TULSIRAMJI GAIKWAD-PATIL College of Engineering & Technology

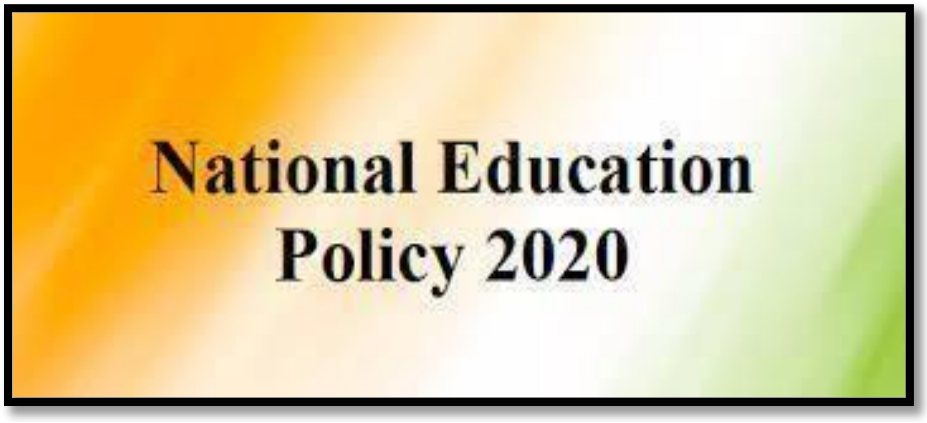
Mohgaon, Wardha Road, Nagpur - 441 108

An Autonomous Institute

DEPARTMENT
Artificial Intelligence and Machine Learning
Semester IV

B.Tech.
Artificial Intelligence and Machine Learning

Teaching Scheme
Considering



From

Academic Year 2025-26

Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

SCHEME OF INSTRUCTIONS & SYLLABI

Programme: Artificial Intelligence and Machine Learning

Scheme of Instructions: Second Year B.Tech. in Artificial Intelligence and Machine Learning

Semester–IV

Sr. No.	Course Category	Course Code	Course Title	T/P	Contact Hours			Credits	Exam Scheme			ESE Duration (Hours)	Total Marks
					L	P	Hrs.		CT/IA	CA	ESE		
1	**PCC**	BAI12401	Database Management System	T	3	-	3	3	30	10	60	3	100
2	**PCC**	BAI12402	Software Engineering & Project Management.	T	3	-	3	3	30	10	60	3	100
3	**PCC**	BAI12403	Data visualization & automation Lab	P	-	2	2	1	-	25	25	2	50
4	**PCC**	BAI12404	Operating System Lab.	P	-	4	4	2	-	50	50	2	100
5	**PCC**	BAI12405	Database Management System Lab.	P	-	2	2	1	-	25	25	2	50
6	**OEC**	BAI12407	Introduction to Machine Learning (Open Elective- II.)	T	2	-	2	2	14	6	30	2	50
7	**MDM**	BSH32402	Sampling Method & Estimation Theory	T	2	-	2	2	14	6	30	2	50
8	**VEC**	BSH32403	Environmental Science and Sustainability.	T	2	-	2	2	14	6	30	2	50
9	**HSSM**	BBA32X02	Managerial Economics	T	2	-	2	2	14	6	30	2	50
10	**AEC**	BSH32404	Leadership and Team Dynamics.	P	-	4	4	2	-	50	50	2	100
11	**VSEC**	BAI12406	Data Analytics.	P	-	4	4	2	-	50	50	2	100
			Total	-	**14**	**16**	**30**	**22**	**116**	**244**	**440**	**24**	**800**

Course Category	BSC/ESC (Basic Science Course/Engineering Science Course.)	PCC (Programme Core courses)	PEC (Programme Elective courses)	OEC (Open Elective Course)	Multi-disciplinary courses	VSEC (Skill Course)	VEC (Value Education Courses)	Humanities Social Science & Management		Experiential Learning Courses	CC (Liberal Learning Courses)	VAC (Value added Course)
								AEC (Ability Enhancement Course)	IKS (Indian Knowledge System)			
Credits		10	-	2	2	2	-	4		-	-	2
Cumulative Sum	16/13	22	-	6	4	6	2	10		2	4	2

PROGRESSIVE TOTAL CREDITS: 65+22=87

HoD Chairperson Department of AI & ML TGPCET, Nagpur	Dean Academics Tulsiramji Gaikwad-Patil College Of Engineering and Technology, Nagpur	Vice Principal (Academics) TGPCET, NAGPUR	Dr. Pramanand Naktode Principal TGPCET, Nagpur	June, 2025 Date of Release	1.00 Version	Applicable for AY 2025-26

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

Teaching Scheme			Examination Scheme	
Theory	**3 Hrs./Wk.**	**Course Code: BAI12401** **Course Name: Database Management System**	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** provide fundamental knowledge of database architectures, data models, and modern database technologies including distributed and cloud-based systems.
2.	**To** develop skills in designing database models using ER/EER/UML diagrams and applying agile tools like Jira for project tracking and manual testing activities.
3.	**To** enable learners to analyze database schemas by identifying redundancy, functional dependencies, and applying normalization techniques for efficient design.
4.	**To** equip students with the ability to evaluate and optimize SQL queries, triggers, and indexing, along with understanding performance testing and automation tools.
5.	**To** impart practical knowledge to implement transaction management, concurrency control, and recovery mechanisms using modern monitoring and DevOps-oriented database tools.

