times, United Artists, USA
- IIT Delhi, Modern Technology – the Untold Story
- Gandhi A., Right Here Right Now, Cyclewala Productions
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
- https://fdp-si.aicte-india.org/8dayUHV_download.php
- https://www.youtube.com/watch?v=8ovkLRYXIjE
- https://www.youtube.com/watch?v=OgdNx0X923I
- https://www.youtube.com/watch?v=nGRcbRpvGoU
- https://www.youtube.com/watch?v=sDxGXOgYEKM

	Vidya Pratishthan's **Kamalnayan Bajaj Institute of Engineering and Technology, Baramati** **(Autonomous Institute)**		
	AI23304-Community Engagement Project		
Teaching Scheme: **PR: 4 Hours/Week**	**Credits** **02**	**Examination Scheme:** **Activity: 10 Marks** **TW: 30 Marks** **OR: 30 Marks**	

Prerequisites: Foundational knowledge in AI, Data handling, and Project Management.

Course Objectives:

- To develop problem-solving skills by identifying real-world community challenges and applying AI & data science techniques for effective solutions.

- To enhance interdisciplinary collaboration by integrating AI, data analytics, and software development with societal needs in community projects.

- To promote research, innovation, and ethical AI practices in field-based projects, ensuring social responsibility and sustainability.

- To equip students with project management skills, including planning, execution, documentation, and presentation of AI-driven community solutions.

Course Outcomes (COs): The students will be able to learn:

CO1: Analyze and identify community-based problems where AI and data science can provide impactful solutions.

CO2: Design and implement AI-driven models or applications to address real-world issues in a structured and ethical manner.

CO3: Demonstrate teamwork, communication, and project management skills by effectively collaborating in multidisciplinary environments.

CO4: Evaluate the societal, economic, and environmental impact of their AI solutions and propose improvements for long-term sustainability.

Course Contents

Community Problem Identification & Data Collection:
Introduction to Community Engineering and its role in AI & Data Science. Identifying real-world challenges in society, healthcare, education, environment, agriculture, etc. Field visits / Data collection techniques (surveys, interviews, IoT sensors, open datasets). Understanding ethical AI practices and data privacy regulations. Case studies on AI applications in social good.

AI Model Development & Solution Design:
AI techniques suitable for community-driven projects (ML, NLP, Data Analytics). Data preprocessing,

feature engineering, and model selection. Model training, validation, and performance evaluation. AI tools and frameworks (TensorFlow, PyTorch, Scikit-learn). Prototyping AI solutions (web, mobile, IoT, cloud deployment).

Project Implementation, Teamwork & Communication:

Agile project management and teamwork in AI-driven projects. Collaborative software development using Git, JIRA, and cloud platforms. Integration of AI models into applications. Testing, debugging, and optimization of AI-based solutions. Communicating technical findings through reports, presentations, and demos.

Social Impact, Deployment & Final Evaluation:

Field testing and validation of AI solutions in real-world scenarios. Assessing economic, environmental, and societal impacts of AI models. Ethical concerns in AI: Bias, fairness, and responsible AI development.

Sustainable AI solutions aligned with UN SDGs (Sustainable Development Goals). Final project presentation, demonstration, and documentation submission.

Project Execution Guidelines

1. Team Formation & Project Selection: Students will work in teams of 3-5 members. Each team will identify a real-world community problem and propose an AI-based solution. Topics must be approved by faculty within the first 2 weeks.

2. Tools & Technologies: Programming: Python, R, JavaScript. AI/ML Frameworks: TensorFlow, Keras, PyTorch, OpenCV, Scikit-learn. Database & Cloud: Firebase, AWS, Google Cloud AI, MongoDB. Visualization & Reporting: Tableau, Power BI, Matplotlib.

Expected Project Domains

- Healthcare: AI-driven disease prediction, mental health analysis.

- Education: AI chatbots for students, e-learning analytics.

- Environment: Air quality monitoring, smart waste management.

- Agriculture: Crop yield prediction, automated pest detection.

- Social Welfare: AI for women's safety, disaster response AI.

- Smart Cities: Traffic optimization, crime prediction using AI.

Project Milestones & Deliverables:

Week	Task	Deliverables
Week 1-2	Problem identification & proposal submission	Problem Statement Document
Week 3-5	Data collection & preprocessing	Data Report
Week 6-8	AI Model Development & Testing	Model Report
Week 9-10	Implementation & Prototyping	Working Prototype
Week 11-12	Social Impact Assessment & Field Testing	Evaluation Report

| Week 13-14 | Final Presentation & Documentation | Project Report & Demo |

Reference Books:
1. Bansal, V. (2019). Hands-On Artificial Intelligence for Healthcare: A Practical Guide to Building AI Models in Healthcare and Life Sciences. BPB Publications.
2. Bose, I., & Pal, A. (2020). Data Science for Engineers. Springer.
3. Chaudhury, S., & Mitra, P. (2018). AI for Social Good: Use Cases in Emerging Economies. Springer.
4. Patel, N., & Agrawal, R. (2020). Artificial Intelligence: A Modern Approach. Pearson India.

E-Resources:
- **https://www.nasscom.in/**
- **https://meity.gov.in/**
- **https://niti.gov.in/**
- **https://data.worldbank.org/**

Audit Course : HS23302- Constitution of India

Course Objectives:

- Familiarize students with the salient features, structure, and significance of the Constitution, including the principles enshrined in the Preamble.
- Provide an understanding of fundamental rights and duties, their scope, significance, and role in ensuring justice, equality, and freedom in a democratic society
- Explain the concept of Directive Principles of State Policy (DPSP) and their role in governance, emphasizing their interrelationship with Fundamental Rights.
- Analyze emergency provisions and constitutional amendments, discussing their implications on Indian democracy and governance.
- Encourage a comparative understanding of the Indian Constitution with other constitutions worldwide, fostering awareness of global governance models.

Course Outcomes:

CO1: Describe the salient features and basic structure doctrine of the Constitution and Interpret the values enshrined in the Preamble

CO2: Comprehend Fundamental Rights and Duties of Indian Citizens

CO3: Analyze the Role of Directive Principles of State Policy (DPSP) in Governance

Course Contents

Unit I: Introduction to the Constitution of India (05 Hours)

Historical Perspective and Making of the Indian Constitution, Salient Features of the Constitution, Preamble and its Significance, Basic Structure of the Constitution ,Emergency Provisions in the Indian Constitution, Important Amendments to the Constitution.

Unit II: Fundamental Rights and Duties (04 Hours)

Fundamental Rights: Meaning, Scope, and Significance, Right to Equality, Freedom, Protection from Exploitation, Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Fundamental Duties of Indian Citizens.

Unit III: **Directive Principles and Governance (04 Hours)**

Directive Principles of State Policy: Meaning and Purpose, Relationship between Fundamental Rights and Directive Principles, Role of Directive Principles in Policy Formulation, Comparison with Other Constitutions

Reference Books:

1. M. Laxmikanth, Indian Polity, McGraw Hill Education, 6th Edition, 2020.
2. D.D. Basu, Introduction to the Constitution of India, LexisNexis, 25th Edition, 2021.
3. Subhash Kashyap, Our Constitution: An Introduction to India's Constitution and Constitutional Law, National Book Trust, 2019.
4. J.N. Pandey, The Constitutional Law of India, Central Law Agency, 2020.
5. Bare Act, Constitution of India, Government of India Publications.

Evaluation and Assessment

Since this is an audit course, there is a mandatory internal evaluation which can be based on the following:

- **Assignments & Reports**– Writing about a constitutional provision or case study.

- **Quiz/MCQs** – To test basic understanding of the Constitution.
- **Group Discussion/Presentation** – On relevant topics like Fundamental Rights or Constitutional Amendments.

