TULSIRAMJI GAIKWAD-PATIL
## College of Engineering & Technology

Mohgaon, Wardha Road, Nagpur - 441 108

An Autonomous Institute
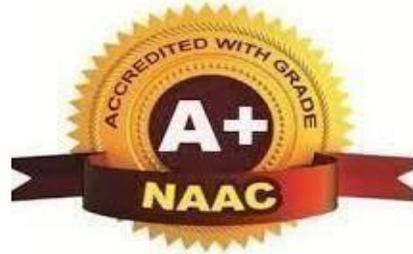
**Department
of
Artificial Intelligence & Machine Learning**

**B.Tech.
Artificial Intelligence & Machine Learning**

Semester III

Syllabus
Considering

National Education Policy 2020

From
Academic Year 2025-26

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur- 441 108
NAAC Accredited (A+ Grade)
(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

Second Year (Semester-III) B. Tech. Artificial Intelligence and Machine Learning

Teaching Scheme		Course code: BAI12301 Course Name: - Artificial Intelligence	Examination Scheme	
Theory	3 Hrs./wk.		CT-I	15 Marks
Tutorial	-		CT-II	15 Marks
Total Credits	3		CA	10 Marks
Duration of ESE: 3 Hrs.			ESE	60 Marks
			Total	100 Marks

Course Objectives:

1.	To create appreciation and understanding the achievements of AI and the theory underlying those achievements.
2.	To create an understanding of the basic issues of knowledge representations.

Course Contents

Unit I	**Introduction to Artificial Intelligence**: Background and Applications, Turing Test and Rational Agent approaches to AI, Introduction to Rag Intelligent Agents, their structure, behavior and environment, Multi Agents. Problem Solving: Problem Characteristics, Production Systems and Control Strategies. AI techniques and trends.
Unit II	**Searching Techniques:** Breadth First Search, Depth First Search, Hill climbing and its Variations, Heuristics Search Techniques: Best First Search, A* algorithm, Constraint Satisfaction Problem, Means-End Analysis, Semantic search.
Unit III	**Knowledge Representation**: Propositional and first-order logic, Semantic networks and frames, Inference techniques, Predicate Logic: Representing Instance and Isa Relationships, Computable Functions and predicates, Resolution, Natural Deduction, Loge programming, forward versus Backward Reasoning, Matching, Control knowledge.
Unit IV	**Reasoning and Learning**: Rule-based systems, decision trees, neural networks, learning models and algorithms. Game playing: Min-Max, Alpha-Beta pruning. Supervised and unsupervised learning, regression, classification, clustering, dimensionality reduction. Default and probabilistic reasoning, Bayesian inference, possible world representations.
Unit V	**Generative AI:** What is Generative AI? Discriminative vs Generative models, Applications of Generative AI (e.g., text, image, audio synthesis) Multimodal Generative Models, CLIP (Contrastive Language–Image Pretraining) Flamingo, Gemini, Kosmos-1 (vision-language models) Overview of foundational techniques, Controllable Generation Prompt Engineering Fine-tuning and adapter layers, Retrieval-Augmented Generation (RAG).

Text Books	
T.1	Artificial Intelligence: A Modern Approach by Stuart J. Russell and Peter Norvig, Global Edition, 2022
T.2	E. Rich and K. Knight, Artificial Intelligence, Tata McGraw Hill, 4th Edition, 2010
T.3	Artificial Intelligence- a practical Approach: Patterson, Tata McGraw Hill, 3rd Edition, 2014

	Reference Books
R.1	Introduction of Artificial Intelligence, Charniak, Pearson Education, 1st Edition, 2002
R.2	Artificial Intelligence and Expert Systems - Jankiraman, Sarukes, Macmillan Ind. Pvt. Ltd, 2000
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc24_cs88/preview
2	https://onlinecourses.nptel.ac.in/noc24_cs08/preview
3	https://aiplanet.com/learn/rag-agents-bootcamp
4	https://en.wikipedia.org/wiki/Semantic_search
5	https://www.singlestore.com/blog/a-complete-guide-to-semantic-search-for-beginners/
6	https://blog.langchain.dev/langgraph-multi-agent-workflows/
7	https://www.promptingguide.ai/techniques

	Course Outcomes	CL	Class Session
CO1	**Understand** the fundamental principles and history of artificial intelligence.	2	9
CO2	**Apply** uninformed and informed search algorithms to solve complex AI problems.	3	9
CO3	**Execute** search algorithms and knowledge representation techniques to solve AI problems.	3	9
CO4	**Implement** diverse AI reasoning and learning techniques to solve problems and develop intelligent systems.	3	9
CO5	**Analyze** and process natural language data using NLP methods.	4	9