Course Contents

Unit I	Database System Concepts and Architecture, Introduction to data and databases, Database system architecture, Data models and schemas, Relational model and constraints, Relational algebra, Distributed and Cloud Databases, Database as a Service (DBaaS), Overview of Database Testing and Automation Tools
Unit II	Conceptual Modelling and Database Design: Data modeling using Entity-Relationship (ER) diagrams, Enhanced Entity-Relationship (EER) model, Relational database design from ER/EER models, Practical database design methodology, Use of UML diagrams in database design, Agile-based Database Design Process, Introduction to Jira Tool for Project and Issue Tracking in Database Projects, Manual Testing of Database Applications (Test Cases, Data Validation, CRUD testing)
Unit III	Database Design Theory and Normalization: Relational Database Design, Features of Good Relational Designs, Normalization, De-Normalization, Functional Dependencies, Multivalued Dependencies, Normal Forms - 1NF, 2NF, 3NF, BCNF, Relational database design and further dependencies, Database Testing for Schema Integrity and Normalization, Data Quality and Consistency Testing, Introduction to Database Version Control (e.g., Git, Liquibase)
Unit IV	Introduction to SQL: Basic SQL commands (SELECT, INSERT, UPDATE, DELETE) Complex queries and joins, Triggers and views, Schema modification, Query processing and optimization, File structures, hashing, and indexing, Database Performance Testing and Query Optimization Tools, Automation Tools for Database Testing (e.g., Selenium with SQL, Apache JMeter), Integration of SQL Databases with Modern Applications (Python/Java)
Unit V	Transaction Management, Concurrency Control, and Recovery: Transaction concepts and ACID properties, Transaction control commands, Concurrency control techniques, Lock-based protocols and deadlock handling, Timestamp-based protocols, Recovery concepts and log-based recovery, Database Testing in Transaction Environments, Introduction to Database Monitoring Tools (e.g., pg Admin, MySQL Workbench, Oracle APEX), Overview of DevOps in Database Systems (Continuous Integration & Deployment of DBs)

Text Books	
T.1	Operating System Concepts: Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Wiley India Pvt. Ltd. 2018
T.2	Modern Operating Systems: Andrew S. Tanenbaum, Herbert Bos, Pearson Education, 2015
T.3	Database System Concepts: Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw Hill Education, 2019

Reference Books	
R.1	Database Systems: The Complete Book: Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom, Pearson Education, 2020
R.2	Operating Systems: Design and Implementation: Andrew S. Tanenbaum, Albert S. Woodhull, Pearson Education, 2015
R. 3	Operating Systems: Three Easy Pieces: Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau: Arpaci-Dusseau Books (University of Wisconsin–Madison), 2018

Useful Links	
1	https://nptel.ac.in/courses/106105214
2	https://pages.cs.wisc.edu/~remzi/OSTEP/
3	https://nptel.ac.in/courses/106106093
4	https://www.w3schools.com/sql/

Course Outcomes		CL
CO1	**Explain** database architectures, data models, and emerging database technologies including distributed and cloud databases.	3
CO2	**Implement** database models using ER/EER/UML diagrams and utilize agile tools such as Jira for effective project tracking and manual testing.	3
CO3	**Analyze** database schemas for redundancy, dependencies and normalization to produce efficient relational designs.	4
CO4	**Evaluate** optimized SQL queries using advanced operations, triggers, and indexing, and their performance with testing and automation tools.	5
CO5	**Implement** transaction management and concurrency control mechanisms ensuring data consistency and recovery using modern monitoring and DevOps database tools.	3

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

Teaching Scheme		Course Code: BAI12402 Course Name: Software Engineering & project Management	Examination Scheme	
Theory	3 Hrs./Wk.		CT1	15 Marks
			CT2	15 Marks
			CA	10 Marks
Total Credits	3		ESE	60 Marks
Duration of ESE: 3 Hrs.			Total	100 Marks

Course Objectives:

1. **To** develop understanding of basic software engineering principles and practices required for systematic software development.
2. **To** enable learners **to** analyze various software process models and understand their application in different project environments.
3. **To** provide knowledge of architectural styles and design patterns essential for effective software system structuring.
4. **To** build the ability to construct and apply software testing strategies including unit testing, system testing, and the use of product metrics.
5. **To** develop competency in identifying and applying steps and techniques for improving overall software quality.

