

Walchand College of Engineering, Sangli

Department of Artificial Intelligence and Machine Learning

Curriculum Contents

TY B.Tech. (AIML)

(AY 2026 - 27)

(Applicable for batch entered into 2024-25)

SEM-V

Walchand College of Engineering, Sangli
(Government Aided Autonomous Institute)

AY 2026-27

Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class | Semester	Third Year | Semester V
Course Code	1AI301
Course Name	Expert Systems
Desired Requisites:	Searches and Logics in AI, Decision Modeling using AI

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	03 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
		Credits: 3			

Course Objectives

1	To understand the core components of Expert Systems.
2	To explore knowledge representation techniques and reasoning mechanisms.
3	To compare rule-based, frame-based, and fuzzy logic architectures for diverse applications.
4	To select appropriate ES frameworks to solve complex, domain-specific problems.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Descriptor**
CO1	Explain the role of the Turing Test and fundamental ES components in simulating human intelligence.	II	Understand
CO2	Interpret complex domain knowledge through various representation techniques.	II	Understand
CO3	Apply inference mechanisms to solve structured problems within an expert system framework.	III	Apply
CO4	Analyze classic AI case studies to identify the relationship between system architecture and domain-specific performance.	IV	Analyze

Module	**Module Contents**	**Hours**
I	**Introduction to Expert Systems** Definitions and characteristics of ES; Comparison with conventional programs; Components of an ES (Knowledge Base, Inference Engine, User Interface); Roles in ES development (Expert, Engineer, User).	06
II	**Knowledge Representation & Reasoning in ES** Propositional and Predicate Logic; Semantic Networks; Inference methods: Forward vs. Backward Chaining; Conflict resolution strategies; Reasoning under uncertainty.	07
III	**Rule-Based Expert Systems** Production rules; Architecture of rule-based systems; Advantages and limitations; Rete algorithm basics; Developing simple rule-based engines.	06
IV	**Frame-Based Expert Systems** Concept of Frames, Slots, and Fillers; Inheritance and Default values; Object-oriented approach to ES; Comparison between rules and frames; Hybrid systems.	06
V	**Fuzzy Expert Systems** Introduction to Fuzzy Logic; Membership functions; Fuzzy sets and operators; Fuzzy IF-THEN rules; Fuzzification and Defuzzification processes.	07

VI	**Case Studies & Applications** Analysis of classic systems: MYCIN (Medical), Deep Blue (Game AI), DENDRAL (Chemistry), CODET (Troubleshooting), and SOPHIE (Instructional); Future trends in ES.	07

Textbooks	
1	Patrick Henry Winston, Artificial Intelligence, Pearson, 3rd Edition, 1992.
2	Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann, 1st Edition, 1998.
3	Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson, 3rd Edition, 2009.
4	David Poole & Alan Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2nd Edition, 2017.

Reference Books	
1	Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice-Hall, 1st Edition, 1990.
2	John Durkin, Expert Systems: Design and Development, Macmillan, 1st Edition, 1994.
3	Peter Jackson, Introduction to Expert Systems, Addison-Wesley, 3rd Edition, 1998.
4	Joseph C. Giarratano & Gary D. Riley, Expert Systems: Principles and Programming, PWS Publishing Co., 4th Edition, 2004.

Useful Links	
1	https://nptel.ac.in/courses/106106140
2	https://nptel.ac.in/courses/108104157
3	https://nptel.ac.in/courses/106106126

CO-PO Mapping

	Programme Outcomes (PO)											**PSO's**	
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO 10**	**PO1 1**	**PSO 1**	**PSO 2**
CO1	3	1				1	2				2	2	3
CO2	3	2	2								1	3	3
CO3	3	3	3	2	2						1	3	3
CO4	2	2	2	2		2			2		3	2	3

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

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AY 2026-27

Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class, Semester	Third Year | Semester V
Course Code	1AI302
Course Name	Machine Learning
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
		Credits: 3			

