TECHNO INDIA UNIVERSITY

WEST BENGAL

Syllabus

for

4-Years B.Tech.

in

Computer Science and Engineering
(Specialization in Artificial Intelligence)

Academic Year: 2024-2025

Semester 7

Machine Learning (TIU-UCS-T451)

Program: B. Tech. in CSE-AI	**Year, Semester:** 4th Yr., 7th Sem.
Course Title: Machine Learning	**Subject Code:** TIU-UCS-T451
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. understand the human learning aspects and primitives in learning process by computer
2. analyze the nature of problems solved with machine learning techniques
3. design and implement suitable machine learning technique for a given application

COURSE OUTCOME:

The student will be able to:

CO1:	Explore the underlying principles, mathematical foundations, practical uses, and constraints of current machine learning methods.	K2
CO2:	Recognize the criteria for assessing the effectiveness of the developed model.	K2
CO3:	Investigate and devise contemporary machine learning applications, emphasizing recent advancements and innovative perspectives.	K4
CO4:	Construct the learning model tailored to a specific task.	K3
CO5:	Utilize cutting-edge development frameworks and software libraries to implement	K3
CO6:	Optimize machine learning models by fine-tuning hyperparameters and improving generalization.	K4

COURSE CONTENT:

MODULE 1:	**INTRODUCTION**	**7 Hours**
Definition - Types of Machine Learning - Examples of Machine Learning Problems - Training versus Testing - Characteristics of Machine learning tasks - Predictive and descriptive tasks - Machine learning Models: Geometric Models, Logical Models, Probabilistic Models. Features: Feature types - Feature Construction and Transformation - Feature Selection.		
MODULE 2:	**CLASSIFICATION AND CONCEPT LEARNING**	**7 Hours**
Classification: Binary Classification- Assessing Classification performance - Class probability Estimation - Multiclass Classification - Regression: Assessing performance of Regression - Error measures - Overfitting- Theory of Generalization: Effective number of hypothesis - Bounding the Growth function.		
MODULE 3:	**LINEAR AND PROBABILISTIC MODELS**	**7 Hours**

Least Squares method - Multivariate Linear Regression - Perceptron, Multiple Layer Perceptron - Support Vector Machines - Obtaining probabilities from Linear classifiers - Kernel methods for non-Linearity - Probabilistic models for categorical data – Naïve Bayes Classifier		
MODULE 4:	**DISTANCE BASED MODELS**	**8 Hours**
Distance Based Models: Neighbors and Examples - Nearest Neighbors Classification - Distance based clustering – K-Means Algorithm - K-Medoids Algorithm - Hierarchical clustering - Vector Quantization, Self-Organizing Feature Map - Principal Component Analysis		
MODULE 5:	**RULE BASED AND TREE BASED MODELS**	**8 Hours**
Rule Based Models: Rule learning for subgroup discovery - Association rule mining - Tree Based Models: Decision Trees - Ranking and Probability estimation Trees - Regression trees - Classification and Regression Trees (CART)		
MODULE 6:	**TRENDS IN MACHINE LEARNING**	**8 Hours**
Ensemble Learning, - Bagging and Boosting - Random Forest - Meta learning - Deep Learning - Reinforcement Learning – Applications.		
	TOTAL LECTURES	**45 Hours**

Books:

1. P. Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012, ISBN-10: 1107422221, ISBN-13: 978-1107422223.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Second Edition (Springer Series in Statistics), 2016, ISBN-10: 0387848576, ISBN-13: 978-0387848570.
3. Christopher Bishop, "Pattern Recognition and Machine Learning (Information Science and Statistics)", Springer, 2007.
4. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012, ISBN-10: 0262018020, ISBN-13: 978-0262018029
5. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, "Learning from Data", AMLBook Publishers, 2012 ISBN 13: 978-1600490064.
6. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997, ISBN-10: 0071154671, ISBN-13: 978-0071154673.
7. Jiawei Han, Micheline Kamber, "Data Mining Concepts and Techniques", Chris Ullman, Morgan Kaufmann Publishers,Third Edition, 2011, ISBN 0123814790, ISBN-13 9780123814791.