Course Contents

Unit-I	**Introduction To Software Engineering:** Software Characteristics, Software Engineering a Layered Technology, Software Process Framework, Software Myths, Software Engineering Principles and Practice: Communication Practices, Planning Practices, Modeling Practices, Construction Practice & Deployment, System Engineering Hierarchy, System Modeling.
Unit-II	**Software Process Models:** The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, Software Deployment, Overview of Agile Model types features; Scrum, Data Modeling**:** Scenario Based Modeling, Flow Oriented Modeling, Class based Modeling, Behavioral Model.
Unit-III	**Design Concepts:** Abstraction, Pattern modularity, Information hiding, Design classes, Refactoring, Creating an Architectural Design: Software architecture, Data design, Architectural styles and patterns, Architectural Design, assessing alternative architectural designs, mapping data flow into a software architecture.
Unit-IV	**Testing Strategies:** A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging, Product Metrics: Software Quality, Framework for Product metrics, Metrics for Analysis Model, Metrics for Design Model, Metrics for testing. Metrics for Process and Products, Metrics for software quality

Unit-V	**Quality Management:** Software quality assurance, Software Reviews, Formal technical reviews, Statistical Software quality Assurance, Software reliability, The ISO 9000 quality standards, Risk management: Risk strategies, Software risks, Risk identification, Risk refinement, RMMM, Risk Response Control, Risk Analysis: Agile management using Jira, Scrum Change Management- Software Configuration Management, Software reengineering, Reverse Engineering: A practical approach, Recent Trends in Software Engineering

Text Books:-	
1	Software Engineering – A Practitioner's Approach (Sixth Edition) Roger S. Pressman, Tata McGraw-Hill (TMH)
2	Software Engineering, Ian Sommerville, Pearson Education(Ninth Edition)
3	Software Engineering : Theory and Practice, Shari Lawrence Pfleeger,Pearson Education (Fourth Edition)

Reference Books:-	
1	Software Engineering – Schaum's Series (TMH)-Tata McGraw-Hill (TMH)
2	Software Engineering : A Primer, Waman S Jawadekar , Tata McGrawHill, 2008
3	Software Project Management, Rajib Mall, 5th Edition, McGrawHill

Useful Links:-	
1.	**https://nptel.ac.in/course/106/101/106101061/**
2.	**https://nptel.ac.in/courses/106/105/106105087/**

	Course Outcome	**CL**
CO1	**Apply** the Knowledge of Basic Software Engineering Principles and Practices.	3
CO2	**Analyze** Fundamentals of Software Process Models.	4
CO3	**Elaborate** Architectural styles and patterns.	4
CO4	**Construct** Software Testing Strategies, Unit Testing, System Testing and Product Metrics.	3
CO5	**Demonstrate** Steps for Improving the Software Quality.	3

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

Teaching Scheme		Course Code: BAI12403 Course Name: Data visualization & automation Lab	Examination Scheme	
Practical	**2 Hrs./Wk.**		CA	25 Marks
Total Credits	**1**		ESE	25 Marks
			Total	50 Marks

Course Objective		
1	**To** build foundational skills in operating system and file-handling commands for managing project environments and preparing datasets for visualization tasks.	
2	**To** enable learners to apply Python libraries and BI tools for loading, cleaning, and visualizing data using basic and advanced charts for exploratory analysis.	
3	**To** develop competency in creating interactive visualizations and dashboards using tools such as Plotly, Power BI, Streamlit, or Flask.	
4	**To** train learners to demonstrate end-to-end workflows for data processing, visualization, and dashboard refresh using Python scripts and notebook/BI automation features.	
5	**To** enhance the ability to analyze data loading, visualization, automation, and reporting methods for delivering complete interactive data-analytics projects.	
Sr. No.	**List of Practical**	**CO**
1	Write commands to navigate directories, manage files, and perform basic system operations.	**CO1**
2	Install and explore Matplotlib, Seaborn, Plotly, and Tableau / Power BI.	**CO2**
3	Load data from CSV and Excel files, handle missing and duplicate values.	**CO2**
4	Create bar charts, line plots, and pie charts for sample datasets.	**CO2**
5	Create pairplots, boxplots, and heatmaps to explore relationships in data.	**CO3**
6	Plot time-based data and analyze trends using Matplotlib and Pandas.	**CO3**
7	Create interactive charts with zoom, hover, and filter options.	**CO3**
8	Automate chart generation and periodic visualization tasks.	**CO3**
9	Use Jupyter Notebook or Power BI automation to refresh dashboards automatically.	**CO3**
10	Export plots and data insights into PDF or Excel using Report Lab and Pandas.	**CO4**
11	Write a simple HTML page to embed Python-generated visualizations.	**CO4**
12	Use Stream lit or Flask to build a basic web dashboard with interactivegraphs.	**CO4**
13	Perform visualization and insights on an open dataset (e.g., weather, COVID-19).	**CO4**
14	Combine data loading, visualization, and report generation into one automated script.	**CO5**
15	Present a complete interactive and automated visualization project.	**CO5**