HoD
Department of AI & ML
TGPCET, Nagpur

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
d Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
NAAC Accredited (A+ Grade)
(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

Second Year (Semester-III) B. Tech. Artificial Intelligence and Machine Learning

Teaching Scheme		Course Code: BAI12302 Course Name: Advanced Python Programming	Examination Scheme	
Theory	3 Hrs./Wk.		CT-I	15 Marks
Tutorial	-		CT-II	15 Marks
Total Credits	3		CA	10 Marks
Duration of ESE: 3 Hrs.			ESE	60 Marks
			Total	100 Marks

Course Objectives:	
1.	Understanding Python programming fundamentals, including environment setup, basic syntax, and control structures.
2.	Explore various sequences and perform operations on sequences.
3.	Understand functions, Learn Object-Oriented Programming concept, understand modules and exception handling.
4.	Develop skills to work with NumPy, Pandasand Matplotlib libraries.
5.	Learn to perform advanced data manipulation tasks such as merging, concatenating, and iterating through Data Frames to extract and explore datasets efficiently.

Course Contents	
Unit I	**Introduction to Python with Data Structures,** Conditional statements, loops, string formatting, Operators and expressions, Control structures (if, else, loops), Functions and lambda expressions, Exception handling, File I/O, Lists, tuples, sets, and dictionaries, List comprehensions, String operations, Iterators and generators
Unit II	**Python Libraries for AI/ML:** NumPy: Arrays, vectorized operations, broadcasting, Pandas: Data Frames, data cleaning, filtering, grouping, Matplotlib & Seaborn: Data visualization, Scikit-learn: Basic ML models and preprocessing, TensorFlow/Keras or PyTorch: Intro to deep learning frameworks.
Unit III	**Exploratory Data Analysis (EDA):** Data cleaning (handling missing values, duplicates), Feature selection and extraction, Data scaling and normalization, Visualization for insights (histograms, box plots, correlation heatmaps.
Unit IV	**Supervised Machine Learning:** Linear regression, Logistic regression, Decision trees and random forests, k-Nearest Neighbors (k-NN). Support Vector Machines (SVM), Model evaluation: accuracy, precision, recall, F1-score, ROC. **Unsupervised Learning:** Clustering (K-means, DBSCAN, hierarchical clustering). Dimensionality reduction (PCA, t-SNE). Association rule learning (Apriori)**,** Data Manipulation basics Explore and Extract Datasets Building neural networks with Keras or PyTorch, Training and tuning models (batch size, epochs, optimizers).
Unit V	**Application of Python:** Web Architecture Fundamentals, Role of Backend in Web Development, , Flask Framework, Client-Server Model and HTTP basics, Flask overview and installation, Introduction to Django, Django vs Flask.

Text Books	
T.1	Python: The complete reference, Martin C. Brown, 1st Edition Mc Graw Hill, 2004
T.2	Python Programming: Justin Seitz, Black Book Kindle edition, 2011

T.3	Machine Learning using Python by Manaranjan Pradhan & U Dinesh Kumar, Wiley Edition, 2006
Reference Books	
R.1	Learn AI with Python by Gaurav Leekha, Kindle Edition, 2021
R.2	Python for Everybody: Exploring Data in Python 3, Charles R. Severance, Shroff Publishers, 2017
Useful Links	
3	https://onlinecourses.swayam2.ac.in/ini25_cs02/preview
4	https://onlinecourses.nptel.ac.in/noc22_cs32/preview

	Course Outcomes	CL	Class Session
CO1	**Understand** basic programming concepts & control structures and functions to solve problems.	2	9
CO2	**Develop** AI/ML solutions using core Python libraries for data tasks, visualization and model building.	3	9
CO3	**Perform** Exploratory Data Analysis by using data cleaning, feature engineering, and insightful visualization.	3	9
CO4	**Implement** regression algorithms to model relationships in data.	3	9
CO5	**Apply** clustering techniques for unsupervised pattern discovery.	3	9

HoD
Department of AI & ML
TGPCET. Nagpur

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
d Technology. Nagpur

	Tulsiramji Gaikwad-Patil College of Engineering and Technology	
	Wardha Road, Nagpur-441 108	
	NAAC Accredited (A+ Grade)	
	(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)	

