TULSIRAMJI GAIKWAD-PATIL COLLEGE OF ENGINEERING & TECHNOLOGY

Wardha Road, Nagpur - 441108
Accredited with NAAC A+ Grade & NBA Accredited (EE, ME, CE & ECE)
Approved by AICTE, New Delhi, Govt. of Maharashtra
(An Autonomous Institution Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)

Department of Artificial Intelligence & Machine Learning

Program: B. Tech Artificial Intelligence and Machine Learning

Semester-III	**BAI12301: Data Structures**				
Teaching Scheme		**Examination Scheme (Th)**		**Examination Scheme (P)**	
Theory (Th)	3 Hrs./week	**CT-I**	15 Marks	-	-
Practical (P)	-	**CT-II**	15 Marks	-	-
Total Credits	**3**	**CA**	10 Marks	-	-
Duration of ESE: 3 Hrs.		**ESE**	60 Marks	-	-
		Total Marks	**100 Marks**	-	-

Pre-Requisites: Basic knowledge of programming and mathematics.

Course Objectives:

1	Understand fundamental concepts of data structures and algorithm analysis.
2	Apply sorting and searching techniques for efficient data handling.
3	Implement stack, queue, and linked list operations.
4	Analyze and use tree structures for hierarchical data representation.
5	Apply graph and hashing techniques for complex problem solving.

Course Content

Unit I	**Introduction to algorithm:** Introduction to algorithm: General concepts of data structures, Types of Data Structure with its properties and Operations, Time and space analysis of algorithms, Big oh, theta, and omega notations, Average, best and worst case analysis. Sorting and Searching Techniques: Selection sort, insertion sort, heap sort, shell sort, linear and binary search.
	Activity 1: Sorting & Complexity Challenge: Students implement different sorting algorithms and compare their time complexity (best, average, worst case) for given datasets.
Unit II	**Stack & Queue:** Stack & Queue: Representation of Stack & queue using array, Application of stacks, Conversion from infix to postfix and prefix expressions, Evaluation of postfix expression using stacks, Linear Queues, Circular Queues, and Priority Queues.
	Activity1: Expression Converter & Evaluator Race: Teams convert infix expressions to postfix/prefix and evaluate them using stacks, competing for speed and accuracy.
Unit III	**Linked List:** Linked List: Representation of ordered list using array and its operation, Linked Lists, singly linked list, Implementation of linked list using static and dynamic memory allocation, operations on linked list, polynomial representations using linked list, circular linked list, doubly linked list.
	Activity1: Linked List Operations Challenge: Students perform insertion, deletion, and traversal operations on different types of linked lists and compare their efficiency.
Unit IV	**Trees:** General and binary trees, Representations and traversals of trees, Binary search trees, Threaded Binary Trees, Binary search trees, the concept of balancing, AVL Trees, B-Trees, B+ Trees.
	Activity1: Tree Traversal & Balancing Task: Students construct binary trees, perform traversals (inorder, preorder, postorder), and analyze balancing using AVL trees.
Unit V	**Graphs and Hashing:** Representation of Graph, Matrix Representation of Graph, List Representation of Graph, Directed Graphs (Digraphs), Breadth first search and Depth first search, spanning trees, Hash tables, hash functions, hashing techniques, Collision resolution techniques, overflow handling.
	Activity 1: Graph Traversal & Hashing Challenge: Teams implement BFS/DFS on graphs and design hash tables with collision handling techniques.

Text Books	
T.1	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press, 2022.
T.2	Mark Allen Weiss, *"Data Structures and Algorithm Analysis in C"*, Pearson Education, 2014.
T.3	Reema Thareja, *"Data Structures Using C"*, Oxford University Press, 2016.
T.4	Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", CareerMonk Publications, 2011.
Reference Books	
R.1	Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", Universities Press, 2008.
R.2	Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, *"Data Structures Using C"*, Pearson Education, 2001.
R.3	Robert Sedgewick and Kevin Wayne, *"Algorithms"*, Addison-Wesley, 2011.
R.4	Steven S. Skiena, *"The Algorithm Design Manual"*, Springer, 2020.
Useful Links	
1	https://nptel.ac.in/courses/106102064
2	https://nptel.ac.in/courses/106106145

CO	Course Outcomes	CL	Class Sessions
CO1	**Understand** the concept of data structure and various searching, sorting techniques.	3	9
CO2	**Apply** the concept of stack and queues to solve real world problem.	3	9
CO3	**Describe** and implement linked list operation.	3	9
CO4	**Demonstrate** different methods for traversing tree	3	9
CO5	**Utilize** the concepts of graphs to build solution.	3	9

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Department of Artificial Intelligence & Machine Learning