Natural Language Processing (NLP) and its Applications (TIU-UCS- T453)

Program: B. Tech. in CSE-AI	**Year, Semester:** 4th Yr., 7th Sem
Course Title: Natural Language Processing	**Subject Code:** TIU-UCS-T453
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

1. Introducing cutting-edge systems and trends in natural language processing to the students.
2. Make sure they comprehend the language's morphology, syntax, semantics, and pragmatic notions and are able to provide the necessary examples to support the aforementioned ideas.
3. Teach them the importance of pragmatics in interpreting natural language.
4. Give students the tools they need to explain a natural language processing application and to demonstrate syntactic, semantic, and pragmatic processing.

COURSE OUTCOME:

The students will be able to:

CO1 :	Explain the fundamental concepts of Natural Language Processing (NLP), including syntax, semantics, and pragmatics.	K2
CO2 :	Apply various text preprocessing techniques such as tokenization, stemming, and lemmatization to prepare data for NLP tasks.	K 3
CO3 :	Analyze different NLP models like N-grams, Hidden Markov Models (HMM), and neural networks to solve language-based problems.	K3
CO4 :	Evaluate the performance of NLP algorithms using appropriate metrics (e.g., accuracy, precision, recall, and F1 score).	K4
CO5 :	Design and implement NLP applications such as sentiment analysis, machine translation, and chatbots using modern frameworks (e.g., NLTK, Spacy, or TensorFlow).	K3
CO6 :	Critically assess the ethical considerations and biases in NLP models and their real-world impact.	K3

COURSE CONTENT:

MODULE 1:	**Introduction to NLP**	**10 Hours**
Natural language processing issues and strategies. Tools of NLP, Linguistic organization of NLP, NLP as an Application domain. Word Classes: Regular Expressions: Chomsky hierarchy, CFG and different parsing techniques, Morphology: Inflectional, derivational, parsing and parsing with FST, Combinational Rules, Joint and conditional probability. Probabilistic Language modeling and its Applications.		
MODULE 2:	**Language Modeling and Naïve Bayes**	**14 Hours**
Markov models, N- grams. Estimating the probability of a word and smoothing. Counting words in Corpora, simple N-grams, smoothing (Add One, Written-Bell, Good-Turing). Part of Speech Tagging and Hidden Markov Models: Part of Speech tagging, Indian Language on focus Morphology Analysis, Accuracy Measure and Probability, HMM, Viterbi algorithm for finding most likely HMM Path. HMM tagging, transformation based tagging. Probabilistic Context Free Grammars: Weighted context free grammars.		
MODULE 3:	**Semantics**	**12 Hours**

Representing Meaning: Unambiguous representation, canonical form, expressiveness, meaning structure of language Semantic Analysis: NLP and IR, How NLP has used IR Towards Latent Semantic. Lexical Semantics: Lexemes(synonymy, hyponymy etc), WordNet, metonymy and their computational approaches Supervised and Unsupervised methods Word Sense Disambiguation: Selectional restriction based, machine learning based and dictionary based approaches.		
MODULE 4:	**Pragmatics**	**9 Hours**
Information Theory: Entropy, Cross-entropy, information gain. Reference resolution and phenomena, syntactic and semantic constraints. Pronoun resolution algorithm, text coherence, and discourse structure Natural Language Generation: Introduction to language generation, architecture, discourse planning (text schemata, rhetorical relations). Resource Constrained WSD, Parsing Algorithms, Parsing Ambiguous Sentences, Probabilistic Parsing Algorithms.		
	TOTAL LECTURES	**45 Hours**

Books:

1. D. Jurafsky & J. H. Martin – "Speech and Language Processing – An introduction to Language processing, Computational Linguistics, and Speech Recognition", Pearson Education
2. Allen, James. 1995. – "Natural Language Understanding". Benjamin/Cummings, 2ed. Bharathi, A., Vineet Chaitanya and Rajeev Sangal. 1995.
3. Natural Language Processing- "A Pananian Perspective". Prentice Hall India, Eastern Economy Edition. 3. Eugene Cherniak: "Statistical Language Learning", MIT Press, 1993.
4. Manning, Christopher and Heinrich Schutze. 1999. "Foundations of Statistical Natural Language Processing". MIT Press.
5. Cognitively Inspired Natural Language Processing Abhijit Mishra, Pushpak Bhattacharyya Springer.

Knowledge Discovery & Data Mining (TIU-UCS-E463B)

Program: B. Tech. in CSE-AI	**Year, Semester:** 4th Yr., 7th Sem.
Course Title: Knowledge Discovery & Data Mining	**Subject Code:** TIU-UCS-E463B
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Learn the fundamentals of knowledge discovery, data preprocessing, and pattern recognition.
2. Apply classification, clustering, association rule mining, and anomaly detection methods.
3. Implement efficient data mining algorithms for large and complex datasets.
4. Work with popular data mining tools like WEKA, RapidMiner, and Python-based libraries.

COURSE OUTCOME :

The student will be able to:

CO-1:	Understand fundamental data mining concepts, techniques, and algorithms.	K2
CO-2:	Apply data mining methods to real-world problems.	K3
CO-3:	Evaluate and compare different data mining algorithms.	K4
CO-4:	Use data mining tools to analyze large datasets.	K2
CO-5:	Communicate data mining results effectively to stakeholders.	K3
CO-6:	Address ethical, privacy, and security concerns in data mining.	K4

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**12 Hours**
Introduction and Rule-based Classification: What is Data Mining? Why do we need data mining? Data Mining System- Architecture and Processes. Challenges in Data Mining. Decision Tree: General approach for solving a classification problem, Decision Tree Induction, Overfitting Pruning. Rule-based Classification: How a rule-based classifier works, rule-ordering schemes, how to build a rule-based classifier, direct and indirect methods for rule extraction.		
MODULE 2:	**CLASSIFICATION AND CONCEPT LEARNING**	**10 Hours**
Advanced Classification Techniques: Bayes' Classifier: Bayes' theorem, Naïve Bayes classifier. Support Vector Machines (SVM): Maximum margin hyperplanes, Linear SVM: separable case, non-separable case, Non-linear SVM.		
MODULE 3:	**LINEAR AND PROBABILISTIC MODELS**	**12 Hours**
Ensemble Methods, Association Rule Mining: Ensemble Methods: Bagging, Boosting, Random Forests Association Rule Mining: Introduction, Frequent itemset generation, (Apriori principle, candidate generation and pruning), Rule generation, Compact representation of frequent item sets, FP-growth algorithm, Sub-graph mining.		
MODULE 4:	**DISTANCE BASED MODELS**	**11 Hours**
Cluster Analysis: Introduction: Motivations, objectives and applications of clustering. Different types of clustering. Partitional Clustering: K-means, Bisecting K-means, PAM. Hierarchical Clustering: Agglomerative, Divisive, MIN, MAX, dendrogram representation. Density-based Clustering: DBSCAN. Cluster evaluation, further reading – OPTICS, DENCLUE, CHAMELEON, BIRCH, CURE, ROCK.		
	TOTAL LECTURES	**45 Hours**

Books:

1. Data Mining Concepts and Techniques, 3rd, Edition, J. Han and M. Kamber, Morgan Kaufmann Publishers, July 2011.
2. Introduction to Data Mining, P. N. Tan, M. Steinbach and V. Kumar, Pearson Publishers.
3. Pattern Recognition and Machine Learning, First Edition, C. Bishop, Springer, 2006.
4. Neural Networks and Learning Machines, Third Edition, S. Haykin, PHI Learning, 2009.