Second Year (Semester-III) B.Tech. Artificial Intelligence and Machine Learning

Teaching Scheme		Course Code: BAI12303 Course Name: Data Structures & Algorithms	Examination Scheme	
Lectures	2 Hrs./week		CT-1	7 Marks
Tutorial	-		CT-2	7 Marks
Total Credit	2		TA	6 Marks
Duration of ESE: 02 Hrs.			ESE	30 Marks
			Total	50 Marks

Course Objectives:	
1	Understand the fundamental concepts of data structures and their real-life applications.
2	Analyze and implement linear and nonlinear data structures using appropriate programming languages.
3	Develop the ability to analyze the complexity of algorithms and perform time-space trade-off analysis.
4	Apply searching, sorting, and graph traversal algorithms to solve computational problems.
5	Understand and implement advanced data structures like AVL Trees, B-Trees, and hashing techniques.

Course Contents	
Unit I	**Fundamentals of Data Structures and Algorithms:** Introduction to Data Structures and ADTs, Definition and importance of Abstract Data Types (ADT), Classification of Data Structures: Linear vs Non-linear, Static vs Dynamic, Algorithm Analysis, Algorithm Complexity: Time and Space, Asymptotic Notations: Big-O, Theta (Θ), Omega (Ω), Case Analysis: Best, Worst, and Average Cases, Recursion, Recursive problem-solving techniques
Unit II	**Linear Data Structures and Their Applications:** Arrays and Strings, Representation, Operations, and Applications, String Manipulation and Basic Operations, Linked Lists, Types: Singly, Doubly, Circular, Circular Doubly Linked Lists, Operations: Insertion, Deletion, Traversal, Searching, Applications: Polynomial Arithmetic, Linked List Comparison, Stacks and Queues, Stack Implementation using Arrays, Applications: Expression Conversion (Infix to Postfix/Prefix), Postfix Evaluation, Queues: Linear, Circular, Priority Queues, Array-based Implementations
Unit III	**Non-Linear Data Structures, Searching, Sorting, and Hashing: Trees:** Definitions and Terminology, Binary Trees: Representation and Traversals (Inorder, Preorder, Postorder)**,** Binary Search Trees (BST): Insertion, Deletion, Searching**,** Balanced Trees: AVL Trees (Rotations, Insertion, Deletion), Threaded Binary Trees**,** B-Trees and B+ Trees: Structure and Operations **Graphs:** Representations: Adjacency Matrix and List**,** Graph Types: Directed, Undirected, Weighted**,** Traversal Techniques: BFS, DFS**,** Applications: Dijkstra's Shortest Path, Prim's and Kruskal's MST Algorithms**.** **Searching and Sorting:** Searching: Linear and Binary Search**,** Sorting: Selection, Insertion, Merge, Shell Sort **Hashing:** Hash Tables and Functions, Collision Resolution: Chaining, Open Addressing.

Text Books	
1	Data Structures Using C, Reema Thareja, Oxford University Press, 2014.
2	Classical Data Structure, D. Samanta, Prentice Hall of India, 2012.

3	Fundamentals of Computer Algorithms by Sartaj Sahni and Sanguthevar Rajasekaran, Ellis Horowitz Edition, 2nd Edition, 2022.		
4	Data Structures using C, Aaron M. Tanenbaum, Pearson Education, 2019.		
Reference Books			
1	Fundamentals of Data Structures in C by Horowitz, Sahni, Anderson-Freed, University Press, 2020.		
2	Introduction to Algorithms by Cormen, Leiserson, Rivest, and Stein (CLRS), MIT Press, 2015.		
3	Data Structures and Algorithm Analysis in C++" by Mark Allen Weiss, Pearson Edition, 2005.		
Useful Links			
1	https://nptel.ac.in/courses/106/105/106105183/		
2	https://nptel.ac.in/courses/106/106/106106091/		

	Course Outcome	**CL**	**Class Session**
CO1	**Apply** data structures, ADTs, and recursion to problem-solving.	3	9
CO2	**Implement** linear data structures to solve real-world problems.	3	9
CO3	**Execute** non-linear data structures and algorithms for efficient data handling.	3	9

HoD
Department of AI & ML
TGPCET. Nagpur

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
·d Technology. Nagpur

	Tulsiramji Gaikwad-Patil College of Engineering and Technology
	Wardha Road, Nagpur-441 108
	NAAC Accredited (A+ Grade)
	(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

Second Year (Semester-III) B. Tech. Artificial Intelligence and Machine Learning

Teaching Scheme		Course Code: BSH32308 Course Name: Ethics in Artificial Intelligence	Examination Scheme	
Theory	2 Hrs./Wk.		CT1	7 Marks
Tutorial	-		CT2	7 Marks
Total Credits	2		CA	6 Marks
Duration of ESE: 2Hrs.			ESE	30 Marks
			Total	50 Marks

Course Objectives:

1. Understand the fundamental ethical principles and moral values related to AI development and deployment.
2. Analyze the impact of AI on society, including issues of fairness, accountability, transparency, and privacy.
3. Explore the future implications of AI ethics and the role of human-centered AI design.