Text Books	
T.1	Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures, Claus O. Wilke, 2019

T.2	Storytelling with Data: A Data Visualization Guide for Business Professionals, Cole Nussbaumer Knaflic, 2015
Reference Books	
R.1	Better Data Visualizations: A Guide for Scholars, Researchers, and Wonks, Jonathan Schwabish, 2021
R.2	Data Visualization: A Successful Design Process, Andy Kirk, 2012
Useful Links	
1	https://jakevdp.github.io/PythonDataScienceHandbook/
2	https://www.oreilly.com/library/view/hands-on-machine-learning/9781492032632/

Course Outcomes		**CL**
CO1	**Implement** fundamental OS and file-handling commands to manage project environments and prepare datasets for visualization tasks.	3
CO2	**Apply** Python libraries and BI tools to load, clean, and visualize data with basic and advanced charts for exploratory analysis.	3
CO3	**Develop** interactive visualizations and dashboards using tools such as Plotly, Power BI, Streamlit, or Flask.	3
CO4	**Demonstrate** data processing, visualization, and dashboard refresh workflows using Python scripts and notebook/BI automation features.	3
CO5	**Analyze** data loading, visualization, automation, and reporting techniques to deliver a complete interactive data-analytics project.	4

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Second Year (Semester – IV) B.Tech. Artificial Intelligence and Machine Learning

Teaching Scheme		Course Code: BAI12404 Course Name: Operating System Lab	Examination Scheme	
Total Credit	2		CA	50 Marks
Duration of ESE : 2 Hrs.			ESE	50 Marks
			Total	100 Marks

Course Objective:

1	**To** provide foundational understanding of operating system structure and its key features.
2	**To** enable learners to analyze the relationship between process scheduling and synchronization techniques for efficient system operation.
3	**To** develop knowledge of various memory allocation techniques and their impact on system performance.
4	**To** equip students to evaluate deadlock management strategies and corresponding recovery techniques.
5	**To** examine disk scheduling algorithms and understand their significance in optimizing file system operations.

List of experiments

1	Write a program to simulate the following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time. a) FCFS b) SJF c) Round Robin d) Priority.
2	Write a program to simulate a multi-level queue scheduling algorithm considering the following scenario. All the processes in the system are divided into two categories – system processes and user processes. System processes are to be given higher priority than user processes. Use FCFS scheduling for the processes in each queue.
3	Write a program to simulate the following file allocation strategies. a) Sequential b) Indexed c) Linked
4	Write a program to simulate the MVT and MFT memory management techniques.
5	Write a program to simulate the following contiguous memory allocation techniques a) Worst-fit b) Best-fit c) First-fit
6	Write a program to simulate paging technique of memory management.
7	Write a program to simulate the following file organization techniques a) Single level directory b) Two level directory c) Hierarchical.
8	Write a program to simulate Banker's algorithm for the purpose of deadlock avoidance.
9	Write a program to simulate disk scheduling algorithms a) FCFS b) SCAN c) C-SCAN.
10	Write a program to simulate producer-consumer problem using semaphores.
11	Write a program to simulate the Dining Philosopher Problem using semaphores.
12	Write a program to implement Interprocess Communication (IPC) using Pipes.
13	Write a program to simulate Page Replacement Algorithms — *FIFO, LRU, Optimal.*
14	Write a program to simulate Producer-Consumer problem using Shared Memory.
15	Design a simple program that simulates multiple operating system functionalities such as process scheduling, memory management, and file handling.

Text Books

T.1	Operating System Concepts (8th Edition) by Silberschatz, Peter B. Galvin and Greg Gagne, Wiley Indian Edition (2010).
T.2	Modern Operating Systems (Third Edition) by Andrew S Tanenbaum, Prentice Hall India (2008).

T.3	Advanced Concepts In Operating Systems by Niranjan G. Shivaratri.

Reference Books

R.1	Operating Systems (5th Ed) – Internals and Design Principles by William Stallings, Prentice Hall India, 2000.
R.2	Operating System: Concepts and Design by Milan Milenkovik , McGraw Hill Higher Education.