5. Pattern Classification, Second Edition, R. Duda, P. Hart and D. Stock, Wiley-Interscience, 2000.

Big Data Analytics (TIU-UCS-E463A)

Program: B. Tech. in CSE-AI	**Year, Semester:** 4th Yr., 7th Sem.
Course Title: Big Data Analytics	**Subject Code:** TIU-UCS-E463A
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Learn the fundamentals of big data, its characteristics, and challenges.
2. Use Hadoop, Spark, and other tools for scalable data processing.
3. Perform data mining, machine learning, and statistical analysis on large datasets.
4. Explore NoSQL databases and distributed storage systems for efficient data handling.
5. Implement analytics solutions for business, healthcare, finance, and other domains.

COURSE OUTCOME :

The student will be able to:

CO-1:	Understand the basic concepts of intelligent information retrieval, including user interactions, tags, clustering, classification, and recommendations	K2
CO-2:	Apply intelligent information retrieval techniques to solve real-world problems, such as search engine ranking, spam filtering, and product recommendations.	K3
CO-3:	Develop and evaluate intelligent information retrieval systems.	K4
CO-4:	Use Hadoop and MapReduce to process large-scale data.	K2
CO-5:	Implement algorithms using MapReduce.	K3
CO-6:	Address ethical, privacy, and security challenges in intelligent information retrieval.	K3

COURSE CONTENT :

MODULE 1:		**12 Hours**
Intelligent Information Retrieval Learning from user interactions. Rating and voting, emailing and link forwarding, bookmarking, purchasing items, reviews. Extracting intelligence from tags. Tag related metadata. Tag generation. Leveraging tags: dynamic navigation, using tag clouds, targeted search, recommendations based on tags. Extracting intelligence from content: Blogs, Wikis, Message boards.		
MODULE 2:		**12 Hours**
Clustering, Classification and Recommendations Clustering and web intelligence. Overview of clustering algorithms. Classification and Web Intelligence. Need for classification. Overview. Automatic categorization of emails and spam filtering. Classification and fraud detection. Combining classifiers. Creating Suggestions and Recommendations. Concepts of distance and similarity. Recommendations based on similar users. Recommendations based on similar items.		

Recommendations based on content.		
MODULE 3:		**12 Hours**
Introduction to Hadoop Starting Hadoop. Components of Hadoop. HDFS. Working with files in HDFS. Introduction to MapReduce. Streaming in Hadoop. Advanced MapReduce: Chaining MapReduce jobs, Joining data from different sources. Developing MapReduce programs in local mode and pseudo-distributed mode. Moving data into and out of Hadoop. Data input and output in MapReduce. Applying MapReduce patterns to Big Data. Streamlining HDFS for big data.		
MODULE 4:		**9 Hours**
Algorithms Using MapReduce Matrix-Vector Multiplication by MapReduce. Relational-Algebra Operations. Computing Selections by MapReduce. Computing Projections by MapReduce. Union, Intersection, and Difference by MapReduce. Computing Natural Join by MapReduce. Grouping and Aggregation by MapReduce. Matrix Multiplication.		
TOTAL LECTURES		**45 Hours**

Books:

1. Algorithms of the Intelligent Web. H. Marmanis and D. Babenko. Manning Publishers, 2009.
2. Collective Intelligence in Action. S. Alag. Manning Publishers, 2009.
3. Hadoop in Action by Chuck Lam. Manning Publishers. 2011.
4. Hadoop in Practice by Alex Holmes. Manning Publishers. 2012.
5. Mining of Massive Datasets by Jure Leskovec, Anand Rajaraman, Jeff Ullman. Cambridge University Press. 2011.
6. Mining the Web: Discovering Knowledge from Hypertext Data. S. Chakrabarti, Morgan-Kaufmann Publishers, 2002.
7. Recommender Systems Handbook: Francesco Ricci, Lior Rokach, Bracha Shapira, Paul B. Kantor, Springer, 2011.