SEMESTER II

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AI23311- Natural Language Processing

Teaching Scheme:	Credits	Examination Scheme:
Theory: 3 Hours/Week	**04**	Activity Marks:10 Marks
		In Sem: 30 Marks
Practical: 2 Hour/Week		End Sem: 60 Marks
		Practical: 30 Marks

Prerequisites: Discrete Mathematics, Data Structures and Algorithms, Artificial Intelligence

Course Objectives:

- To understand the basic concepts of Natural Language Processing.

- To understand use of morphological aspect in NLP.

- To learn and understand word level analysis in NLP.

- To learn and implement syntax parsing techniques.

- To learn and implement semantics parsing techniques.

- To learn and implement Machine Learning text analytics.

Course Outcomes (COs): The students will be able to:

CO1: Understand the fundamental concepts in field of NLP.

CO2: Understand morphological aspect and processing in NLP.

CO3: Demonstrate part-of-speech taggers and perform word level analysis.

CO4: Demonstrate the syntax structure and grammar through different techniques.

CO5: Build and Analyze different word embedding techniques.

CO6: Apply and Evaluate Machine translation techniques like classification/clustering.

Course Contents

Unit I: Introduction to NLP (07 Hours)

Introduction: NLP-Definition, Phases of NLP, Challenges of NLP, Applications of NLP, Empirical Laws of language, Zipf's law, Heap's law, Approaches of NLP: Rule based, Data Based, Knowledge Based approaches.

Unit II: Basic Text Processing and Morphology (07 Hours)

Tokenization, Sentence segmentation, Spelling correction, Morphology-morphemes, Types, Inflectional and Derivational morphology, Stemming, lemmatization, Porters algorithm, Minimum edit distance, N-gram Language Modeling- probabilistic language model, Auto completion prediction, Evaluation and perplexity, Smoothing techniques.

Unit III: Word Level Analysis (07 Hour)

Sequence labeling tasks of NLP, POS tagging, POS tag sets, Hidden Markov Model-Introduction, Markov processes, HMM characterization -Likelihood of a sequence (Forward Procedure, Backward Procedure), Best state sequence-Viterbi algorithm, Re-estimation (Baum-Welch: Forward-Backward Algorithm) , Models for sequential tagging – Maximum Entropy (ME), Conditional Random Field(CRF), Long Short Term Memory (LSTM).

Unit IV: Syntax Analysis (07 Hour)

Parsing Natural Language, Tree banks: A data-driven approach to syntax, Representation of syntactic structure: Syntax analysis using Dependency Graph and Phrase Structure Trees(CFG), Models for ambiguity resolution: Probabilistic Context Free Grammar(PCFG), Generative models, Discriminative models..

Unit V: Semantics and Text Representation (07 Hours)

Basic ideas in Lexical semantics, Vector semantics, Words and Vector, Semantics with dense vectors, Singular Value Decomposition (SVD) and Latent Semantic Analysis(LSA), TF-IDF, Embedding's from prediction:- One hot encoding, Word2vec, Skip-gram and CBOW, Glove model, Soft-max, evaluation measures-rough scores, Applications.

Unit VI: Text Analytics (07 Hours)

Chunking: Chunking strategies, Topic models, Text summarization, Text classification, Text categorization Opinion mining. Use Case(any 1): Customer segmentation/Health care/Social media/sales and marketing.

Text Books:

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing", Third Edition,
Prentice Hall, ISBN: 978-0131873216, 2025
2. Christopher D.Manning and Hinrich Schutze,, "Foundations of Statistical Natural Language

Processing", MIT Press, *ISBN*-10. 0262133601, 1999

3. Allen James, "Natural Language Understanding", Second Edition, Benjamin/Cumming, ISBN: 978-0805303346, 1994

Reference Books:

1. Steven Bird,Ewan Klein and Edword Loper," NLP with Python:Analyzing text with the Natural Language Toolkit", O'Reilly Media,Inc, *ISBN*- 0596516495, 2009

2. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", 2nd ed. CRC press, ISBN 9781498798105, 2010

3. Journals: Computational Linguistics, Natural Language Engineering, Machine Learning, Machine Translation, Artificial Intelligence.

4. Conferences: Annual Meeting of the Association of Computational Linguistics (ACL), Computational Linguistics (COLING), European ACL (EACL), Empirical Methods in NLP (EMNLP), Annual Meeting of the Special Interest Group in Information Retrieval (SIGIR), Human Language Technology (HLT)

E-Resources:

- **https://onlinecourses.nptel.ac.in/noc23_cs45/preview**

- **https://onlinecourses.nptel.ac.in/noc20_cs87/preview**

List of Assignments

Guidelines:

- Open source NLP libraries like NLTK, spaCy, TensorFlow/PyTorch etc. Develop strong coding skills, particularly in Python, which is a common language for NLP.

- Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality and sincerity.

1. Text Preprocessing - Implement text preprocessing techniques, including tokenization and normalization, and apply it to any text data.

2. Spell checking and correction: Apply minimum edit distance between two strings for spelling correction.

3. Viterbi Decoding Algorithm for POS: Given a sequence of words, implement the Viterbi algorithm to find the most likely sequence of POS tags by estimating emission and transition probabilities from a tagged corpus.

4. LSTM for Part of Speech tagging: Implement LSTM-based model for Parts of Speech (POS) tagging. Given a sequence of words, train the LSTM network to predict the corresponding POS tags by learning word dependencies and context from a labeled dataset.

5. Co-reference resolution model: Implement a co-reference resolution model to identify and link pronouns or noun phrases to the entities they refer to within a given text.

6. Word sense disambiguation: Implement a Word Sense Disambiguation (WSD) model using WordNet to determine the correct meaning of a word based on its context in a sentence.

7. Word embedding: Implement word embeddings for the English language to analyze word representations and their semantic relationships (Word2Vec/GloVe/fastText).

8. By using multinomial Naive Bayes, RandomForest, Logistic Regression classifiers, perform news classification and analysis to categorize news articles into predefined categories and extract actionable insights. Use AG_news dataset.

9. Implement Agglomerative hierarchical clustering algorithm to predict the quality of wine. Use Wine Quality dataset from UCI Machine Learning repository.

10. Text mining: Implement a text mining model to analyze customer reviews and identify sentiments (positive, negative, neutral) and preferences using techniques like sentiment analysis and keyword extraction.

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Elective – II AI23312 (A) - Advanced Big Data Analytics and Applications		
Teaching Scheme: **Theory: 3 Hours/Week** **Practical: 2 Hour/Week**	**Credits** **04**	**Examination Scheme:** **Activity Marks: 10 Marks** **In Sem: 30 Marks** **End Sem: 60 Marks** **Practical:30 Marks**

Prerequisites: Big Data Fundamentals & Applications

Course Objectives:

- To delve into the advanced methodologies and tools in Big Data Analytics and their applications.

- To provide a deeper understanding of distributed computing, machine learning, and data processing for large-scale datasets.

- To explore advanced algorithms for data mining, clustering, regression, and predictive analytics in the context of Big Data.

- To understand the integration of artificial intelligence techniques with Big Data systems for predictive modeling and real-time data analytics.

- To design and implement scalable data solutions for Big Data storage and processing using distributed frameworks like Apache Spark and Hadoop.

- To analyze industry-specific use cases of Big Data in domains like healthcare, finance, and social media, and explore their impact on decision-making and business strategies.

Course Outcomes (COs): Upon completing the course, students will be able to:

CO1: Design and implement advanced data processing frameworks to handle large datasets effectively.

CO2: Utilize and integrate machine learning algorithms within Big Data platforms for enhanced decision-making.

CO3: Develop custom solutions for data storage, retrieval, and analytics using NoSQL databases and distributed computing tools.

CO4: Evaluate and optimize Big Data applications for specific industry needs.

CO5: Investigate the ethical implications of Big Data applications and propose frameworks for responsible data usage.