Useful Links

1	https://nptel.ac.in/courses/106/105/106105214/
2	https://nptel.ac.in/courses/106/102/106102132

Course Outcomes		
After the completion of this course, students will be able to-		**CL**
CO1	**Classify** the structure and key features of operating system.	2
CO2	**Analyze** the interaction between process scheduling and synchronization techniques to ensure efficiency.	4
CO3	**Illustrate** memory allocation techniques and their impact.	4
CO4	**Evaluate** strategies for managing deadlocks, and recovery techniques.	5
CO5	**Examine** the performance of disk scheduling algorithms and their role in optimizing file system operations.	4

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

Teaching Scheme		Course Code: BAI12405 Course Name: Database Management System Lab	Examination Scheme	
Practical	**2 Hrs./Wk.**		CA	25 Marks
Total Credits	**1**		ESE	25 Marks
			Total	50 Marks

Course Objective	
1	To Introduce the fundamentals of SQL for creating tables, defining constraints, and organizing relational data.
2	To Develop the ability to perform data manipulation operations such as inserting, updating, deleting, and retrieving records.
3	To Build competency in writing SQL queries using filtering, sorting, grouping, aggregation, joins, subqueries, and views.
4	To Enable learners to apply advanced SQL features such as constraints, computed columns, unions, and nested queries for real-world scenarios.
5	To Equip students to design and implement a mini real-life database application demonstrating complete SQL workflow including triggers and views.

Sr. No.	**List of Practical**	**CO**
1	Creating a Table: Write an SQL query to create a table named Employees with columns: EmpID, Name, Age, Department, and Salary.	**CO1**
2	Inserting Data into a Table- Insert at least five records into the Employees table.	**CO2**
3	Updating Data in a Table: Update the salary of an employee based on their EmpID.	**CO2**
4	Deleting Data from a Table: Delete an employee record based on a specific condition (e.g., Age < 25).	**CO2**
5	Performing a SELECT Query with a WHERE Clause: Retrieve employees who belong to the "IT" department and have a salary greater than 50,000.	**CO2**
6	SELECT Query with Calculated Columns: Write a query to display the Name, Salary, and a calculated column Annual Salary (Salary * 12).	**CO3**
7	Using DISTINCT, BETWEEN, and LIKE Clauses ● Retrieve distinct department names. ● Select employees whose salary is between 40,000 and 80,000. ● Retrieve employees whose name starts with ‘A’.	**CO3**
8	Using ORDER BY and UNION Clause ● Retrieve employee names sorted by salary in descending order. ● Perform a UNION query between two tables Employees and Managers having similar columns.	**CO4**
9	SELECT Query with COMPUTE BY, GROUP BY Group employees by department and compute the total salary for each department	**CO3**
10	Nested Query (Subquery) Retrieve employees who earn more than the average salary in the company.	**CO3**
11	Write SQL queries using INNER JOIN, LEFT JOIN, and RIGHT JOIN to display employee details along with their department names from two tables — Employees and Departments.	**CO3**

12	Write SQL queries to find the maximum, minimum, average, and total salary of employees in each department and filter departments having total salary greater than 1,00,000.	**CO3**
13	Create a **view** that displays only Name, Department, and Salary of employees earning above 60,000. Retrieve data from this view.	**CO4**
14	Write SQL commands to create a table with constraints — PRIMARY KEY, FOREIGN KEY, UNIQUE, NOT NULL, and CHECK — and demonstrate how they work with sample data.	**CO1**
15	Design and implement a simple database application using SQL that demonstrates table creation, data manipulation, joins, views, and triggers based on real-life scenarios.	**CO5**

Text Books	
T.1	Database System Concepts – Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw Hill, 7th Edition, 2020.
T.2	Database Management Systems – Raghu Ramakrishnan and Johannes Gehrke, McGraw Hill, 3rd Edition, 2019.
Reference Books	
R.1	Fundamentals of Database Systems – Ramez Elmasri and Shamkant B. Navathe, Pearson Education, 7th Edition, 2020.
R.2	SQL, PL/SQL: The Programming Language of Oracle – Ivan Bayross, BPB Publications, 5th Edition, 2021.
Useful Links	
3	https://onlinecourses.nptel.ac.in/noc22_cs91/preview
4	https://onlinecourses.swayam2.ac.in/ini24_cs01/preview

Course outcome		CO
1	**Create** relational tables with appropriate constraints and structure using SQL DDL commands.	6
2	**Manipulate** data effectively using SQL DML operations such as insert, update, delete, and conditional retrieval.	3
3	**Apply** filtering, sorting, grouping, aggregation, joins, and subqueries to analyze and retrieve meaningful information from relational datasets.	3
4	**Construct** views, computed columns, unions, and constraint-based designs to enhance database functionality and integrity.	3
5	**Develop** a real-life SQL-based mini application integrating table creation, data handling, joins, views, and triggers.	5

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

Teaching Scheme		Course Code: BAI12407(OE-II) Course Name: Introduction to Machine Learning	Examination Scheme	
Theory(OE)	2 Hrs./Wk.		CT1	7 Marks
			CT2	7 Marks
			CA	6 Marks
Total Credits	2		ESE	30 Marks
Duration of ESE: 2 Hrs.			Total	50 Marks

Course Objectives:	
1	To apply basic ML algorithms to solve problems.
2	To analyze model performance using evaluation metrics.
3	To evaluate and select suitable ML techniques for applications.