Computer Vision (TIU-UCS-E463C)

Program: B. Tech. in CSE-AI	**Year, Semester:** 4th Yr., 7th Sem.
Course Title: Computer Vision	**Subject Code:** TIU-UCS-E463C
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** Theory–3

COURSE OBJECTIVE :

Enable the student to:

1. Learn the fundamentals of computer vision and its integration with cloud platforms.
2. Explore APIs from AWS, Google Cloud, and Azure for image and video analysis
3. Develop and deploy deep learning-based vision models using cloud computing.
4. Solve problems in healthcare, security, retail, and autonomous systems using cloud-based computer vision.

COURSE OUTCOME :

The student will be able to:

CO-1:	Understand the Core Concepts of Computer Vision.	K2
CO-2:	Analyze Binary Images and Geometric Properties	K4
CO-3:	Apply Fundamentals of Image Processing.	K3
CO-4:	Explore Advanced Concepts in Image Formation and Reflectance.	K3
CO-5:	Develop Techniques for Shape and Motion Analysis	K4
CO-6:	Implement Machine Learning and Deep Learning Techniques for Computer Vision Applications	K3

COURSE CONTENT :

MODULE 1:		**11 Hours**
Image Formation Models, Monocular imaging system, Orthographic & Perspective Projection, Camera model and Camera calibration, Image representations (continuous and discrete), Edge detection. Image Processing and Feature Extraction: Harris corner detector, SIFT, HoG descriptor		
MODULE 2:		**11 Hours**
Displacement and Motion models, Global motion estimation: Affine and Projective; Motion Estimation: Optical flow computation, Laplacian and Gaussian pyramids, Robust optical flow estimation; KLT tracker, Advanced Trackers such as KCF		
MODULE 3:		**11 Hours**
Structure from motion; Depth estimation, Active stereo: Fringe projection techniques; Binocular imaging systems, Stereo Vision, Fundamental matrix estimation, RANSAC, Image rectification and disparity estimation		
MODULE 4:		**12 Hours**
Viola Jones face detection, Face representation: Eigen faces and 2D PCA. Deformable curves and surfaces, Snakes and active contours; Image Segmentation. Machine Learning and Deep Learning paradigms for Computer vision.		
	TOTAL LECTURES	**45 Hours**

Books:

1. Shah M., Fundamentals of Computer Vision, 1997.
2. Szeliski R., Computer Vision: Algorithms and Applications, Springer, 2011.
3. Forsyth D. & Ponce J., Computer Vision - A Modern Approach, Prentice Hall, 2002.

Artificial Neural Network (TIU-UCS-E463D)

Program: B. Tech. in CSE-AI	**Year, Semester:** 4th Yr., 7th Sem.
Course Title: Artificial Neural Network	**Subject Code:** TIU-UCS-E463D
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Learn the architecture, working principles, and mathematical foundations of artificial neural networks.
2. Implement feedforward, convolutional, and recurrent neural networks using backpropagation and optimization techniques.
3. Apply techniques like regularization, dropout, and hyperparameter tuning for efficient learning.
4. Solve challenges in image processing, natural language processing, and predictive analytics.

COURSE OUTCOME :

The student will be able to:

CO-1:	Understand fundamental neural network concepts, including perceptrons, MLPs, and RBF networks.	K2
CO-2:	Apply linear and nonlinear regression techniques to machine learning problems.	K3
CO-3:	Learn the basics of deep learning, including CNNs and RNNs.	K2
CO-4:	Implement neural networks using frameworks like TensorFlow and PyTorch.	K3
CO-5:	Evaluate neural network performance and select optimal models.	K3
CO-6:	Explore advanced topics like generative models, reinforcement learning, and transfer learning.	K4

COURSE CONTENT :