Course Contents

Unit I	**Introduction to AI Ethics and Moral Values:** Fundamentals of AI Ethics: Definition of AI Ethics and Moral Values, Importance of Ethics in AI Development, Historical Perspective on Ethics in Technology Ethical Theories and Their Relevance to AI: Utilitarianism, Deontology, Virtue Ethics, Human vs. Machine Morality Core Ethical Principles in AI: Transparency and Explain ability, Fairness and Bias Reduction, Accountability and Responsibility, Privacy and Data Protection, AI Safety and Security.
Unit II	**Ethical Challenges and AI Governance:** Addressing Bias and Discrimination in AI: Causes and Consequences of AI Bias, Case Studies: Bias in Facial Recognition, Hiring, and Criminal Justice, Methods for Fair AI Development Ethical AI in Decision-Making and Society: AI in Healthcare, Finance, Education, and Law Enforcement, AI and Human Rights (Surveillance, Freedom of Expression),Autonomous AI Systems (Self-Driving Cars, Military Drones) AI Regulations and Governance: Role of Governments, Corporations, and International Organizations, Overview of AI Ethics Guidelines (EU AI Act, UNESCO, IEEE),Case Studies: Ethical AI Governance Frameworks.
Unit III	**Ethical AI Development and Future Perspectives:** Designing and Implementing Ethical AI: Human-Centered AI Design, Explainable and Interpretable AI,AI Safety and Risk Management Social and Economic Impacts of AI:AI for Social Good (Healthcare, Environment, Accessibility),Impact of AI on Employment and Workforce Displacement, Sustainable and Responsible AI Development Future Ethical Considerations in AI: Emerging Challenges (Deep fakes, Generative AI, Sentient AI),The Role of AI in Shaping Future Societies, Ethical Considerations for Artificial General Intelligence (AGI)

Text Books

T.1	Artificial Intelligence: A Guide for Thinking Humans, Melanie Mitchell, 2013
T.2	"The Ethical Algorithm: The Science of Socially Aware Algorithm Design" – Michael Kearns & Aaron Roth, Paperback Edition, 2017

Reference Books	
R.1	Artificial Intelligence and Ethics, Robert C. Williamson, 2002
R.2	The Age of Surveillance Capitalism, Shoshana Zuboff, Paperback Edition, 2004
Useful Links	
1	https://iep.utm.edu/ethics-of-artificial-intelligence/
2	https://library.fiveable.me/artificial-intelligence-and-ethics

	Course Outcomes	CL	Class Session
CO1	**Demonstrate** a thorough understanding of AI ethics and moral values.	2	9
CO2	**Analyze** AI bias, ethical implications across sectors, and global AI governance frameworks.	4	9
CO3	**Apply** ethical principles in AI development and decision-making.	3	9
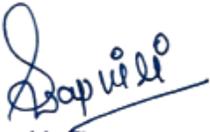
HoD
Department of AI & ML
TGPCET, Nagpur

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
·d Technology, Nagpu·

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
NAAC Accredited (A+ Grade)
(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

Second Year (Semester-III) B. Tech. Artificial Intelligence and Machine Learning

Teaching Scheme		Course Code: BSH32303 Course Name: Numerical Method & Statistical Analysis	Examination Scheme	
Theory	2 Hrs./Wk.		CT1	7 Marks
Tutorial	-		CT2	7 Marks
Total Credits	2		CA	6 Marks
Duration of ESE: 2Hrs			ESE	30 Marks
			Total	50 Marks

Course Objectives:

1.	Provide the knowledge of the various statistical methods in the field of Artificial Intelligence and Machine Learning.
2.	Implements the numerical solution of the problems to solve critical problems in Artificial Intelligence and Machine Learning.
3.	Understand the basic definitions and concepts in graph theory in solving problems such as connectivity, cycle detection and path finding.