Course Contents

Unit I	**Fundamentals of Machine Learning:** Introduction to Artificial Intelligence and Machine Learning, Types of Learning: Supervised, Unsupervised, Semi-supervised, Reinforcement, Applications of ML in various domains, Steps in building a Machine Learning model, Data preprocessing: cleaning, normalization, encoding, train-test split, Performance metrics: Accuracy, Precision, Recall, F1 Score, Confusion Matrix
Unit II	**Supervised Learning:** Regression: Linear Regression, Polynomial Regression, Evaluation using MSE, RMSE, R^2 Score, Classification: k-Nearest Neighbours (k-NN), Decision Trees and Random Forests, Naïve Bayes Classifier, Support Vector Machines (SVM), Overfitting and Regularization (L1, L2)
Unit III	**Unsupervised and Advanced Learning:** Clustering: K-Means, Hierarchical Clustering, Evaluation: Silhouette Score, Elbow Method, Dimensionality Reduction: PCA (Principal Component Analysis), t-SNE, Reinforcement Learning: Basics of RL, Agent–Environment interaction, Q-Learning, Introduction to Neural Networks (Perceptron Model, Backpropagation)

Text Books	
T.1	Introduction to Machine Learning – Ethem Alpaydin, MIT Press, 2020.
T.2	Machine Learning – Tom M. Mitchell, McGraw-Hill, 2017.
T.3	Python Machine Learning – Sebastian Raschka and Vahid Mirjalili, Packt, 2020.

Reference Books	
R.1	Pattern Recognition and Machine Learning – Christopher M. Bishop, Springer, 2016.
R.2	Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow – Aurélien Géron, O'Reilly, 2023.
R.3	Machine Learning for Beginners – Oliver Theobald, 2021.

Useful links	
1	NPTEL Course: Introduction to Machine Learning – IIT Madras
2	NPTEL Course: Introduction to Machine Learning – IIT Kharagpur

Course Outcome		CL
1	**Apply** basic machine learning algorithms to real-world data.	3
2	**Analyze** and interpret model performance using evaluation metrics.	4
3	**Evaluate** and select appropriate ML models for given applications.	5

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Program: B. Tech Fourth Year (CSE- Data Science/AIML)

Semester		Course Code		Course Name	
IV		BSH32402		Sampling Method & Estimation Theory	
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 (Th)	CA	6 Marks	-	-
Duration of ESE:2Hrs		ESE	30 Marks	-	-
		Total Marks	50 Marks	-	-

Pre-Requisites: Mean, mode, median, standard deviation etc.

Course Objectives:

1	To equip students with the skills to develop unbiased estimators and apply confidence intervals for accurate statistical inference.
2	To understand populations and samples, apply sampling methods, and analyze distributions of sample statistics.
3	To Understand the fundamental Concept of hypothesis testing, including the null hypothesis and alternative hypothesis and the basic logic behind hypothesis testing.

Course Content

Unit I	**Estimation Theory:** Unbiased and efficient estimates, Point estimates and interval estimates, Confidence interval for means, Confidence interval for proportions, Confidence interval for differences and sums of mean and proportions.
Unit II	**Sampling Theory:** Population and sample, Sampling with and without replacement, Population parameters, sample statistics, Sampling distribution of means, and Sampling distribution of proportions
Unit III	**Hypothesis testing:** Introduction, significant level and p-value, Null Hypothesis, Alternative Hypothesis, Type-I and Type-II errors, confidence interval, hypothesis test, t-Test, Z-test, chi square test.

Text Books

1	M.R. Spiegal, Theory and problems of Probability and Statistics: 2nd edition Schaum Series
2	Higher Engineering Mathematics by B.S. Grewal, 40th Edition, Khanna Publication
3	Fundamentals of Mathematical Statistics (Modern Approach) S.C. Gupta and V. K. Kapoor 10th Edition
4	Probability and Statistics (Schaum's Outline Series), Murray Speigal, John Schiller, R. A. Srinivasam.
5	Advanced Engineering Mathematics by Erwin Kreyszig, 8th Edition, Wiley India

Reference Books

1	Advanced Engineering Mathematics by H K Das
2	Introductory methods of Numerical Analysis, by S.S. Sastry, PHI

CO	**Course Outcomes**	**CL**
CO1	**Analyze** and interpret results from point and interval estimates.	**3**
CO2	**Implement** the most appropriate Sampling Techniques for a given applied problems	**3**
CO3	**Apply** hypothesis testing to real-world scenarios.	**3**

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

Teaching Scheme		Course code: BSH32403 Course Name: - Environmental Science and Sustainability	Examination Scheme	
Theory	2Hrs./wk.		CT-I	7
Tutorial	-		CT-II	7
Total Credits	2		CA	6
Duration of ESE: 2Hrs.			ESE	30
			Total	50

Course Objectives:

1.	To understand solid and E-waste management.
2.	To know global environmental impact on air pollution.
3.	To create an understanding about Environment management rules and policies.