MODULE 1:	**FUNDAMENTALS OF NEURAL NETWORKS**	**8 Hours**
Introduction to neural networks, The human brain, Introduction to Neural Networks, Models of a neuron, Feedback and network, architectures, Knowledge representation, Prior information and invariance, Learning processes, Perceptron, Batch perceptron algorithm.		
MODULE 2:	**MULTILAYER PERCEPTRON AND BACKPROPAGATION**	**10 Hours**
Linear, non-linear regression, and multilayer perceptron (MLP), Linear regression, Logistic regression, Gradient Descent Algorithm, Multi-layer perceptron, Nonlinear Activation Units and Learning Mechanisms, XOR problem, Back propagation, Practical, Consideration in Back Propagation Algorithm, Heuristics for Back-Propagation, Multi-Class, Classification Using Multi-layered Perceptrons.		
MODULE 3:	**MACHINE LEARNING MODELS AND KERNEL METHODS**	**8 Hours**
Least Squares method - Multivariate Linear Regression - Perceptron, Multiple Layer Perceptron - Support Vector Machines - Obtaining probabilities from Linear classifiers - Kernel methods for non-Linearity - Probabilistic models for categorical data – Naïve Bayes Classifier Radial Basis Function (RBF), Multivariate interpolation problem, Radial basis functions (RBF), Recursive least squares algorithm, Comparison of RBF with MLP, Kernel regression using RBFs, Kernel Functions, Basics of constrained optimization, Comparison Between MLP and RBF.		
MODULE 4:	**FUZZY NEURAL NETWORKS AND HYBRID SYSTEMS**	**9 Hours**
Introduction to Fuzzy Neural Networks, Overview of Fuzzy system, Integration of fuzzy logic and neural networks, Fuzzy neurons, Hybrid neural nets, Trainable neural nets for fuzzy IF-THEN rules , Tuning fuzzy control parameters by neural nets , Fuzzy rule extraction from numerical		

data, Neuro-fuzzy classifiers, FULLINS , Applications of fuzzy neural systems.		
MODULE 5:	**INTRODUCTION TO DEEP LEARNING AND CONVOLUTIONAL NEURAL NETWORKS**	**10 Hours**
Introduction to Deep learning and Convolution Neural Network, Layers and Blocks , Parameter Management , Deferred Initialization , Custom Layers , GPUs , From Fully-Connected Layers to Convolutions , Convolutions for Images , Padding and Stride , Multiple Input and Multiple Output Channels , Pooling , Batch Normalization, Convolutional Neural Networks (LeNet) ,Deep Convolutional Neural Networks (AlexNet) , Residual Networks (ResNet) , Densely Connected Networks (DenseNet) , Networks with Parallel Concatenations (GoogLeNet).		
	TOTAL LECTURES	**45 Hours**

Books:

1. P. An introduction to neural networks (Kevin Gurney University of Sheffield)
2. Neural Fuzzy Systems (Robert Full´er)
3. Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering (Nikola K. Kasabov)
4. Dive into Deep Learning (Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola)

Machine Learning Lab(TIU-UCS-L451)

Program: B.Tech. in CSE-AI	**Year, Semester:** 4th, 7th.
Course Title: Machine Learning Lab	**Subject Code:** TIU-UCS-L451
Contact Hours/Week: 0–0–3	**Credit:** 1.5

COURSE OBJECTIVE :

Enable the student to:

1. Apply fundamental machine learning techniques using Python.
2. Optimize and fine-tune machine learning models using hyperparameter tuning.
3. Deploy and evaluate machine learning models effectively.