CO6: Analyze the impact of Big Data in practical applications and its contribution to driving innovation in data science.

Course Contents

Unit I: Advanced Data Processing Architectures (07 Hours)

Advanced Hadoop Ecosystem: MapReduce, YARN, and Hadoop 3.x, Apache Flink and Apache Kafka: Real-Time Data Processing, Advanced Spark: RDD, DataFrames, and Spark Streaming, Big Data Management: Distributed File Systems & Storage Mechanisms, Introduction to NoSQL Databases: Cassandra, HBase, MongoDB.

Unit II: Machine Learning & Predictive Analytics (07 Hours)

Supervised and Unsupervised Learning: A Comprehensive Exploration, Advanced Clustering Algorithms for Big Data, Neural Networks and Deep Learning, Predictive Analytics Using Time Series Analysis, Cross-Validation and Hyper Parameter Tuning.

Unit III: Big Data Security and Privacy (07 Hours)

Privacy and Security Challenges in Big Data Systems, Cryptography and Secure Data Transmission in Big Data, Data Anonymization and Masking Techniques, Compliance with Data Protection Regulations (GDPR, CCPA), Ethical Issues in Big Data Analytics.

Unit IV: Scalable Data Storage and Distributed Computing (07 Hours)

Advanced Concepts in Distributed File Systems (DFS), Scalability Techniques in Cloud-Based Storage Systems, Consistency Models in Distributed Databases (CAP Theorem), Data Replication and Fault Tolerance in Big Data Platforms, Big Data Infrastructure Optimization.

Unit V: Big Data Applications in Industry (07 Hour)

Big Data in Healthcare: Predictive Diagnostics and Personalized Medicine, Financial Services: Fraud Detection and Risk Management, Marketing and E-commerce: Customer Segmentation and Personalization, Real-time Analytics for Smart Cities and IoT Applications, Case Studies on the Impact of Big Data in Industry

Unit VI: Future Trends and Innovations in Big Data Analytics (07 Hours)

AI Integration with Big Data, Quantum Computing and Big Data, Advanced Visualization for Big Data Insights, Blockchain and Big Data, Privacy and Ethics in Big Data.

Text Books:

1. Raj Kamal and Preeti Saxena, "Big Data Analytics: Introduction to Hadoop, Spark, and Machine Learning", McGraw-Hill Education, 2018. ISBN: 9789353164966.
2. Benoy Antony, "Professional Hadoop", Wiley, 2016.
3. Michael Minelli et al., "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
4. Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining: Concepts and Techniques", Elsevier Publishers, 3rd Edition, ISBN: 9780123814791.

Reference Books:

1. Wajid Khattak, Paul Buhler, and Thomas Erl, "Big Data Fundamentals: Concepts, Drivers & Techniques", Wiley, 2015.
2. "Data Science for Business", Foster Provost, Tom Fawcett, O'Reilly Media, 2013.
3. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, 2015.
4. Tarek S. S. and Mohamed E. S, "Data Science and Big Data Analytics", Wiley, 2016.

E-Resources:

- NPTEL Online Courses on Big Data and Hadoop (https://archive.nptel.ac.in)
- Coursera: "Big Data Specialization" by UC San Diego
- (https://www.coursera.org/specializations/big-data)

- edX: "Big Data Analysis with Scala and Spark" by UC Berkeley
- (https://www.edx.org/course/big-data-analysis-with-scala-and-spark)
- YouTube: "Data Science and Big Data Analytics" playlist (https://www.youtube.com)
- MIT Open Courseware: "Advanced Data Analytics" (https://ocw.mit.edu)

List of Assignments

1. Implement a distributed data processing pipeline using Apache Hadoop and Spark.
2. Develop a machine learning model to predict customer churn based on historical data.
3. Create a data security model for encrypting and anonymizing sensitive information in a Big Data system.
4. Implement and test a distributed storage system using HDFS and Apache HBase for large-scale data storage.
5. Create a real-time fraud detection system using streaming data from financial transactions.
6. Develop a predictive analytics solution for personalized healthcare recommendations using patient data.
7. Configure a multi-node Hadoop cluster and process large datasets for a business intelligence solution.
8. Build a recommendation engine for an e-commerce platform using collaborative filtering and clustering algorithms
9. Design a privacy-preserving Big Data system using data masking techniques.
10. Deploy a cloud-based Big Data storage and processing solution using Docker containers.

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Elective – II AI23312 (B) - AI Powered Web Development

Teaching Scheme: Theory: 3 Hours/Week Practical: 2 Hour/Week	Credits 04	Examination Scheme: Activity Marks:10 Marks In Sem: 30 Marks End Sem: 60 Marks Practical: 30 Marks

Prerequisites: Foundational knowledge in AI:

Course Objectives:

- To enhance understanding of AI integration in advanced web development techniques.

- To introduce back-end frameworks for deploying AI models in production.

- To provide practical experience in computer vision and NLP for web applications.

- To explore recommendation systems and personalized user experiences using AI.

- To deepen knowledge of web security using AI for fraud and anomaly detection.

- To empower students to create robust AI-driven web applications for real-world use.

Course Outcomes (COs): The students will be able to:
CO1: Recall advanced concepts in JavaScript, AI tools, and frameworks.

CO2: Describe the workings of AI in real-time web applications, including personalization and computer vision.

CO3: Develop AI-powered web applications using TensorFlow.js and other AI frameworks.

CO4: Assess the performance and ethical considerations of AI models integrated into web apps.

CO5: Evaluate the effectiveness of recommendation systems, chatbots, and AI security features.

CO6: Design and deploy fully functional AI-driven web applications with advanced features.

Course Contents

Unit I: Advanced Web Development with JavaScript and AI (07 Hours)
Introduction to advanced JavaScript concepts (ES6+, async programming, modules). Working with front-end frameworks: React.js basics, Integrating AI in React.js apps with TensorFlow.js, Using TensorFlow.js for real-time predictions in the browser, building dynamic UIs based on AI-driven data, Overview of Single Page Applications (SPAs) and AI integration.

Unit II: Deep Dive into Backend Development for AI (07 Hours)
Setting up Node.js, Express.js for back-end development, Advanced handling of data: Fetch API, Web Sockets for real-time communication, Deploying AI models on a server using Flask or Django, Serving AI models through RESTful APIs, Introduction to cloud services: AWS, Google Cloud for hosting AI models, Authentication and security concerns when integrating AI models.

Unit III: Computer Vision for Web Applications (07 Hours)

Introduction to OpenCV and its use in web development: Implementing object detection and classification in web apps, Real-time image processing in web browsers using TensorFlow.js, Building AI-powered web applications with image and video analysis (e.g., real-time facial recognition), Integrating computer vision features in web applications (image search, object tracking), Hands-on project: Building a simple image classification web app.

Unit IV: Advanced Natural Language Processing in Web Apps (07 Hours)

Understanding deep learning models for NLP (RNN, LSTM, Transformers), Implementing text classification, translation, and summarization in web applications, Advanced chatbot development with machine learning (dialog management, NLP libraries), Integrating real-time speech-to-text and text-to-speech features into web applications, Using pre-trained models for named entity recognition (NER), sentiment analysis, Hands-on project: Building an advanced NLP web app with text processing and chatbot features.

Unit V: Real –time AI based Personalization and Recommendations (7 Hours)

Understanding collaborative filtering and content-based filtering for recommendation systems, Building AI-driven recommendation engines (product, content, movie), Implementing real-time AI features in web applications for personalized user experience, AI-powered predictive models to optimize web search results, Building and testing recommendation engines in real-time applications, Hands-on project: Building an AI-powered recommendation system for e-commerce or social media.