Course Objectives

1	Describe machine learning concepts, hypothesis space, and learning paradigms.
2	Develop regression and classification models for prediction and performance analysis.
3	Examine clustering methods and identify hidden patterns in datasets.
4	Explain reinforcement learning frameworks and apply Q-learning concepts.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Descriptor
CO1	Explain the fundamentals, types, workflow, and applications of Machine Learning.	II	Understand
CO2	Apply regression and classification techniques and evaluate model performance.	III	Apply
CO3	Analyze clustering techniques and unsupervised learning methods for pattern discovery.	IV	Analyse
CO4	Apply dimensionality reduction, association learning, and reinforcement learning techniques.	III	Apply

Module	Module Contents	Hours
I	**Machine Learning Basics** Introduction to Machine Learning, Types of Machine Learning, Machine Learning Pipeline**,** Hypothesis Space & Occam's Razor**,** Applications of Machine Learning	06
II	**Regression Techniques** Regression Basics, Linear Regression (Simple & Multiple), Polynomial Regression, Regularization Techniques (Ridge, Lasso) Model Evaluation Metrics: MAE, MSE, RMSE, R^2 Score	06

III	**Classification Algorithms** Classification Concepts, Naïve Bayes Algorithm, Logistic Regression, K-Nearest Neighbors (KNN), Decision Trees & Random Forest, Support Vector Machines (SVM), Evaluation Metrics: Confusion Matrix, Precision, Recall, F1-score, ROC Curve	07
IV	**Clustering Techniques** Introduction to Unsupervised Learning, Clustering Concepts, K-Means Clustering, Hierarchical Clustering, DBSCAN Algorithm, Cluster Evaluation Techniques	07
V	**Dimensionality Reduction & Association** Curse of Dimensionality, Principal Component Analysis (PCA), t-SNE (Introduction), Association Rule Learning:, Apriori Algorithm, Market Basket Analysis	06
VI	**Reinforcement Learning** Introduction to Reinforcement Learning, Key Elements: Agent, Environment, Reward, Markov Decision Process (MDP), Q-Learning Algorithm, Exploration vs Exploitation, Applications	07

Textbooks	
1	S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 4th ed. Hoboken, NJ, USA: Pearson, 2020
2	A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2019.
3	T. Hastie, R. Tibshirani, and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd ed. New York, NY, USA: Springer, 2009.
4	J. Han, M. Kamber, and J. Pei, Data Mining: Concepts and Techniques, 3rd ed. Waltham, MA, USA: Morgan Kaufmann, 2011

References	
1	C. M. Bishop, Pattern Recognition and Machine Learning. New York, NY, USA: Springer, 2006.
2	K. P. Murphy, Machine Learning: A Probabilistic Perspective. Cambridge, MA, USA: MIT Press, 2012.
3	I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning. Cambridge, MA, USA: MIT Press, 2016.

Useful Links	
1	https://nptel.ac.in/courses/106105152
2	https://nptel.ac.in/courses/106106143
3	https://digimat.in/nptel/courses/video/106106202
4	https://nptel.ac.in/courses/106105247

CO-PO Mapping													
	Programme Outcomes (PO)											PSO	
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2
CO1	3	2			2				1	3	2	2	2
CO2	3	3	2	2	3		3		2		2	3	3
CO3	3	3	2	3	3		2		1	2	2	3	3
CO4	3	3	3	3	3	1		1	1		3	3	3
The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.													
Assessment													
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)													

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AY 2026-27

Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class, Semester	Third Year | Semester V
Course Code	1AI303
Course Name	Database Management System
Desired Requisites:	Basic Mathematics and Logic, Basic Programming Knowledge

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
	-	30	30	40	100
		Credits: 1			

Course Objectives

1.	To introduce the fundamental concepts of database systems, data models, and architecture for efficient data management.
2.	To develop skills in designing relational databases using ER modeling, normalization, and SQL for structured data handling.
3.	To understand transaction management, concurrency control, and recovery techniques for maintaining data consistency and reliability.
4.	To explore modern database technologies such as NoSQL, data warehousing, and distributed databases for handling large-scale and unstructured data in AI/ML applications..