Course Contents

Unit I	**Solid and Hazardous Waste Management-** Waste hierarchy; Municipal solid waste management: Sources, generation, characteristics, collection and transportation, waste processing and disposal (including reuse options, biological methods, energy recovery processes and landfilling). Management E-waste: Sources, generation and characteristics; Waste management practices including storage, collection and transfer.
Unit II	**Global and Regional Environmental Issues Global effects of air pollution** – Natural Resource: Renewable and Non-renewable energy sources and its management. Greenhouse gases, global warming, climate change, urban heat islands, acid rain, ozone hole. Ecology and various ecosystems; Biodiversity; Factors influencing increase in population, energy consumption, and environmental degradation.
Unit III	**Environmental Management and Sustainable Development** Environmental Management Systems; Environmental auditing, Human health risk assessment: The Environment (Protection) Act (EPA) 1986-2002; Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs

Text Books

T.1	Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press
T.2	360-Degree Waste Management, Volume 1: Fundamentals, Agricultural and Domestic Waste, and Remediation, Nishikant A. Raut, et al., published by Elsevier, 2023
T.3	Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press

Reference Books

R.1	Jackson, A.R.W. and Jackson, J.M., Environmental Science: The Natural Environment and Human Impact,2nd Ed., Pearson Education, 2000.
R.2	Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc25_ce122/preview
2	https://onlinecourses.nptel.ac.in/noc25_ce45/preview
3	https://onlinecourses.nptel.ac.in/noc25_hs218/preview

	Course Outcomes	CL	Class Session
CO1	**Understand** the basis of solid waste and its management processes.	2	10
CO2	**Examine** the environmental issues of regional and global level.	3	10
CO3	**Illustrate** the different environmental policies to control pollution.	4	10

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Program: BBA & Applicable to All B.Tech Programmes

Teaching Scheme		BBA32X02: Managerial Economics	Examination Scheme	
Lectures	2 Hr / Week		CT	30
Tutorials	-		CA	20
Total Credits	2		ESE	50
			Total	30 Marks
			Duration of ESE: 02 Hrs	

Course Outcome

1	Apply economic principles to practical business decisions
2	Analyze demand and supply functions, market equilibrium, consumer behavior, and utility maximization concepts
3	Evaluate production functions, cost concepts, and cost–volume–profit relationships to support efficient production planning and cost management decisions.

	Course Contents	Hours
Unit I	**Nature & Scope of Managerial Economics:** Managerial Economics Introduction, Meaning, nature and scope. Fundamental Economics Concepts: Opportunity Cost, Discounting principle, Time perspective, Incremental reasoning, Equi-Marginal concept, Marginal concept in economics. Economies of information: Risk, uncertainty, Theory of firm.	(9)
Unit II	**Demand & Supply analysis:** Demand and Supply Introduction, Market demandand supply functions and curves. Market equilibrium. Consumer behavior and rational choice: cardinal and ordinal approaches of consumer utility-Maximization of consumer utility by the technique of indifference curves and budget lines., Demand Fore casting and its methods and uses.	(9)
Unit III	**Production Function & Cost Analysis:** Introduction- Laws of diminishing returns to a factor. Returns to scale, Economies & Diseconomies of scale. Production function-Estimation of production function: Cobb Douglas and CES Production functions. Concepts of cost - Cost analysis, economic & accounting cost, Role of time in cost analysis. Cost Volume profit Analysis.	(9)

Text Books

T.1	Managerial Economics, Suma Damodran, 2006, Oxford University Press, New Delhi
T.2	Indian Economy, Mishra &Puri, 2007, Himalaya Publishing House
T.3	Managerial Economics, Peterson & Levis, Prentice Hall of India

R.1	Managerial Economics, P. L. Mehta, Sultan Chand & Sons, New Delhi
R.2	

Reference Books

T.3	Government resources: Startup India website for policies and case studies
T.4	Harvard Business Review / business case collections for real startup stories
Useful Links	
1	Startup India (www.startupindia.gov.in/)

Useful Links	
1	https://archive.nptel.ac.in/courses/110/101/110101149/
2	https://www.youtube.com/watch?v=vLPpF0hunwc

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

Teaching Scheme		Course Code: BSH32404 Course Name: Leadership and Team Dynamics	Examination Scheme	
Theory	2 Hrs./Wk.		CA	50 Marks
Total Credits	2		ESE	50 Marks
Duration of ESE: 4 Hrs.			Total	100 Marks