Unit VI: Web Security and Privacy (7 Hours)

Introduction to AI-based security measures for web applications, Detecting and preventing web attacks (XSS, SQL injection) using machine learning, Using AI for fraud detection in online platforms, ensuring privacy in AI-driven applications (data anonymization, GDPR compliance), AI-powered monitoring and anomaly detection in web traffic, Implementing AI-based CAPTCHA and two-factor authentication (2FA) systems.

Text Books:

1. Casciaro, M., & Mammino, L. (2020). Node.js Design Patterns: Design and Implement Production-Grade Node.js Applications Using Proven Patterns and Techniques (3rd ed.). Packt Publishing. ISBN: 978-1839214110.

2. Grinberg, M. (2018). Flask Web Development: Developing Web Applications with Python (2nd ed.). O'Reilly Media. ISBN: 978-1491991732.

Reference Books:

1. Subramanian, V. (2019). Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node (2nd ed.). Apress. ISBN: 978-1484243909.

2. Kanber, B. (2018). Hands-On Machine Learning with JavaScript: Solve Complex Computational Web Problems Using Machine Learning. Packt Publishing. ISBN: 978-1788998246.

3. Kaehler, A., & Bradski, G. (2018). Learning OpenCV 4: Computer Vision with Python. O'Reilly Media. ISBN: 978-1491937990.

4. Bird, S., Klein, E., & Loper, E. (2009). *Natural Language Processing with Python.* O'Reilly Media. ISBN: 978-0596516499.

List of Assignments

1. Develop a React.js app that integrates TensorFlow.js for real-time predictions.

2. Build a Node.js backend to deploy and serve AI models for text classification.

3. Implement a computer vision feature in a web app for object recognition.

4. Create a chatbot with NLP using TensorFlow.js or DialogFlow.

5. Develop a recommendation system with AI for personalized user content.

6. Implement a real-time sentiment analysis feature for user comments.

7. Build a dynamic e-commerce web app with product recommendations powered by AI.

8. Integrate an AI-powered search engine into a web application.

9. Create a web application with speech-to-text and text-to-speech capabilities

10. Implement AI-based web security features (e.g., fraud detection, anomaly detection).

11. Develop an image processing app with real-time AI predictions.

12. Implement a multi-factor authentication system using AI-based security features.

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Elective-II AI23312 (C) AI-Driven Business Intelligence		
Teaching Scheme: Theory: 3 Hours/Week Practical: 2 Hour/Week	**Credits 04**	**Examination Scheme:** Activity Marks: 10 Marks In Sem: 30 Marks End Sem: 60 Marks Practical: 30 Marks

Prerequisites: Database Management Systems, Data Visualization Basics, Business and Decision-Making Concepts.

Course Objectives:
- To understand the fundamentals of Business Intelligence (BI) and its significance in decision-making.
- To explore data warehousing, data mining, and OLAP techniques for business applications.
- To apply various BI tools and visualization techniques to analyze business data.
- To study predictive analytics and machine learning models in BI applications.
- To develop BI dashboards and reports using industry-standard tools.
- To study real-world case studies on AI implementation in e-commerce BI.

Course Outcomes: The students will be able to learn:

CO1: Explain the fundamentals of Business Intelligence and its applications.

CO2: Design and implement Data Warehousing solutions for business applications.

CO3: Apply Data Mining techniques for pattern extraction and decision-making.

CO4: Use BI tools for reporting and dashboard creation.

CO5: Implement predictive analytics and machine learning techniques in BI.

CO6: Investigate and present a case study on AI-driven BI implementation in e-commerce.

Course Contents

Unit No. I: Introduction to AI-Driven Business Intelligence (07 Hours)
Overview of Business Intelligence, Evolution and Need for BI, BI Applications in Various Industries, Data Sources and Data Integration, Data Sources and AI-Powered Data Integration.

Unit No. II: Data Warehousing, OLAP, and AI Integration (07 Hours)
Introduction to Data Warehousing, OLAP and its Operations with AI Enhancements, Data Marts vs. Data Warehouses, Star Schema and Snowflake Schema, AI in Data Modeling, AI-Driven Data Warehouse for a Retail Business.

Unit No. III: AI-Powered Data Mining for Business Intelligence (07 Hours)
AI-Based Association Rule Mining, Classification, and Clustering, Decision Trees, k-Means, Apriori Algorithm with AI Enhancements, Sentiment Analysis and AI-Driven Text Mining, AI-Powered Customer Relationship Management

Unit No. IV: AI-Driven BI Tools and Visualization (07 Hours)
Introduction to AI-Powered BI Tools, AI in Data Visualization, Smart Dashboards and Automated Reports, AI-Based KPI and Performance Metrics, Case Study: AI-Enhanced BI Visualization for Sales and Marketing.

Unit No. V: Predictive Analytics and AI in Business Intelligence: (07 Hours)
Introduction to AI-Based Predictive Analytics, Regression Analysis and AI-Based Forecasting, Supervised and Unsupervised Learning in BI, AI-Powered Time Series Analysis in BI, Case Study: AI-Driven Customer Churn Prediction.

Unit No. VI: AI Applications in Business Intelligence and Case Studies (07 Hours)
AI in Supply Chain Management, AI-Driven Financial BI and Fraud Detection, Social Media Analytics with AI, Role of AI in Cloud-Based BI Solutions, Ethical Issues in AI-Driven Business Intelligence. Role of AI in Cloud-Based BI Solutions, Ethical Issues in AI-Driven Business Intelligence, Case Study: Implementing AI-Driven BI in E-commerce.

Text Books:

1. R. N. Prasad, Seema Acharya, "Fundamentals of Business Analytics, 2nd Edition, Wiley India, 2016.
2. David Loshin, "Business Intelligence: The Savvy Manager's Guide", 2nd Edition, Morgan Kaufmann, 2012.
3. Data Mining for Business Analytics: Concepts, Techniques, and Applications in Python" (3rd Edition, 2019) by Galit Shmueli, Peter C. Bruce, Peter Gedeck, and Nitin R. Patel.
4. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit", 3rd Edition, Wiley, 2013.

Reference Books:

1.The Business Case for AI: A Leader's Guide to AI Strategies, Best Practices & Real-World Applications" by Kavita Ganesan, 1st Edition, 2022.
2.Augmented Intelligence: Making Better Decisions with Data & AI" by Thomas Ramge, 1st Edition, 2023.
3.Access Rules: Freeing Data from Big Tech for a Better Future" by Viktor Mayer-Schönberger and Thomas Ramge, 1st Edition, 2022.

List of Assignments:

1. Perform Extract, Transform, and Load (ETL) using Python and SQL on a sample sales dataset. Create a star schema and performing AI-enhanced OLAP operations.

2. Design a star schema for an e-commerce company and implement OLAP queries.

3. Perform sentiment analysis on product reviews using NLP techniques.

4. Develop an AI-powered sales performance dashboard with interactive filters and KPIs.

5. Build a predictive model to forecast future sales trends using regression techniques.

6. Implement a real-time data streaming pipeline using Apache Kafka and AI models.

7. Implement anomaly detection using Auto encoders or Isolation Forest to identify unusual sales patterns.

8. Implement the Apriori algorithm to identify frequent itemsets and generate association rules in retail transactions.

9. Use LSTM/ARIMA models to predict future sales trends based on historical data.

10. Implement collaborative filtering and content-based filtering to recommend products based on user behavior.

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Elective – III AI23313 (A) - Federated Learning		
Teaching Scheme: **Theory: 3 Hours/Week** **Practical: 2 Hour/Week**	**Credits** **04**	**Examination Scheme:** **Activity Marks:10 Marks** **In Sem: 30 Marks** **End Sem: 60 Marks** **Practical: 30 Marks**

Prerequisites: Machine Learning, Deep Learning, Probability and Statistics

Course Objectives:

- Understand the fundamentals of Federated Learning (FL) and its necessity in AI & DS.
- Explore FL architectures, algorithms, and privacy-preserving techniques.
- Learn about optimization techniques to improve model training efficiency in Federated Learning.
- Address challenges related to heterogeneous data, personalization, and security in Federated Learning.
- Examine real-world applications and research trends in Federated Learning.
- Identify and discuss future research challenges and advancements in Federated Learning.