Course Outcomes (LO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Understand and apply database fundamentals, including data models, relational algebra, and SQL.	III	Apply
CO2	Design efficient schemas using ER modeling, normalization, and constraints.	III	Apply
CO3	Implement transaction management, concurrency control, and recovery mechanisms.	III	Apply
CO4	Analyze modern database technologies like NoSQL and data warehousing for large-scale and AI-driven data.	IV	Analyse

List of Experiments / Lab Activities/Topics

List of Lab Assignments:

1. Implement relational database systems by applying SQL commands (DDL, DML, DCL), ER modelling, and integrity constraints for efficient database design and management.
2. Implement advanced SQL queries using joins, nested queries, views, aggregate functions, GROUP BY, and HAVING clauses.
3. Implement database normalization techniques up to BCNF for efficient database design.
4. Implement database programming concepts using triggers and stored procedures, and apply transaction management techniques to ensure ACID properties in database systems
5. Implement concurrency control mechanisms and log-based recovery techniques to maintain consistency and reliability in database systems.
6. Create an Inventory Management Database to maintain stock and supplier details. Implement user authentication and access privileges in DBMS.
7. Implement MongoDB database operations including installation, CRUD operations, document modelling, querying, aggregation, indexing, and management of embedded documents and collection relationships.
8. Integrate MongoDB with Python using PyMongo to perform database operations, manage AI/ML datasets, pre-process data, and develop real-world AI/ML applications, MongoDB CRUD Operations using Python MongoDB Connectivity with Node.js.
9. Design a MongoDB database to manage student records including personal details, course information, attendance, and examination marks. Perform CRUD operations and generate reports.
10. Develop a database for managing patient records, doctor details, appointments, prescriptions, and billing information using MongoDB collections.

Textbooks	
1	Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2	Fundamentals of Database Systems, Authors: Ramez Elmasri, Shamkant Navathe
3	Database Management Systems,Authors: Raghu Ramakrishnan, Johannes Gehrke
4	“MongoDB: The Definitive Guide” by Kristina Chodorow, O Reilly Publications
5	Rob J. Hyndman and George Athanasopoulos, Forecasting: Principles and Practice, 3rd Edition, OTexts, 2021.
6	Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 3rd Edition, O'Reilly Media, 2022.

References	
1	Connally T., Begg C., "Database Systems", 4th Edition, Pearson Education, 2002, ISBN 8178088614
2	NoSQL Distilled, Author Pramod J. Sadalage and Martin Fowler
3	● Kristina Chodorow, Michael Dierolf, “MongoDB: The Definitive Guide”, O Reilly Publications, ISBN: 978-1-449-34468-9
4	● Adam Fowler, “NoSQL For Dummies”, John Wiley & Sons, ISBN-1118905628
5	Avrim Blum, John Hopcroft, and Ravindran Kannan, Foundations of Data Science, 1st Edition, Cambridge University Press, 2020.

6	Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman, Mining of Massive Datasets, 3rd Edition, Cambridge University Press, 2020.

Useful Links	
1	https://nptel.ac.in/courses/106105175
2	https://nptel.ac.in/courses/106106220
3	https://nptel.ac.in/courses/106106093
4	https://nptel.ac.in/courses/106106095

CO-PO Mapping

	Programme Outcomes (PO)											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2	1		2							2	
CO2	3	3	3	2	2							3	2
CO3	3	2	3	3	3							3	3
CO4	2	2	2	2	3							3	3

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

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AY 2026-27

Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class | Semester	Third Year | Semester V
Course Code	1AI304
Course Name	Data Science and Analytics
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
		Credits: 02			