Course Contents

Unit I	**Statistics**: Mean Deviation and Standard Deviation, Multiple regression analysis, Regression equation of three variables, Residual MSE and MAE, Coefficient of determination, Root Mean Square error, Interquartile Range, Quartile, Decile and Percentile.
Unit II	**Numerical Methods:** Numerical Solution of Algebraic and Transcendental equations: RegualaFalsi, Newton-Raphson (Successive Approximation Methods). Numerical Solutions of System of Linear equations: Gauss elimination, and Gauss-Seidel Methods.
Unit III	**Graph Theory:** Basic concepts of graph theory, Digraphs, Basic definitions, Matrix representation of graphs, Subgraphs and quotient graphs, Paths and circuits, Reachability and connectedness, Node base, Euler's path & Hamilton's path, Tree, Binary tree, Undirected tree, Spanning tree, Weighted graphs (only definitions and examples), Minimal spanning tree by Kruskal's algorithm, Representation of algebraic expressions by Venn diagram and binary tree.

Text Books

T.1	Higher Engineering Mathematics by B.S. Grewal, 40th Edition, Khanna Publication, 2004.
T.2	Advanced Engineering Mathematics by Erwin Kreyszig, 10th Edition, Wiley India, 2015.
T.3	Essential Math for Data Science by Thomas Nield, 2006.
T.4	Probability, Statistics and Random Processes T. Veerarajan, 1st Edition, 2018.
T.5	Fundamentals of Mathematical Statistics (Modern Approach) S.C. Gupta and V.K. Kapoor 10th Edition, 2014.

Reference Books

R.1	A Text Book of applied Mathematics, Volume II, by P.N. Wartikar& J.N. Wartikar, Poona Vidyarthi Griha Prakashan, 2016.
R.2	Introductory methods of Numerical Analysis, by S.S. Sastry, PHI, 2005.
R.3	Probability, Statistics with Reliability, Queuing and Computer Science Application K.S. Trivedi, Paperback Edition, 2008.

	Course Outcomes	CL	Class Session
CO1	**Apply** statistical concepts to real world situation and problem solving.	3	9
CO2	**Analyze** the efficiency, accuracy and stability of numerical methods through theoretically analysis.	4	9
CO3	**Interpret** computational problems in graph theoretical framework.	2	9

HoD
Department of AI & ML
TGPCET, Nagpur

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
d Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
NAAC Accredited (A+ Grade)
(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

Second Year (Semester-III) B. Tech. Artificial Intelligence and Machine Learning

Teaching Scheme		Course Code: BBA32302 Course Name: Entrepreneurship and Skill Development	Examination Scheme	
Lectures	2 Hrs./week		CT	14 Marks
Tutorial	--		CA	06 Marks
Total Credit	2		ESE	30 Marks
Duration of ESE: 02 Hrs.			Total	50 Marks

Course Objective:	
1	To know the students about basic concept of economics.
2	To aware the students about competitions and entrepreneurship.
3	To get the knowledge of sales and marketing.

Course Contents	
Unit I	**Theory of Demand & Utility:** Law of Demand. Types of Demand, Elasticity of demand, methods of measurement of elasticity of demand, law of diminishing marginal utility. **Theory of Production**: factors of production. (meaning & characteristics of Land, Labor, capital & entrepreneur).
Unit II	**Price Determination & depreciation:** Laws of return, Average cost, Marginal cost, fixed cost, variable cost, Depreciation, Methods to calculate depreciation **Market**: perfect competition. Imperfect competition (monopoly, oligopoly, monopolistic competition).
Unit III	**Entrepreneurship, Business Plan and Idea Presentation:** Definition, Steps towards successful enterprise, opportunity identification, various analytics to be performed for idea validation. **Business Plan and Idea Presentation:** Transforming idea to plan on paper, various reports for validation of business, presenting and pitching idea. Stages of idea stage to fully scaled corporation, types of company and their difference in specifications, legislation and legal precautions, funding sources, stages of funding, various methods of collaborations, disinvestment, winding company.

Text Books

1	O.P. Khanna, "Industrial Engineering and Management", Dhanpat Rai& sons,1999
2	R. Panner Selvam, "Production and Operations Management", PHI Learning, 2002
3	Mart and Telsang – Industrial Engineering and Production Management, S. Chand and Co., 1998
4	Poornima M Charantimath, "Entrepreneurship development small business enterprises", Pearson

Reference Books

1	Shailendra Kale– Production and Operations Management, McGraw Hill, India 2013
2	Fundamentals of Management: Essential Concepts and Applications, Pearson Education, Robbins, S.P. and Decenzo David A.
3	Economics: Principles of Economics, N Gregory Mankiw, Cengage Learning.
4	Principles and Practices of Management by L.M. Prasad.
5	Principles of Management by Tripathy and Reddy.