Course Outcomes (COs): The students will be able to:

CO1: Describe the principles and applications of Federated Learning.

CO2: Implement FL algorithms and frameworks for distributed AI models.

CO3: Analyze and apply privacy-preserving techniques in Federated Learning.

CO4: Optimize federated learning models for communication efficiency and scalability.

CO5: Solve challenges related to non-IID data and personalization in Federated Learning.

CO6: Identify future research directions and emerging challenges in Federated Learning.

Course Contents

Unit I: Introduction to Federated Learning (07 Hours)

Overview of Distributed Machine Learning, need for FL in AI & DS, Centralized vs. Decentralized Learning Applications of FL (Healthcare, Finance, IoT, Edge AI).

Unit II: Federated Learning Frameworks & Architectures (07 Hours)

FL System Design & Components, Federated Averaging (FedAvg) Algorithm, Client-Server vs. Peer-to-Peer FL, Cross-Silo vs. Cross-Device FL, Open-Source FL Frameworks (TensorFlow Federated, PySyft, Flower).

Unit III: Privacy-Preserving Techniques in FL (07 Hour)

Privacy Concerns in FL, Secure Aggregation Methods, Differential Privacy & Homomorphic Encryption, Secure Multi-Party Computation (MPC), Adversarial Attacks & Defenses in FL.

Unit IV: Optimization & Communication Efficiency in FL (07 Hour)

Optimization Challenges in FL, Model Compression (Quantization, Pruning, Knowledge Distillation), Communication-Efficient FL, Asynchronous vs. Synchronous FL, FL for Low-Power & Edge Devices.

Unit V: Personalization & Heterogeneous Data Handling (07 Hours)

Non-IID Data Challenges, Personalization Strategies in FL, Adaptive FL & Transfer Learning, Case Study: Google's FL in Gboard, Apple's FL for Siri.

Unit VI: FL in Healthcare, IoT, Edge Computing, and Smart Cities (07 Hours)

Federated Reinforcement Learning, Blockchain for Secure FL, Explain ability & Fairness in FL, Ethical & Regulatory Considerations, Future Research Challenges in FL.

Text Books:

1. Federated learning comprehensive overview of methods and applications Springer Nature Switzerland AG; 1st ed. 2022 edition by Heiko Ludwig (Editor), Nathalie Baracaldo.
2. Federated Learning, Qiang Yang, Yang Liu, Yong Cheng, Yan Kang, Tianjian Chen, and Han Yu -Synthesis Lectures on Artificial Intelligence and Machine Learning 2019.
3. Federated Learning Systems: Towards Next-Generation AI, Marcello Trovati, 2022.

Reference Books:

1. 1.Federated Learning for Healthcare: Principles and Applications, Megha Annavaram, Morgan & Claypool Publishers,2021.
2. 2.Secure and Trustworthy Federated Learning, Joey Tianyi Zhou,2022.
3. Federated Learning with Python by Kiyoshi Nakayama PhD, George Jeno , O'Reilly Media, Inc. Pub.

E-Resources:

- https://research.aimultip1e.com/federated-learning

- https://towardsdatascience.com

- https://www.persistent.com/blogs/privacy-preserving-ai-private-ai-the-rise-of-federated-learning

List of Assignments

1. Train a classification model using both centralized and federated learning on the same dataset and compare accuracy.

2. Develop a peer-to-peer Federated Learning system where clients communicate without a central server.

3. Train a personalized FL model for predicting disease risk across hospitals with diverse patient data.

4. Simulate an adversarial attack on an FL model and implement defense techniques.

5. Implement an FL model to train a medical image classifier without sharing patient data across hospitals.

6. Implement local fine-tuning techniques to personalize federated models for different clients.

7. Implement an FL-based text classification or sentiment analysis model trained on decentralized data sources (e.g., mobile devices with different users' text data).

8. Develop a federated reinforcement learning (FRL) system for traffic signal optimization in smart cities.

9. Implement FL on IoT devices to predict user energy consumption while ensuring data privacy.

10. Develop an explainable FL model that provides transparent decision-making.

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Elective – III AI23313 (B) - AI-based Innovation and Product Development

Teaching Scheme: Theory: 3 Hours/Week Practical: 2 Hour/Week	Credits 04	Examination Scheme: Activity Marks:10 Marks In Sem: 30 Marks End Sem: 60 Marks Practical: 30 Marks

Prerequisites: Basics of Artificial Intelligence, Machine Learning, and Software Engineering

Course Objectives:
- To introduce students to the principles of AI-based innovation and its application in product development.
- To develop problem-solving skills using AI methodologies.
- To understand the AI lifecycle and integrate AI into real-world product development.
- To foster creativity in AI-based startups and entrepreneurship.
- To understand ethical considerations, intellectual property rights, and deployment strategies for AI-based innovations.
- To explore AI applications in various industries for problem-solving and business transformation.

Course Outcomes (COs): The students will be able to:

CO1: Develop AI-based solutions for real-world problems.

CO2: Apply AI technologies to create scalable and efficient products.

CO3: Analyze case studies of successful AI-based products.

CO4: Implement AI models in a product development cycle with appropriate tools.

CO5: Evaluate the business impact and feasibility of AI-based products.

CO6: Develop an AI-based prototype that addresses a real-world problem.

Course Contents

Unit I: Introduction to AI-Based Innovation and Product Development (07 Hours)
Fundamentals of Innovation and AI in Product Development, Role of AI in Emerging Technologies (IoT, Blockchain, AR/VR, etc.), AI Innovation Lifecycle: From Idea to Market.

Unit II: AI Product Ideation and Problem Solving (07 Hours)
Ideation Techniques: Brainstorming, Design Thinking, Identifying AI-Driven Opportunities and Market Gaps, Problem-Solution Fit for AI-Based Products, User-Centric AI Design.

Unit III: AI Model Development for Product Integration (07 Hour)
Selection of AI/ML Algorithms for Product Development, Data Collection, Processing, and Annotation, Model Development and Deployment Strategies, Transfer Learning and Model Optimization, Tools: TensorFlow, PyTorch, AutoML, and MLOps.

Unit IV: AI Product Engineering and Prototyping (07 Hour)
System Architecture for AI-Based Products, Integration of AI with Cloud and Edge Computing, APIs and AI Services, Testing and Validation of AI Systems.

Unit V: AI Business Strategies and Entrepreneurship (07 Hours)
System Architecture for AI-Based Products, Integration of AI with Cloud and Edge Computing, APIs and AI Services: OpenAI, Google AI, AWS AI, Azure AI, Testing and Validation of AI Systems.

Unit VI: AI Product Deployment, Scaling, and Regulations (07 Hours)
Deployment Strategies: Cloud, On-Premise, and Edge AI, Performance Monitoring and Continuous Improvement, AI Governance, Compliance, and Regulatory Frameworks, Security, Privacy, and Ethical Challenges in AI Product Development.

Text Books:
1. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig, 4th Edition, 2020.
2. Machine Learning Yearning by Andrew Ng, 1st Edition, 2018.
3. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, 1st Edition, 2016.

Reference Books:
1. Artificial Intelligence: A Guide for Thinking Humans by Melanie Mitchell, 1st Edition, 2019.
2. AI Superpowers by Kai-Fu Lee, 1st Edition, 2018.
3. The Hundred-Page Machine Learning Book by Andriy Burkov, 1st Edition, 2019.
4. Data Science for Business by Foster Provost and Tom Fawcett, 1st Edition, 2013.

E-Resources:
1. Coursera – AI for Everyone by Andrew Ng (DeepLearning.AI).
2. Coursera – AI Product Management by Duke University.
3. edX – Artificial Intelligence for Innovation by HarvardX.