COURSE OUTCOME :

On completion of the course, the student will be able:

CO-1	Illustrate and apply techniques to pre-process data for both supervised and unsupervised learning models using Python.	K3
CO-2	Develop and assess machine learning algorithms for regression, classification, and clustering tasks using Python.	K3
CO-3	Implement and evaluate feature selection, dimensionality reduction, and hyperparameter tuning techniques to enhance model performance.	K4
CO-4	Utilize Python machine learning libraries to build, optimize, and deploy machine learning models.	K4
CO-5	Analyze and implement machine learning algorithms while assessing their performance using appropriate validation techniques.	K4

CO-6	Evaluate machine learning models by applying suitable evaluation metrics and visualization techniques for performance improvement.	K4

COURSE CONTENT :

MODULE 1:	**INTRODUCTION TO PYTHON FOR MACHINE LEARNING**	**6 Hours**
Understanding Python libraries (NumPy, Pandas, Matplotlib, Seaborn, Scikit-learn), Data loading, manipulation, and visualization techniques, Data preprocessing: Handling missing values, feature scaling, and encoding		
MODULE 2:	**SUPERVISED LEARNING - REGRESSION & CLASSIFICATION**	**15 Hours**
Implementing Linear Regression and Logistic Regression, Training and evaluating Decision Trees, Random Forests, and Support Vector Machines (SVM), Hyperparameter tuning using GridSearchCV & RandomizedSearchCV		
MODULE 3:	**UNSUPERVISED LEARNING & DIMENSIONALITY REDUCTION**	**6 Hours**
Implementing K-Means Clustering and choosing the optimal K, Feature extraction and Principal Component Analysis (PCA)		
MODULE 4:	**NEURAL NETWORKS**	**6 Hours**
Implementing a Feedforward Neural Network using TensorFlow/Keras, Tuning number of layers, neurons, batch size, and learning rate, Training and testing on MNIST dataset		
MODULE 5:	**NATURAL LANGUAGE PROCESSING**	**6 Hours**
Text tokenization and TF-IDF vectorization, Implementing Naïve Bayes for Sentiment Analysis, Hyperparameter tuning for Naïve Bayes (Laplace smoothing)		
MODULE 6:	**MACHINE LEARNING MODEL DEPLOYMENT**	**6 Hours**
Saving trained ML models using joblib, Creating a Flask API for serving predictions, Testing the deployed model with real-time inputs		
	TOTAL LAB HOURS	**45 Hours**

Books:

1. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly Media.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press.
3. Sebastian Raschka, *Python Machine Learning*, Packt Publishing.
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning*, Springer.
5. François Chollet, *Deep Learning with Python*, Manning Publications.

Project-I (TIU-UCS-P495)

Program: B.Tech. in CSE-AI	**Year, Semester:** 4th, 7th.

Course Title: Project-I	**Subject Code:**TIU-UCS-P495
Contact Hours/Week: 0–2–4	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

1. Develop students' ability to identify and formulate research problems in various computer Science domains.
2. Enhance students' skills in conducting structured literature reviews to evaluate existing research, technologies, and frameworks.
3. Equip students with the analytical skills to identify research gaps and define clear, well-structured research objectives based on technical and theoretical gaps.

COURSE OUTCOME :

On completion of the course, the student will be able:

CO-1	Understand research methodologies and identify relevant computer science research problems.	K2
CO-2	Conduct a structured literature review using relevant research sources.	K5
CO-3	Analyze gaps in current technologies, frameworks, or algorithms.	K5
CO-4	Define clear research objectives and justify their significance.	K6
CO-5	Develop a research plan with appropriate methodologies and tools.	K4
CO-6	Communicate research findings effectively through technical writing and presentations.	K6

COURSE CONTENT :

Module-1:	**RESEARCH PROBLEM IDENTIFICATION**
Introduction to research methodologies in software engineering, AI, data science, cybersecurity, and networking. Identifying industry-relevant and academic research gaps. Ethical considerations in computer science research.	
Module-2:	**LITERATURE REVIEW**
Conducting a structured literature review using IEEE, ACM, Springer, etc. Evaluating existing models, architectures, frameworks, and software solutions. Identifying trends, limitations, and emerging technologies in CSE.	
Module-3:	**IDENTIFYING RESEARCH GAPS & DEFINING OBJECTIVES**
Assessing limitations in existing technologies and approaches. Recognizing gaps in performance, security, scalability, or efficiency. Formulating precise research objectives relevant to software, AI, security, or networking.	