Course Objectives:	
1	To develop students' ability to collaborate effectively through structured team-based activities.
2	To enhance communication, listening, and interpersonal skills essential for teamwork.
3	To build leadership, role-sharing, and conflict-resolution capabilities in group environments.
4	To cultivate decision-making, time-management, and problem-solving competencies in practical scenarios.
	To foster trust, responsibility, and reflective thinking through real-world engineering project simulations.
List of experiments	
1	Perform activity on Icebreakers and Introductions Setting the Stage 2
2	Perform activity on Collaborative Problem Solving
3	Perform activity on Role Assignment and Leadership
4	Perform activity on Conflict Resolution Exercise
5	Perform activity on Communication & Listening Skills
6	Perform activity on Team Decision-Making
7	Perform activity on Trust-Building Activities
8	Perform activity on Time Management Challenge
9	Perform activity on Group Reflection and Feedback
10	Perform activity on Real-World Engineering Project Simulation
Text Books	
T.1	Leadership: Theory and Practice — Peter G. Northouse, SAGE Publications, 8th Edition, 2021.
T.2	Team of Teams: New Rules of Engagement for a Complex World — General Stanley McChrystal, Penguin Books, 2015.
Reference Books	
R.1	The Five Dysfunctions of a Team: A Leadership Fable — Patrick Lencioni, Jossey-Bass, 2002.
R.2	Leaders Eat Last: Why Some Teams Pull Together and Others Don't — Simon Sinek, Portfolio/Penguin, 2014.
Useful links	
1	https://nptel.ac.in/courses/110107159

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

Teaching Scheme		Course Code: BAI12406 Course Name: Data Analytic Lab	Examination Scheme	
Practical	**4 Hrs./Wk.**		CA	50 Marks
Total Credits	**2**		ESE	50 Marks
			Total	100 Marks

Course Objective	
1	To apply data extraction and connection techniques from multiple data sources using Power BI.
2	To implement data cleaning and transformation processes using Power Query Editor.
3	To analyze data models and create measures using DAX for business insights.
4	To design and develop interactive visualizations, reports, and dashboards.
5	To evaluate and publish Power BI solutions for real-time analytics and decision-making.

Sr. No.	**List of Practical**	**CO**
1	Introduction to Power BI Desktop and interface navigation	**CO1**
2	Load and connect to different data sources (Excel, CSV, SQL Server, Web)	**CO1**
3	Perform data cleaning and transformation using Power Query Editor	**CO1**
4	Apply data modeling concepts in Power BI	**CO2**
5	Create calculated columns and measures using DAX	**CO2**
6	Create visualizations: bar charts, line charts, pie charts, tables, slicers	**CO3**
7	Use filters, slicers, and drill-through to make reports interactive	**CO3**
8	Build hierarchies and use drill-down functionality in charts	**CO3**
9	Create KPI indicators and use conditional formatting	**CO4**
10	Use date and time intelligence functions in DAX	**CO2**
11	Design dashboards with bookmarks and navigation buttons	**CO4**
12	Publish report to Power BI Service and share dashboards	**CO5**
13	Schedule data refresh and manage dataset settings	**CO5**
14	Build a complete Power BI project using a real-world dataset (e.g., sales, HR, finance, education)	**CO4**

Text Books	
T.1	Power BI for the Excel Analyst *Author*: Mike Alexander Publisher: Wiley
T.2	The Definitive Guide to DAX: Business intelligence with Microsoft Excel, SQL Server Analysis Services, and Power BI Authors: Alberto Ferrari, Marco Russo, Publisher: Microsoft Press

Reference Books	
R.1	Power BI Cookbook: Creating Business Intelligence Solutions of Analytical Data Models, Reports, and Dashboards Author: Brett Powell, Publisher: Packt Publishing
R.2	Mastering Power BI: A Comprehensive Guide to Business Analytics with Power BI Authors: Chandraish Sinha *Publisher*: Packt Publishing

Useful Links	
3	https://learn.microsoft.com/en-us/power-bi/
4	https://www.microsoft.com/en-us/power-platform/products/power-bi/learning

Course Outcomes		CL
1	**Apply** data loading, cleaning, and transformation techniques using Power Query to prepare datasets for analysis.	3
2	**Develop** effective data models and create DAX-based calculated columns and measures for analytical reporting.	3
3	**Construct** a variety of Power BI visualizations and implement interactive features for enhanced report exploration.	3
4	**Design** professional dashboards incorporating KPIs, conditional formatting, bookmarks, and navigation features.	6
5	**Analyze** Power BI reports and datasets by publishing, sharing, and scheduling data refresh in Power BI Service.	4

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			Total	30 Marks
			Duration of ESE: 02 Hrs	

Course Outcome	
1	Apply economic principles to practical business decisions
2	Analyze demand and supply functions, market equilibrium, consumer behavior, and utility maximization concepts
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R.1	Managerial Economics, Peterson & Levis, Prentice Hall of India
R2	Managerial Economics, P. L. Mehta, Sultan Chand & Sons, New Delhi

Useful Links

1	https://archive.nptel.ac.in/courses/110/101/110101149/
2	https://www.youtube.com/watch?v=vLPpF0hunwc

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