List of Assignments

1. Identify a real-world problem in a specific industry (e.g., Agriculture, Healthcare, Finance, Education, or Retail) and propose an AI-driven solution. Outline the problem statement, AI methodology, expected impact, and feasibility of implementation.

2. Implement a basic AI prototype using TensorFlow/PyTorch for an application and Train the model with relevant datasets and evaluate its performance.

3. Develop a sentiment analysis model to analyze customer reviews of products or services.

4. Comparative Analysis of AI Deployment Strategies.
   Compare and contrast AI deployment strategies (Cloud AI vs. Edge AI) based on cost, performance, latency, scalability, and security. Conduct a small-scale experiment or case study to support your comparison.

5. Business Model Development for AI Products

   Create a Business Model Canvas for an AI-based product. Define the value proposition, customer segments, revenue streams, and cost structures. Ethical Challenges in AI

   Analyze a real-world AI application (e.g., facial recognition, deep fake technology, AI bias in hiring) and discuss the ethical challenges involved. Propose solutions to mitigate risks and ensure responsible AI usage.

6. Building and Testing an AI Model

   Develop and test an AI model for a simple yet practical application (e.g., movie recommendation system, AI-based spam detector, sentiment analysis tool). Use appropriate datasets and evaluate accuracy, precision, and recall.

7. Design the architecture of an AI-based product, including cloud and edge integration.

8. Implement AI security measures to protect against adversarial attacks and data breaches.

9. Develop an AI model to analyze social media sentiment trends for financial markets.

10. Study and compare AI model deployment techniques across cloud, on-premise, and edge computing environments. Analyze the trade-offs between latency, scalability, and cost.

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Elective – III AI23313 (C) - Industrial AI-Powered Intelligence(IndusAI)

Teaching Scheme: Theory: 3 Hours/Week Practical: 2 Hour/Week	Credits 04	Examination Scheme: Activity Marks: 10 Marks In Sem: 30 Marks End Sem: 60 Marks Practical: 30 Marks

Prerequisites: : Internet of Things , Cloud Computing , Cyber Security.

Course Objectives:
- Gain an in-depth understanding of Industrial IoT (IIoT) systems and their significance in industrial applications.
- Explore the implementation of IIoT systems and their practical deployment.
- Identify the key components essential for building IIoT architecture.
- Examine the role of cloud computing in the context of IIoT.
- Investigate security challenges in IIoT systems and explore potential solutions.
- Analyze diverse IIoT applications and understand real-world use cases that benefit society.

Course Outcomes: The students will be able to learn:

CO1: Comprehend the fundamentals of Industrial IoT (IIoT), including its challenges, benefits, and significance in industrial applications.

CO2: Demonstrate the application of sensors, actuators, and communication protocols in IIoT implementation.

CO3: Explain the essential components required for IIoT architecture.

CO4: Assess the role of cloud computing in IIoT, focusing on data storage, processing, analytics, and Digital Twin technology.

CO5: Understand the critical importance of IIoT security and explore strategies to mitigate security risks.

CO6: Classify various IIoT applications and analyze real-world use cases across different industries.

Course Contents

Unit No. I: Fundamentals of the Industrial Internet of Things (IIoT) (07 Hours)
Introduction, Comparison: IoT and IIoT, Evolution of Industrial Revolutions, Optimizing Manufacturing with IIoT: Efficiency and Automation, Fundamental Requirements and Design Principles for IIoT Deployment, Harnessing IIoT for Plant Maintenance and Predictive Management, Key Opportunities, Challenges, and Advantages of IIoT Integration, Real Applications of IIoT Across Various Industries

Unit No. II: Communication Protocols for IIoT Systems (07 Hours)
Industrial Sensors and Actuators for Process Control, Functions of Sensors and Actuators in IIoT, IIoT Sensor Networks and Connectivity, Process Automation and Data Acquisition in IIoT Systems, Wireless Communication Technologies for IIoT: ZigBee, ZigBee IP, Z-Wave, Wi-Fi Backscatter, NFC, 6LoWPAN, and RPL, IoT Low-Power WAN Technologies: SigFox, nWave, Dash7, Low-Power Wi-Fi, LTE Category-M, and Ingenu RPMA.

Unit No. III: Industrial IoT (IIoT) Framework and Architecture (07 Hours)

Core Components of IIoT: An overview of sensors, gateways, routers, modems, cloud brokers, servers, and wireless sensor networks (WSN), along with their seamless integration. IIoT Architecture: Examination of business models, reference architectures, and the Industrial Internet Architecture Framework (IIAF). Layered Structure of IIoT: Understanding the sensing, processing, communication, and networking layers in IIoT systems.

Unit No. IV: Cloud Computing and Data Analytics for IIoT (07 Hours)

IoT Cloud Ecosystem: Introduction to Cloud of Things (CoT) platforms such as Predix, PTC ThingWorx, and Microsoft Azure, along with cloud-based services and business models like SaaS, PaaS, and IaaS. Data Analytics in IIoT: Exploring the role of data analytics in IIoT and key techniques for data visualization. Digital Twin Technology in IIoT: Understanding the concept, significance, core components, process design, and data requirements of Digital Twins in industrial applications.

Unit No. V: Security Challenges and Solutions in Industrial IoT (IIoT) (07 Hours)

Overview of IIoT Security: Exploring the importance of security in Industrial IoT, its relationship with traditional web technologies, key vulnerabilities, privacy challenges, and essential security requirements, Key Elements of IIoT Security: Covering threat analysis, identity management, access control, message integrity, non-repudiation, and ensuring system availability. IIoT Network Security & Cybersecurity Management: Implementing network protection strategies and best practices for securing industrial environments against cyber threats.

Unit No. VI: Industrial Applications, Use Cases, and Impact on Industry Evolution (07 Hours)

Applications and Use Cases – Smart robotics, smart metering, smart irrigation, smart factories, healthcare services, smart offices, smart logistics, and cyber manufacturing systems. Industrial Evolution – Introduction to Industry 4.0, its definition, significance, key characteristics, design principles, benefits, applications, and an introduction to Industry 5.0 (Society 5.0).

Text Books:

1. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2017
2. S. Misra, C. Roy, and A. Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0", CRC Press, 2020
3. Veneri, Giacomo, and Antonio Capasso, "Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0", 1st edition, Packt Publishing Ltd., 2018.

Reference Book:

1.Ulrich Sendler München, Germany, "The Internet of Things Ulrich Sendler Editor Industrie 4.0 Unleashed", Springer Viewg
2. R. Anandan, Suseendran Gopalakrishnan, Souvik Pal, Noor Zaman, "Industrial Internet of Things (IIoT): Intelligent Analytics for Predictive Maintenance", Wiley publication.

E-Resources:

- How Protocol Conversion Addresses IIoT Challenges: White Paper ByRed Lion .
- https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SECA4005.pdf
- https://www.ge.com/digital/applications/digital-twin
- https://www2.deloitte.com/us/en/insights/focus/industry-4-0/digital-twin-technology-smartfactory.html
- Introduction to Industry 4.0 and Industrial Internet of Things : https://onlinecourses. nptel.ac.in/noc20_cs69/preview

List of Assignments

1. Utilize wireless communication protocols for device connectivity and data exchange.
2. Write a program to send real-time notifications for monitoring and interacting with industrial environments using Gas sensor (MQ-135).
3. Develop a program for motion detection and automation experiments using PIR sensor,
4. Design a User Interface for Monitoring and Controlling a CPS System – Create a UI for real-time visualization and control of a Cyber-Physical System (CPS). Using temperature sensor, Humidity sensor, Pressure sensor.
5. Write a program to transmit IIoT sensor data to the cloud and store it in a database (Soil Moisture).
6. Develop an IIoT-Based Energy Monitoring and Optimization Application – Implement a program for tracking and improving energy efficiency.
7. Enabled Robotics and Automation Solutions – Write a program to integrate IIoT with robotic systems for industrial automation.
8. Develop a program to implement security protocols and data protection techniques in an IIoT system.
9. Perform Industrial Data Analysis Using IIoT Tools – Write a program to analyze industrial data using machine learning, big data techniques, and visualization tools.
10. Implement IIoT-based fleet tracking using GPS and AI-based route optimization for smart logistics management.