Program: B. Tech Artificial Intelligence and Machine Learning

Semester-III	BAI12302: Artificial Intelligence				
Teaching Scheme		**Examination Scheme (Th)**		**Examination Scheme (P)**	
Theory (Th)	3 Hrs./week	**CT-I**	15 Marks	-	-
Practical (P)	-	**CT-II**	15 Marks	-	-
Total Credits	**3**	**CA**	10 Marks	-	-
Duration of ESE: 3 Hrs.		**ESE**	60 Marks	-	-
		Total Marks	**100 Marks**	-	-

Pre-Requisites: Object-Oriented Programming

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 Content

Unit I	**Introduction to Artificial Intelligence**: Definition, scope, and history of AI, AI applications: healthcare, robotics, NLP, gaming, etc., Intelligent agents: types and environments, Problem-solving in AI, State space representation. Search techniques: Uninformed search (BFS, DFS, UCS), Informed search (Greedy, A*), Performance evaluation of algorithms.
Unit II	**Knowledge Representation & Reasoning:** Propositional logic and first-order logic, Inference mechanisms (forward backward chaining), Rule-based systems, Semantic networks and frames, Ontologies and knowledge bases, Reasoning under uncertainty.
Unit III	**Machine Learning Fundamentals**: Introduction to Machine Learning, Types of learning: Supervised learning, Unsupervised learning, Reinforcement learning, Regression techniques (Linear, Logistic), Classification algorithms: K-Nearest Neighbors (KNN), Decision Trees, Naive Bayes, Model evaluation: Accuracy, Precision, Recall, F1-score, Overfitting and underfitting.
Unit IV	**Advanced AI Techniques**: Artificial Neural Networks (ANN): Perceptron, Multi-layer networks, Deep Learning basics, Natural Language Processing (NLP): Text preprocessing, tokenization, Computer Vision basics, Reinforcement Learning concepts: Q-learning, reward systems, Evolutionary algorithms & genetic algorithms
Unit V	**AI Applications & Ethics:** Expert systems and case studies, Robotics and autonomous system, AI in real-world applications: Healthcare, finance, education., Ethical issues in AI: Bias, fairness, transparency Explainable AI (XAI), Future trends in AI, AI regulations and societal impact

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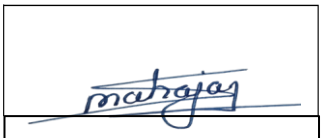
Text Books	
T.1	Artificial Intelligence: A Modern Approach *by Stuart J. Russell and Peter Norvig,* Global Edition, 2022
T.2	E. Rich and K. Knight, Artificial Intelligence, Tata McGraw Hill, 4th Edition, 2010
T.3	Artificial Intelligence- a practical Approach: Patterson, Tata McGraw Hill, 3rd Edition,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

CO	Course Outcomes	CL	Class Sessions
CO1	**Understand** fundamental AI concepts, intelligent agents, problem-solving approaches, and search algorithms.	3	9
CO2	**Analyze** knowledge representation techniques and reasoning mechanisms for intelligent systems.	3	9
CO3	**Understand** machine learning algorithms and model performance.	3	9
CO4	**Apply** advanced AI techniques including neural networks, deep learning, NLP, and reinforcement learning.	3	9
CO5	**Analyze** AI applications, ethical issues, and their societal impact	3	9



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Semester-III	**BSH32309: Numerical Techniques & Data Analysis**				
Teaching Scheme		**Examination Scheme (Th)**		**Examination Scheme (P)**	
Theory (Th)	2 Hrs./week	**CT-I**	7 Marks	-	-
Practical (P)	-	**CT-II**	7 Marks	-	-
Total Credits	**2**	**CA**	6 Marks	-	-
Duration of ESE: 2 Hrs.		**ESE**	30 Marks	-	-
		Total Marks	**50 Marks**	-	-

Pre-Requisites: Linear Algebra and Calculus

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 Content

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.

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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, 1 st 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.
Useful Links	
1	https://archive.nptel.ac.in/courses/111/105/111105077/
2	https://archive.nptel.ac.in/courses/111/107/111107105/

CO	Course Outcomes	CL	Class Sessions
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

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Semester-III | **BBA32302: Entrepreneurship and Skill Development**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme (P)	
Theory (Th)	2 Hrs./week	**CT-I**	7 Marks	-	-
Practical (P)	-	**CT-II**	7 Marks	-	-
Total Credits	**2**	**CA**	6 Marks	-	-
Duration of ESE: 2 Hrs.		**ESE**	30 Marks	-	-
		Total Marks	**50 Marks**	-	-

Course Objectives:

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 Content

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

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

Reference Books

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

Useful Links

1	https://onlinecourses.nptel.ac.in/noc21_mg70/preview
2	https://onlinecourses.nptel.ac.in/noc22_de08/preview