Career Advancement & Skill Development-VII: Managerial Economics

(TIU-UCS-S403)

Program: B. Tech. in CSE-AI	**Year, Semester:** 4th Yr., 7th Sem.
Course Title: Career Advancement & Skill Development-VII: Managerial Economics	**Subject Code:** TIU-UTR-S403
Contact Hours/Week: 2–0–0 (L–T–P)	**Credit:** 2

COURSE OBJECTIVE :

Enable the student to:

1. introduce fundamental concepts of managerial economics, including cost classification, demand-supply analysis, and market structures.
2. develop analytical skills for applying production, cost, and revenue concepts in business decision-making.
3. equip students with knowledge of macroeconomic principles, including GDP, inflation, and fiscal policies, for understanding economic environments..

COURSE OUTCOME :

The student will be able to:

CO-1	Define fundamental concepts of managerial economics, cost classification, and firm objectives.	K1
CO-2	Explain demand and supply analysis, elasticity, and business forecasting techniques.	K2
CO-3	Apply production and cost concepts, including cost-output relationships and returns to scale.	K3
CO-4	Analyze revenue types, pricing policies, and the impact of government regulations on pricing.	K3
CO-5	Compare different market structures, including perfect and imperfect competition, and oligopolistic strategies.	K4
CO-6	Evaluate macroeconomic concepts such as GDP, inflation, fiscal and monetary policies, and balance of payments.	K4

COURSE CONTENT :

Module-1:	**INTRODUCTION**	**5 Hours**
Fundamental Concepts of Managerial Economics, Factors Responsible for Managerial Decision, Cost Concept & Classification, Objectives of the Firm, Correlation Between Productivity and Profitability.		
Module-2:	**DEMAND AND SUPPLY ANALYSIS**	**5 Hours**
Meaning, Types and Determinants, Demand Estimation, Demand Elasticities for Decision Making, Business and Economic Forecasting (Qualitative and Quantitative Methods), Supply Analysis (Meaning, Elasticities, and Determinants), Market Equilibrium.		
Module-3:	**PRODUCTION ECONOMICS**	**5 Hours**

Production and Production Function (Types & Estimation), Cost-Output Relationship, Short-Run and Long-Run Cost Curves, Law of Variable Proportion, Returns to Scale, Economies and Diseconomies of Scale, Economies of Scope, Factor Inputs.		
Module-4:	**REVENUE ANALYSIS AND PRICING POLICIES**	**5 Hours**
Revenue Types, Relationship Between Total Revenue and Price Elasticity of Demand, Pricing Policies and Practices (Objectives, Determinants, Pricing Methods), Government Policies and Pricing.		
Module-5:	**MARKET STRUCTURE**	**5 Hours**
Perfect Competition, Imperfect Competition (Monopoly, Monopolistic, Oligopoly), Oligopolistic Strategy, Cartels, Kinked Demand, Price Leadership, Oligopolistic Rivalry & Theory of Games, Measurement of Economic Concentration, Policy Against Monopoly and Restrictive Trade Practices, Competition Law.		
Module-6:	**INTRODUCTION TO MACROECONOMICS**	**5 Hours**
Circular Flow of Income and Expenditures, Components of National Income and Its Significance, Multiplier Concept, Measuring Gross Domestic Product (GDP), Inflation and Business Cycles, Government Fiscal and Monetary Policy, Balance of Payments, Foreign Exchange Markets.		
	TOTAL LECTURE	**30 Hours**

Books:

1. Mote, Paul and Gupta: Managerial Economics- Concepts and Cases, Tata McGraw Hill,2007
2. Peterson and Lewis: Managerial Economics, 4th Ed., Prentice Hall, 2004
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