Course Objectives

1	To introduce the data science and analytics lifecycle within various engineering domains.
2	To impart engineering skills for executing data pre-processing pipelines and visualization.
3	To establish solid statistical foundations for data-driven validation.
4	To build predictive analytics models and evaluate performance using industrial validation metrics.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Descriptor**
CO1	Explain the stages of the data science and analytics lifecycle, engineering data taxonomies.	II	Understand
CO2	Apply fundamental statistical measures and visualization techniques to interpret engineering datasets	III	Apply
CO3	Use inferential testing frameworks and correlation measures to execute data-driven hypothesis tests	III	Apply
CO4	Analyze predictive analytics models and optimize their performance using standard industrial validation metrics.	IV	Analyze

Module	**Module Contents**	**Hours**
I	**Foundations and Analytics Lifecycle** Basics and need of Data Science, Real-world Applications. Data Analytics Lifecycle Framework, Data Types, Types of Engineering Data, Data Quality Dimensions.	04
II	**Data Wrangling, Pre-processing and Visualization** Data Pre-processing Pipelines, Data Cleaning, Data Transformation Techniques, Feature Extraction and Selection. Exploratory Data Analysis (EDA), Data Visualization, Types and Principles of Visual Perception.	05
III	**Data Statistical Essentials** Need of Statistics in Analytics. Descriptive Statistics: Mean, Median, Mode; Measures of Dispersion: Range, Variance, Standard Deviation. Inferential Statistics: Bayes Theorem, Conditional Probability, Pearson Correlation. Elements of Hypothesis Testing: Z-Test, T-Test.	05

IV	**Predictive Data Analytics** Overview of Predictive, Descriptive, and Prescriptive Paradigms. Core Supervised Modelling: Regression and Classification Implementation using Scikit-learn. Unsupervised Rule Analytics: Mining Item-sets via Apriori Algorithm.	04
V	**Advanced Analytics Paradigms** Specialized Data Analytical Streams. Time Series Analysis Foundations, Trends and Components. Text Analysis Pipelines, Sentiment Analysis, Tokenization and Text Classification Workflows.	04
VI	**Analytics Evaluation, Optimization, and Validation** Model Evaluation and Selection Parameters. Confusion Matrix, Precision, Recall, F1-Measure. AUC-ROC Curves, k-Fold Cross-Validation, Hyperparameter Tuning.	04

Textbooks	
1	Rob J. Hyndman and George Athanasopoulos, Forecasting: Principles and Practice, 3rd Edition, OTexts, 2021.
2	Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 3rd Edition, O'Reilly Media, 2022.
3	Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, An Introduction to Statistical Learning: with Applications in Python, 1st Edition, Springer, 2023.
4	Allen B. Downey, Think Stats: Exploratory Data Analysis, 3rd Edition, O'Reilly Media / Green Tea Press, 2024.

References	
1	Avrim Blum, John Hopcroft, and Ravindran Kannan, Foundations of Data Science, 1st Edition, Cambridge University Press, 2020.
2	Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman, Mining of Massive Datasets, 3rd Edition, Cambridge University Press, 2020.
3	Rafael A. Irizarry, Introduction to Data Science: Data Analysis and Prediction Algorithms with Case Studies, 2nd Edition, CRC Press / Leanpub, 2024.
4	Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models, 3rd Edition, Stanford University (Online Manuscript), 2026.

Useful Links	
1	**nptel.ac.in/courses/106106212**
2	**nptel.ac.in/courses/106107220**
3	**nptel.ac.in/courses/111106415**
4	**nptel.ac.in/courses/110106072**

CO-PO Mapping

	Programme Outcomes (PO)											**PSO's**	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO 1**	**PSO 2**
CO1	2	1									1	1	
CO2	3	2		2	3						2	2	1
CO3	3	3		3							1	2	2
CO4	3	3	2	2	3						2	3	3

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.
Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2026-27

Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class, Semester	Third Year | Semester V
Course Code	1AI351
Course Name	Machine Learning Laboratory
Desired Requisites:	Machine Learning, Python Programming

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
	-	30	30	40	100
		Credits: 1			

Course Objectives

1.	To develop hands-on skills in implementing machine learning algorithms
2.	To understand data pre-processing, visualization, and feature engineering techniques
3.	To apply supervised and unsupervised learning algorithms
4.	To evaluate and compare machine learning models

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain fundamental concepts of data pre-processing, supervised and unsupervised learning algorithms	II	Understand
CO2	Apply data pre-processing techniques and implement regression and classification algorithms	III	Apply
CO3	Apply unsupervised learning techniques and dimensionality reduction methods	III	Apply
CO4	Analyze and compare the performance of machine learning models.	IV	Analyze

List of Experiments / Lab Activities/Topics

List of Lab Assignments:

The lab assignments should be implemented using python programming and R Programming.