CO	Course Outcomes	CL	Class Sessions
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

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Program: B. Tech Artificial Intelligence and Machine Learning

Semester-III	**BCE4804: Sustainable Development Goals**				
Teaching Scheme		**Examination Scheme (Th)**		**Examination Scheme (P)**	
Theory (Th)	2 Hrs./week	**CT-I**	7 Marks	-	-
Practical (P)	-	**CT-II**	7 Marks	-	-
Total Credits	**2**	**CA**	6 Marks	-	-
Duration of ESE: 2 Hrs.		**ESE**	30 Marks	-	-
		Total Marks	**50 Marks**	-	-

Course Objectives:

1	To develop a comprehensive understanding of the UN Sustainable Development Goals (SDGs) and their interconnections.
2	To analyze the global challenges addressed by the SDGs and their impact on various sectors.
3	To explore innovative solutions and best practices for implementing the SDGs.
4	To evaluate the progress made towards achieving the SDGs at national and international levels.
5	To foster a sense of global citizenship and social responsibility among students.

Course Content

Unit I	Introduction to Sustainable Development Goals (SDGs): Definition of Sustainability, Aspects of sustainability, historical perspective of sustainable development, Climate Change Conferences and Summits, the Brundtland Commission Report, transition from Millennium Development Goals (MDGs) to SDGs, the role of UN and the need for SDGs and Adoption by the World, scope and inclusion of the 2030 Agenda for Sustainable Development.
Unit II	Framework & Structuring of the 17 SDGs: SDG 1: No Poverty, SDG 2: Zero Hunger, SDG 3: Good Health and Well-being, SDG 4: Quality Education, SDG 5: Gender Equality, SDG 6: Clean Water and Sanitation, SDG 7: Affordable and Clean Energy, SDG 8: Decent Work and Economic Growth, SDG 9: Industry, Innovation and Infrastructure, SDG 10: Reduced Inequalities, SDG 11: Sustainable Cities and Communities, SDG 12: Responsible Consumption and Production, SDG 13: Climate Action, SDG 14: Life below Water, SDG 15: Life on Land, SDG 16: Peace, Justice and Strong Institutions, SDG 17: Partnerships for the Goal.
Unit III	SDGs Implementation and Future Perspectives: Interconnections between the SDGs, the role of technology and innovation in SDG implementation, financing the SDGs, measuring SDG progress, future challenges and opportunities, Climate change and its impact on sustainable development, Case studies of successful SDG implementation – India, World.

Text Books

T.1	Hazra, Somnath., Bhukta, Anindya (2020) Sustainable Development Goals An Indian Perspective, Springer International Publishing, Switzerland
T.2	Ziai, Aram (2016) Development Discourse and Global History from colonialism to the sustainable development goals. Routledge, London & New York

Reference Books

R.1	Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G., Woelm, F. 2020. The Sustainable Development Goals and COVID-19. Sustainable Development Report 2020. Cambridge: Cambridge University Press.
R.2	OECD (2019), Sustainable Results in Development: Using the SDGs for Shared Results and Impact, OECD Publishing, Paris, https://doi.org/10.1787/368cf8b4-en.

Useful Links

1	https://nptel.ac.in/courses/109106200
2	https://www.un.org/sustainabledevelopment/

CO	Course Outcomes	CL	Class Sessions
CO1	To explore the historical origins and evolution of the UN-SDGs.	2	9
CO2	To analyze the 17 SDGs and their interlinkages.	2	9
CO3	To analyze the role of technology and innovation in achieving the SDGs along with future challenges and opportunities.	3	9

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Semester-III | **BAI12303: Data Structures Lab**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme(P)	
Theory (Th)	-	**INT**	-	**INT**	-
Practical (P)	2 Hrs./week	**ESE**	-	**ESE**	-
Total Credits	**1**	**CA**	-	**CA**	25 Marks
Duration of ESE: 2Hrs		**ESE**	-	**ESE-P**	25 Marks
		Total Marks	-	**Total Marks**	**50 Marks**

Pre-Requisites: **Basic knowledge of programming and mathematics.**

Course Objectives:

1.	**Understand fundamental concepts of data structures and algorithms**
2.	**Analyze time and space complexity of algorithms.**
3.	**Apply linear data structures like stack, queue, and linked list**
4.	**Implement tree structures and their operations**
5.	**Apply graph and hashing techniques for problem solving**