	Vidya Pratishthan's **Kamalnayan Bajaj Institute of Engineering and Technology, Baramati** **(Autonomous Institute)**
	HS23311 - Environmental Studies

Teaching Scheme: **Theory: 2 Hours/Week**	**Credits** **02**	**Examination Scheme:** **Activity Marks: 10 Marks** **End Sem: 60 Marks**

Course Objectives:
- Understand the fundamental concepts of environmental science and its relevance to engineering.
- Analyze the environmental impact of various engineering industries.
- Learn about sustainable engineering practices, pollution control, and waste management.
- Study environmental laws in India and global initiatives for environmental conservation.
- Explore corrective measures and preventive technologies for mitigating environmental damage.

Course Outcomes: The students will be able to learn:
CO1: Gain an understanding of environmental issues related to engineering industries.
CO2: Analyze the impact of engineering industries on the environment
CO3: Learn sustainable engineering solutions for mitigating environmental damage
CO4: Be aware of Indian and global initiatives for environmental protection
CO5: Develop a sense of responsibility towards environmental conservation in their professional field.

Course Contents

Unit No. I: Introduction to Environmental Studies (06 Hours)
Importance of Environmental Studies, Components of the Environment: Atmosphere, Hydrosphere, Lithosphere, and Biosphere, Ecosystems and Biodiversity: Types, Importance, and Conservation, Sustainable Development Goals (SDGs) and Role of Engineers in Sustainability, Renewable and Non-Renewable Resources, Water Resources: Overuse, Pollution, and Engineering Solutions, Energy Resources: Fossil Fuels, Nuclear Power, and Renewable Energy Alternatives, Land Resources: Soil Degradation, Deforestation, and Urbanization.

Unit No. II: Impact of Engineering Industries on Environment (07 Hours)
Manufacturing & Automobile Industry: Air pollution, Carbon emissions, Waste disposal, Chemical & Pharmaceutical Industry: Water and soil contamination, Hazardous waste, Construction & Infrastructure: Land degradation, Dust pollution, Waste generation, Electronics & IT Industry: E-waste, Energy consumption, Semiconductor waste, Power Generation (Thermal, Hydropower, Nuclear): Pollution, Waste heat, Radiation hazards, Causes and Effects of Climate Change, Global Warming and Greenhouse Effect.

Unit No. III Engineering Solutions for Environmental Mitigation and Sustainable Practices (07 Hours)
Carbon Capture and Storage (CCS), Green Chemistry & Eco-friendly Materials, Sustainable Design & Life Cycle Assessment (LCA), Energy-efficient Technologies & Smart Grids, Case Studies on Successful Pollution Reduction Waste Management Strategies: Solid Waste and Biomedical Waste Management, E-Waste: Sources, Impact, and Recycling, Hazardous Waste Handling and Treatment, Circular Economy and Zero-Waste Technologies Sustainable Engineering Practices: Renewable Energy Technologies (Solar, Wind, Biomass, Hydropower) Green Buildings and Sustainable Architecture, Electric Vehicles and Smart Transportation Systems, Sustainable Agriculture and Water Conservation

Technologies.

Unit No. IV Environmental Initiatives in India and Worldwide (06 Hours)

National Initiatives: Swachh Bharat Abhiyan, Namami Gange, National Green Tribunal (NGT), Corporate Social Responsibility (CSR) & Environmental Compliance, Environmental Activism and the Role of NGOs, Environmental Laws and Policies in India, The Environmental Protection Act, 1986, Role of Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCB), International Environmental Agreements (Kyoto Protocol, Paris Agreement, COP Summits), Global Initiatives: UNEP, IPCC, World Bank Environmental Policies.

Text Books:

1. Benny Joseph, Environmental Studies, McGraw Hill Education, 3rd Edition, 2021.

2. Anubha Kaushik & C.P. Kaushik, Environmental Studies, New Age International Publishers, 5th Edition, 2022.

Reference Books:

1. R. Rajagopalan, Environmental Studies: From Crisis to Cure, Oxford University Press, 3rd Edition, 2021.
2. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, University Press, 3rd Edition, 2021.
3. Suresh K. Dhameja, Environmental Science and Engineering, S.K. Kataria & Sons, 2nd Edition, 2020.

List of Activities For Reference

Unit 1: Introduction to Environmental Studies:

Ecosystem Study Report – Visit a local park, water body, or forested area and document its ecosystem components (flora, fauna, food chains).
Sustainability Case Study – Choose one of the Sustainable Development Goals (SDGs) and prepare a report on its implementation in India.
Renewable vs. Non-Renewable Resources – Prepare a comparative chart listing sources, usage, and sustainability factors. Water Conservation Survey – Conduct a survey in your neighborhood or campus to assess water consumption and suggest conservation strategies.

Unit 2: Impact of Engineering Industries on Environment:

Industrial Impact Assessment – Select an engineering industry (automobile, chemical, IT, etc.) and Analyze its environmental impact. Carbon Footprint Calculation – Calculate the carbon footprint of your daily activities (electricity, transportation, food, etc.) and suggest ways to reduce it.
Climate Change Awareness Video – Create a short video (2–3 min) explaining global warming and its impact. Case Study on Pollution Control Failures – Research a real-world incident of industrial pollution (e.g., Bhopal Gas Tragedy, Minamata Disease) and analyze the causes and consequences.

Unit 3: Engineering Solutions for Environmental Mitigation and Sustainable Practices.

Waste Management Audit – Conduct a waste audit in your college or home, classify the waste generated, and propose a waste management plan. E-Waste Collection Drive – Organize a drive to collect and safely dispose of e-waste in your locality. Submit a report on the amount collected and its disposal method.
Renewable Energy Model – Create a working or conceptual model of a solar panel, wind turbine, or biomass plant. Green Building Analysis – Identify a green building in your city (or college) and analyze its energy-efficient features.

Unit 4: Environmental Initiatives in India and Worldwide

Report on National Environmental Policies – Summarize key environmental laws in India and their effectiveness. International Climate Agreements Presentation – Prepare a presentation on major agreements like the Paris Agreement, Kyoto Protocol, and their impact on India.
NGO/CSR Initiative Study – Research an NGO or corporate social responsibility (CSR) initiative

focused on environmental protection and prepare a report. Swachh Bharat Implementation Review – Visit a local area, document cleanliness conditions, and suggest improvements under Swachh Bharat Abhiyan.

Evaluation Criteria (10 Marks Total)

- Depth of Research & Analysis (03 Marks)
- Presentation & Clarity (03 Marks)
- Creativity & Practical Application (02 Marks)
- Timely Submission (02 Mark)

	Vidya Pratishthan's
	Kamalnayan Bajaj Institute of Engineering and Technology, Baramati
	(Autonomous Institute)

AI23315:VSEC - DevOps and Git		
Teaching Scheme: **Practical: 4 Hour/Week**	**Credits** **02**	**Examination Scheme:** **Activity: -10 Marks** **Term Work: 30 Marks** **Practical: 30 Marks**

Prerequisites: Basic python programming, Data Science.

Course Objectives:

- To Understand DevOps principles and their relevance to AI & Data Science projects.
- To Learn Git operations for version control, collaboration, and project management.
- To Apply DevOps practices to automate CI/CD pipelines using Jenkins, Docker, and Kubernetes.
- To Utilize collaborative Git workflows, including pull requests, branching, and merging.
- To deploy AI/DS applications and maintain environment consistency.
- To Utilize Kubernetes for orchestration to scale and deploy AI/DS solutions efficiently in production.