	Course Outcomes	**CL**	**Class Session**
CO1	**Describe** demand & utility of product in industries.	2	9
CO2	**Discuss** the terms price determinations, depreciation and market.	2	9
CO3	**Create** effective business plans to establish and operate new businesses.	3	9

HoD
Department of AI & ML
TGPCET, Nagpur

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
·d Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
NAAC Accredited (A+ Grade)
(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

Second Year (Semester-III) B.Tech. Artificial Intelligence and Machine Learning

Teaching Scheme		Course Code: BAI12304 Course Name: Advanced Python Programming Lab	Examination Scheme	
Practical	2 Hrs./Wk.		CA	25 Marks
Total Credits	1		ESE	25 Marks
Duration of ESE: 2 Hrs.			Total	50 Marks

Course Objectives:

1	Install Python environment and introduce fundamental Python programming concepts.
2	Understanding conditional and looping constructs.
3	Working with string and its operations.
4	Define classes and objects.
5	Working with Python libraries - Pandas, Numpy and Matplotlib.

Sr. No.	List of Practical	CO
1	Write a Python program to demonstrate: Basic input/output & Operators and expressions.	CO1
2	Write programs using conditional statements and loops: Calculate factorial, check for prime, reverse a string.	CO1
3	Create and use functions and lambda expressions: Implement a calculator using functions and lambda.	CO1
4	Demonstrate file handling in Python: Read from/write to a text file.	CO1
5	Practice with data structures: Create and manipulate lists, tuples, sets, and dictionaries.	CO2
6	Demonstrate string operations and comprehensions: String slicing, search, replace, list comprehensions.	CO2
7	Create and use iterators and generators: Build a generator for Fibonacci series.	CO2
8	Create arrays, perform slicing, broadcasting, and vectored operations.	CO2
9	Load a CSV dataset & Clean missing values, group by a column, and filter data by using Pandas.	CO3
10	Use Matplotlib and Seaborn to plot histograms, scatter plots, and correlation heatmaps.	CO3
11	Train a simple Linear Regression model on a sample dataset.	CO4
12	Perform EDA, preprocessing, model training, evaluation, and result visualization on a real-world dataset (e.g., heart disease prediction, sentiment analysis, or image classification).	CO4
13	Implement k-NN and SVM on classification datasets and compare accuracy	CO5

Text Books

T.1	Python: The complete reference, Martin C. Brown, 1st Edition Mc Graw Hill, 2004
T.2	Python Programming: Justin Seitz, Black Book Kindle edition, 2011
T.3	Machine Learning using Python by Manaranjan Pradhan & U Dinesh Kumar, Wiley Edition, 2006

Reference Books

R.1	Learn AI with Python by Gaurav Leekha, Kindle Edition, 2021

	R.2	Python for Everybody: Exploring Data in Python 3, Charles R. Severance, Shroff Publishers, 2017
Useful links		
	1	https://www.geeksforgeeks.org
	2	https://www.manning.com/books/deep-learning-with-python
	3	https://www.w3schools.com
	4	https://onlinecourses.swayam2.ac.in/ini25_cs02/preview
	5	https://onlinecourses.nptel.ac.in/noc22_cs32/preview

	Course Outcome	**CL**	**Class Session**
CO1	**Demonstrate** proficiency in Python programming fundamentals.	3	4
CO2	**Apply** proficiency for comprehensive data tasks by using key data analysis libraries.	3	4
CO3	**Visualize** data using statistical plotting techniques.	3	4
CO4	**Design** a complete ML pipeline from data preprocessing to model evaluation.	6	4
CO5	**Evaluate** fundamental supervised by using machine learning models.	5	4

HoD
Department of AI & ML
TGPCET, Nagpur

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
d Technology, Nagpur

<table>
<tr><td colspan="3">

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
NAAC Accredited (A+ Grade)
(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)
</td></tr>
</table>

Second Year (Semester-III) B.Tech. Artificial Intelligence and Machine Learning

Teaching Scheme		Course Code: BAI12305 Course Name: Data Structures & Algorithm Lab	Examination Scheme	
Practical	2 Hrs./Wk.		CA	25 Marks
Total Credits	1		ESE	25 Marks
Duration of ESE: 2Hrs.			Total	50 Marks

Course Objectives:

1	Understanding Fundamental Data Structures: Students should grasp the fundamental concepts of various data structures such as arrays, linked lists, stacks, queues, trees, and graphs.
2	Analyzing Algorithm Efficiency: Students should learn how to analyze the efficiency of algorithms concerning time complexity and space complexity.
3	Implementing Data Structures: Students should be able to implement various data structures using programming languages such as C, C++, Java, or Python.
4	Understanding Advanced Data Structures: Beyond the basics, students may delve into more advanced data structures such as hash tables, heaps, AVL trees, B-trees, and advanced graph algorithms.
5	Working with Abstract Datatypes (ADTs): Students should understand the concept of ADTs and how they relate to data structures. This involves understanding how to encapsulate data and operations within abstract data types, providing clear interfaces for interacting with the data.

| Sr. No.	List of Practical	CO
1	Write a program to analyze the time complexity (Big O, Θ, Ω) of simple iterative and recursive functions.	CO1
2	Implement and compare Sorting algorithms: Selection Sort, Insertion Sort, Merge Sort, Shell Sort	CO1
3	Implement Linear Search and Binary Search. Compare performance for different input sizes.	CO2
4	Implement Stack using array. Perform push, pop, peek operations.	CO2
5	Convert an infix expression to postfix and prefix using stack.	CO3
6	Evaluate a postfix expression using a stack.	CO3
7	Implement Linear Queue and Circular Queue using arrays. Perform enqueue and dequeue operations.	CO3
8	Implement Priority Queue using array or structure. Demonstrate insertion and deletion.	CO3
9	Implement Singly and Doubly Linked Lists. Include insert, delete, traverse, and search operations.	CO4
10	Implement Circular Singly Linked List and Circular Doubly Linked List.	CO4
11	Perform Polynomial Addition using Linked List.	CO4
12	Create and traverse a Binary Tree (inorder, preorder, postorder).	CO5
13	Implement Binary Search Tree (BST): Insertion, deletion, and traversal.	CO5
14	Represent Graph using Adjacency List and Matrix. Implement BFS and DFS.	CO5

Text Books

1	Classical Data Structure, D. Samanta, Prentice Hall of India, 2004.	
2	Fundamentals of Computer Algorithms by Sartaj Sahni and Sanguthevar Rajasekaran, Ellis Horowitz, 2022.	
3	Data Structures using C, Aaron M. Tanenbaum, Pearson Education, 2019.	

Reference Books

1	An Introduction to Data Structures and Applications, Jean-Paul Tremblay, PaulG. Sorenson, P. G. Sorenson, Tata McGraw Hill Publication, 2004.
2	Data Structures using C and C++, Y. Langsam, Pearson Education, 2019.

Useful links

1	https://nptel.ac.in/courses/106/105/106105183/
2	https://nptel.ac.in/courses/106/106/106106091/

	Course Outcome	CL	Class Session
CO1	**Evaluate** algorithm performance using time complexity notations.	5	4
CO2	**Implement** searching and sorting algorithms for specific inputs.	5	4
CO3	**Apply** stack and queue data structures to solve practical problems.	3	4
CO4	**Develop** programs with diverse linked lists for linear data problem-solving.	3	4
CO5	**Execute** traversal algorithms on tree and graph data structures.	3	4
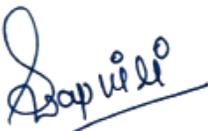
HoD
Department of AI & ML
TGPCET, Nagpur

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
·d Technology, Nagpu·
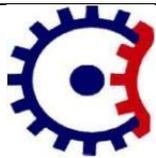
Second Year (Semester-III) B. Tech. Artificial Intelligence and Machine Learning

Teaching Scheme		Course Code: BAI2306 Course Name: Community Project	Examination Scheme	
Practical	4 Hrs./Wk.		CA	50 Marks
Total Credits	2		Total	50 Marks

Course Objectives:

1	Application of techniques & principles of data science in specific applications with respect to social needs.
2	Ability to implement effective trouble-shooting for project.
3	Development of effective communication skill.

Course Content

Engaging students in a multidisciplinary project and leverages computer science, artificial intelligence, machine learning technology, design and implementation of AI based solutions. The project will focus on real world problems, ethical considerations and the integration of advanced technologies.