List of Experiments

1	Execute selection sort and insertion sort. Analyze time complexity (best, average, worst case).	**CO1**
2	Implement linear search and binary search and compare performance.	**CO1**
3	Implement stack using array and perform push, pop, and peek operations.	**CO2**
4	Convert infix expression to postfix/prefix and evaluate postfix expression using stack.	**CO2**
5	Implement linear queue and circular queue using array and perform operations.	**CO2**
6	Implement singly linked list with insertion, deletion, and traversal operations.	**CO3**
7	Implement doubly linked list and circular linked list operations.	**CO3**
8	Implement binary tree and perform inorder, preorder, and postorder traversals..	**CO4**
9	Implement BFS and DFS for graph traversal and hashing with collision handling techniques.	**CO4**
10	Develop a mini project using data structures to solve a real-world problem. The system should use appropriate data structures (such as stack, queue, linked list, tree, or graph) for efficient data management. Implement operations, analyze performance, and justify the choice of data structures used.	**CO5**

Text Books

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

Reference Books

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

Useful Links

L.1	https://nptel.ac.in/courses/106102064
L.2	https://nptel.ac.in/courses/106106145

CO	Course Outcomes	CL	Class Sessions
CO1	**Explain** concepts of data structures and algorithm analysis.	3	8
CO2	**Analyze** time and space complexity of algorithms**..**	3	8
CO3	**Implement** linear data structures such as stack, queue, and linked list.	3	8
CO4	**Apply** tree structures and their operations.	3	8
CO5	**Apply** graph traversal and hashing techniques to solve problems.	3	8

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Semester-III | **BAI12304: Advanced Python Programming Lab**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme(P)	
Theory (Th)	-	**INT**	-	**INT**	-
Practical (P)	2 Hrs./week	**ESE**	-	**ESE**	-
Total Credits	**1**	**CA**	-	**CA**	20 Marks
Duration of ESE: 2Hrs		**ESE**	-	**ESE-P**	30 Marks
		Total Marks	-	**Total Marks**	**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.

List of Experiments

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**
14	Write a simple Flask program to display the message 'Hello-Flask!	**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	
L.1	https://onlinecourses.swayam2.ac.in/ini25_cs02/preview
L.2	https://onlinecourses.nptel.ac.in/noc22_cs32/preview

CO	Course Outcomes	CL	Class Sessions
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.	3	4
CO5	**Evaluate** fundamental supervised by using machine learning models.	3	4

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Semester-III | **BAI12306: Community Project**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme(P)	
Theory (Th)	-	**INT**	-	**INT**	-
Practical (P)	4 Hrs./week	**ESE**	-	**ESE**	-
Total Credits	**2**	**CA**	-	**CA**	50 Marks
Duration of ESE: 2Hrs		**ESE**	-	**ESE-P**	50 Marks
		Total Marks	-	**Total Marks**	**100 Marks**

Pre-Requisites: Principal of Artificial Intelligence and machine Learning

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.

CO	Course Outcomes	CL	Class Sessions
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	**Analyse** 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

Chairperson

Open Elective-I
Data Visualization

TULSIRAMJI GAIKWAD-PATIL COLLEGE OF ENGINEERING & TECHNOLOGY
Wardha Road, Nagpur - 441108
Accredited with NAAC A+ Grade & NBA Accredited (EE, ME, CE & ECE)
Approved by AICTE, New Delhi, Govt. of Maharashtra
(An Autonomous Institution Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)

Department of Artificial Intelligence & Machine Learning

Program: B.Tech. Artificial Intelligence and Machine Learning

Semester-III | **BAI12301**: Data Visualization

Teaching Scheme		Examination Scheme (Th)		Examination Scheme(P)	
Theory (Th)	4 Hrs./week	**CT-I**	15 Marks	-	-
Practical (P)	-	**CT-II**	15 Marks	-	-
Total Credits	**4**	**CA**	10 Marks	-	-
Duration of ESE: 3 Hrs		**ESE**	**ESE**	-	-
		Total Marks	**Total 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 (Colorblindfriendly palettes, contrast) Chart design principles (Readability, simplicity, accuracy) TimeSeries 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

T.1	Big Data Visualization, James D. Miller, 2004.
T.2	The Big Book of Dashboards: Visualizing Your Data Using Real-World Business Scenarios – Steve Wexler, Jeffrey Shaffer, Andy Cotgreave, 2012.

Reference Books

R.1	The Functional Art: An Introduction to Information Graphics and Visualization – Alberto Cairo, Pearson Education (US), 2013
R.2	Interactive Data Visualization for the Web , Scott Murray, 2013
R.3	The Big Book of Dashboards – Steve Wexler, Jeffrey Shaffer, Andy Cotgreave, 2014

Useful Links	
L.1	https://towardsdatascience.com/big-data-visualization-879d52f99ddc
L.2	https://www.storytellingwithdata.com/

CO	Course Outcomes	CL	Class Sessions
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

Chairperson