Course Outcomes (COs): The students will be able to

CO1: Apply the key concepts of Git and DevOps to demonstrate their importance in development.

CO2: Use Git for version control, branching, merging, and team collaboration in a development environment.

CO3: Set up and implement CI/CD pipelines with Jenkins and GitHub for automated deployment.

CO4: Deploy applications using Docker containers and automate processes with Docker files.

CO5: Implement Kubernetes orchestration to scale and manage models in production.

CO6: Collaborate in teams using Git and CI/CD tools to deploy projects effectively

List of Assignments

1. Set up a Git repository for a data science project and push it to GitHub to manage version control, track changes, and ensure code stability.
2. Create feature branches for the project, merge them, and resolve conflicts to maintain separate workspaces for team collaboration.
3. Fork an open-source AI project, create a feature branch, submit a pull request, and address conflicts during the review process.
4. Research and explain how DevOps principles, like CI/CD, can improve deployment and updates for machine learning projects.
5. Set up Jenkins to trigger automated builds whenever new code is pushed to GitHub for your AI/DS project.

6. Create a Docker container for your AI model and test it on your local machine to ensure consistent performance across environments.
7. Use Docker Compose to manage multiple containers for a web-based AI app, including containers for the AI model, database, and frontend.
8. Set up a local Kubernetes cluster with Minikube to deploy and scale your Dockerized AI application.
9. Implement auto-scaling for your AI app on Kubernetes and monitor its health and performance metrics.
10. Set up a CI/CD pipeline with Jenkins, Docker, and Kubernetes to automate the development-to-deployment process for your AI model.

Text Books:

1. Chacon, Scott, and Ben Straub, "Pro Git", Apress, 2014, ISBN: 978-1484200773.
2. Poulton, Nigel, "Docker Deep Dive", Leanpub, 2023, ISBN: 978-1916585256.
3. Hightower, Kelsey, Brendan Burns, and Joe Beda, "Kubernetes Up & Running", 3rd Edition O'Reilly Media, 2022, ISBN: 9781098110208.

Reference Books:

1. Richard E. Silverman,"A Working Introduction Git Pocket Guide", O'Reilly Media,Inc
2. Ferdinando Santacroce, "Git Essentials" Packt Publishing Ltd.
3. Gene Kim, Patrick Debois, John Willis, and Jez Humble, "The DevOps Handbook" IT Revolution Press, ISBN- 978-1942788003.
4. Jez Humble and David Farley, "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation", Pearson Education, Inc, ISBN-13: 978–0–321–60191–9
5. John Ferguson Smart, "Jenkins: The Definitive Guide", O'Reilly Media,Inc, ISBN-978–1–449–30535–2
6. Russell Glass and Sean Callahan, "The Big Data-Driven Business", WILEY, ISBN- 978-1118889800

E-Resources:

- Git and GitHub for Beginners (FreeCodeCamp) – https://www.freecodecamp.org/news/git-and-github-for-beginners/
- Docker Essentials - Free Course by IBM : https://cognitiveclass.ai/courses/docker-essentials/
- Kubernetes for Beginners - FreeCodeCamp – https://www.freecodecamp.org/news/the-docker-handbook/
- DevOps Essentials by edX (Free) – https://www.edx.org/learn/devops
- Shubham Soni, "CI/CD with Docker, Jenkins, and Kubernetes"- https://surajsoni3332.medium.com/deployment-of-django-app-using-jenkins-ci-cd-pipeline-2ddf54971f03

Open Access Datasets for AIDS Projects:

- Kaggle Datasets: https://www.kaggle.com/datasets
- UCI Machine Learning Repository: https://archive.ics.uci.edu/ml/index.php
- Google Dataset Search: https://datasetsearch.research.google.com/
- AWS Public Datasets: https://registry /.opendata.aws

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VPKBIET	**(An Autonomous Institute)**

Audit Course : HS23312- Democracy, Election, and Governance

Course Objectives:
- Analyze the structure and role of democratic institutions
- Understand the electoral process and the role of the Election Commission of India,
- Study the framework of governance in India, covering the executive, legislative, and judicial branches at both central and state levels.

Course Outcomes:

CO1: Explain the evolution and significance of democracy in India, its core principles, and its role in nation-building.

CO2: Describe the composition, powers, and functions of the Election Commission of India, and understand the electoral process.

CO3: Interpret the governance structures at the Union and State levels, covering executive, legislative, and judicial functions

Course Contents

Unit I: Democracy in India

Evolution of Democracy, Dimensions of Democracy: Social, Economic and Political, Decentralization: Grassroots Level Democracy, Challenges before Democracy: women and marginalized sections of the society

Unit II: Election

Election Commission of India-composition, powers and functions, and electoral process. Types of emergency grounds, procedure, duration, and effects. Amendment of the constitution- meaning, procedure, and limitations.

Unit III: **Governance**

Union Executive- President, Vice-president, Prime Minister, Council of Ministers. Union Legislature-Parliament and Parliamentary proceedings. Union Judiciary-Supreme Court of India – composition and powers and functions. State Executive- Governor, Chief Minister, Council of Ministers. State Legislature-State Legislative Assembly and State Legislative Council. State Judiciary-High court. Local Government-Panchayat raj system Challenges of caste, gender, class, democracy and ethnicity.

Reference Books:
1. Banerjee-Dube, I. (2014). A history of modern India. Cambridge University Press.

2. Bhargava, R. (2008). Political theory: An introduction. Pearson Education India.

3. Bhargava, R., Vanaik, A. (2010) Understanding Contemporary India: Critical Perspective. New Delhi: Orient Blackswan.

4. Chandhoke. N., Proyadardhi.P, (ed) (2009), 'Contemporary India: Economy, Society, Politics', Pearson India Education Services Pvt. Ltd, ISBN 978-81- 317-1929-9.

5. Chandra, B. (1999). Essays on contemporary India. Har-Anand Publications.

6. Chaterjee, P. (1997). State and Politics in India.

7. Dasgupta. S., (ed) (2011), 'Political Sociology', Dorling Kindersley (India) Pvt. Ltd., Licensees of Pearson Education in south Asia. ISBN: 978-317-6027- 7.

8. Deshpande, S. (2003). Contemporary India: A Sociological View, New Delhi:Viking Publication.

9. Guha, R. (2007). India After Gandhi: The History of the World's Largest. Democracy, HarperCollins Publishers, New York.

10. Guha, R. (2013). Gandhi before India. Penguin UK.

11. Jayal. N.G. (2001). Democracy in India.New Delhi: Oxford University Press.

12. Kohli, A. (1990). Democracy and discontent: India's growing crisis of governability. Cambridge University Press.

13. Kohli, A., Breman, J., & Hawthorn, G. P. (Eds.). (2001). The success of India's democracy (Vol. 6). Cambridge University Press.

14. Kothari, R. (1989). State against democracy: In search of humane governance. Apex Pr.

15. Kothari, R. (1970). Politics in India. New Delhi: Orient Blackswan.

16. Kothari, R. (1995). Caste in Indian politics. Orient Blackswan.

17. Sarkar, S. (2001). Indian democracy: the historical inheritance. the Success of India's Democracy, 23-46.

Evaluation and Assessment

Since this is an audit course, evaluation will be based on active participation, understanding of concepts, and analytical skills:

1. Assignments & Reports – Writing assignments on topics like electoral reforms, democratic challenges, or constitutional amendments.

2. Quizzes/MCQs – Multiple-choice or short-answer questions covering key topics like the Election Commission, parliamentary proceedings, and governance.

3. Group Discussions/Presentations– Debates on issues like democracy and social justice, governance challenges, and the effectiveness of grassroots-level democracy.