Key aspects of the project:

1. Project planning and management
2. Problem identification
3. Ethical considerations
4. System Design and Architecture
5. Data collection and Management
6. Hardware Implementation
7. Data Collection and Visualization
8. User Experience and Feedback
9. Deployment and Testing
10. Evaluation and impact assessment
11. Documentation and Reporting

Final Presentation and Report

	Course Outcome	CL	Class Session
CO1	**Demonstrate** the knowledge, skills and attitudes of a professional engineer.	3	4
CO2	**Apply** methodologies and professional way of documentation and communication .	3	4
CO3	**Analyze** the key stages in development of the project.	4	4
CO4	**Design** engineering solutions to complex problems using a systems approach.	6	4
CO5	**Develop** software skills by learning algorithms and methodology.	6	4
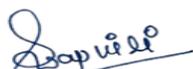
HoD
Department of AI & ML
TGPCET. Nagpur
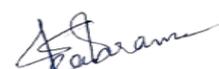
Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
·d Technology. Nagpur

17

Open Elective-I
Data Visualization

	Tulsiramji Gaikwad-Patil College of Engineering and Technology	
	Wardha Road, Nagpur-441 108	
	NAAC Accredited (A+ Grade)	
	(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)	

Second Year (Semester-III) B. Tech. Artificial Intelligence and Machine Learning

Teaching Scheme		Open Elective-I Course Code: BAI12301 Course Name: Data Visualization	Examination Scheme	
Lectures	4 Hrs./week		CT-1	15 Marks
Tutorial	-		CT-2	15 Marks
Total Credit	4		CA	10 Marks
Duration of ESE: 03 Hrs.			ESE	60 Marks
			Total	100 Marks

Course Objectives:

1	To understand, analyze effective data visualization to synthesis insights and communicate with complex data clearly.
2	To apply a visualization method to create effective and insightful representation of data.
3	To design & implement interactive visualizations using advanced techniques to synthesize complex data insights.
4	To analyze and evaluate ethical consideration & biases in data visualization to ensure responsible and accurate data representation.
5	To apply AI technique to visualize and interpret large datasets, enhancing data-driven insights and decision making.

Course Contents

Unit I	**Introduction to Data Visualization**: Importance of visual representation, history and evolution of visualization, principles of effective visualization, Types of data, Visual encoding, Prevailing mistakes in data visualization
Unit II	**Data Visualization Techniques**: Data typology, Color theory & accessibility (Colorblind-friendly palettes, contrast) Chart design principles (Readability, simplicity, accuracy) Time-Series Data Visualization (Trends & Forecasting) Dashboard design fundamentals, Dashboard Design Principles & Data Storytelling, Designing Effective Dashboard.
Unit III	**Advanced Visualizations & Interactivity:** Programming-Based: Matplotlib, Seaborn, Plotly, D3.js, ggplot2, Business Intelligence (BI) Tools: Tableau, Power BI, Google Data Studio, Cloud-Based: Google Charts, Data-wrapper, Advanced Charts: Heat maps, Box Plots, Tree maps, Violin Plots Interactive Visualizations using D3.js & Plotly, Real-time Data Visualization, Geographic Data Visualization (Choropleth Maps, Geospatial Charts)
Unit IV	**Data Ethics & Bias in Visualization:** Ethical considerations in presenting data, Avoiding manipulation and misrepresentation, Transparency and accountability in visual storytelling
Unit V	**AI & Big Data Visualization**: Handling large datasets in visualization AI-powered visual insights Automated data storytelling Predictive analytic visualization in recent trends.

		Text Books
	1	Big Data Visualization, James D. Miller, 2004.
	2	The Big Book of Dashboards: Visualizing Your Data Using Real-World Business Scenarios – Steve Wexler, Jeffrey Shaffer, Andy Cotgreave, 2012.
Reference Books		
	1	The Functional Art: An Introduction to Information Graphics and Visualization – Alberto Cairo, Pearson Education (US), 2013
	2	Interactive Data Visualization for the Web , Scott Murray, 2013
	3	The Big Book of Dashboards – Steve Wexler, Jeffrey Shaffer, Andy Cotgreave, 2014
Useful Links		
	1	https://towardsdatascience.com/big-data-visualization-879d52f99ddc
	2	https://www.storytellingwithdata.com/

	Course Outcome	**CL**	**Class Session**
CO1	**Evaluate** data visualizations based on encoding principles, common pitfalls, and their historical significance.	5	9
CO2	**Design** impactful visualizations/dashboards by using key principles to time-series data.	3	9
CO3	**Design** advanced, interactive, and specialized visualizations using programming, BI, and cloud tools.	3	9
CO4	**Evaluate** data visualizations for ethical presentation.	4	9
CO5	**Design** visualizations for Big Data and AI-powered insights.	3	9

HoD **BoS Chairman**
Department of AI & ML
TGPCET, Nagpur
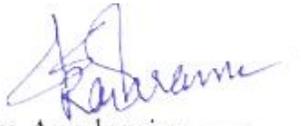
Dean Academics
Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology. Nagpur

Principal
Principal
Tulsiramji Gaikwad-Patil
College Of Engineering &
Technology. Nagpur