1. Data Preprocessing and Exploratory Data Analysis using Python
2. Implementation of Simple Linear Regression Model
3. Implementation of Multiple Linear Regression Model
4. Implementation of Logistic Regression for Binary Classification
5. Implementation of K-Nearest Neighbors (KNN) Algorithm
6. Implementation of Decision Tree Classifier
7. Implementation of K-Means Clustering Algorithm
8. Implementation of Principal Component Analysis (PCA) for Dimensionality Reduction
9. Implementation of Apriori Algorithm for Association Rule Mining
10. Implementation of Q-Learning Algorithm for Reinforcement Learning

Activity: Course Specific Mini Project.

Textbooks	
1	Pattern Recognition and Machine Learning. New York, NY, USA: Springer, 2006. ISBN: 978-0387310732
2	A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.
3	A. C. Müller and S. Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists. Sebastopol, CA, USA: O'Reilly Media, 2016

References	
1	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2019. ISBN: 978-1492032649
2	Python Machine Learning, 3rd ed. Birmingham, UK: Packt Publishing, 2019. ISBN: 978-1789955750

Useful Links	
1	https://onlinecourses-archive.nptel.ac.in/noc18_cs26/preview
2	https://onlinecourses-archive.nptel.ac.in/noc18_cs27/preview
3	https://onlinecourses.nptel.ac.in/noc24_cs102/preview

CO-PO Mapping

	Programme Outcomes (PO)											**PSO**	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1		1				1	1	2	2	1
CO2	3	3	3	2	3	1		3	1	1	2	3	3
CO3	2	3	2	3	3		2	3	1	1	2	3	3

CO4	2	3	2	3	2				1	1	3	2	3

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates the starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

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AY 2026-27

Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class, Semester	Third Year | Semester V
Course Code	1AI352
Course Name	Database Management System Lab
Desired Requisites:	Basic Mathematics and Logic, Basic Programming Knowledge

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
	-	30	30	40	100
		Credits: 1			

Course Objectives

1.	To introduce the fundamental concepts of database systems, data models, and architecture for efficient data management.
2.	To develop skills in designing relational databases using ER modeling, normalization, and SQL for structured data handling.
3.	To understand transaction management, concurrency control, and recovery techniques for maintaining data consistency and reliability.
4.	To explore modern database technologies such as NoSQL, data warehousing, and distributed databases for handling large-scale and unstructured data in AI/ML applications..

Course Outcomes (LO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Understand and apply database fundamentals, including data models, relational algebra, and SQL.	III	Apply
CO2	Design efficient schemas using ER modeling, normalization, and constraints.	III	Apply
CO3	Implement transaction management, concurrency control, and recovery mechanisms.	III	Apply
CO4	Analyze modern database technologies like NoSQL and data warehousing for large-scale and AI-driven data.	IV	Analyse

List of Experiments / Lab Activities/Topics

List of Lab Assignments:

1. Implement relational database systems by applying SQL commands (DDL, DML, DCL), ER modelling, and integrity constraints for efficient database design and management.
2. Implement advanced SQL queries using joins, nested queries, views, aggregate functions, GROUP BY, and HAVING clauses.
3. Implement database normalization techniques up to BCNF for efficient database design.
4. Implement database programming concepts using triggers and stored procedures, and apply transaction management techniques to ensure ACID properties in database systems
5. Implement concurrency control mechanisms and log-based recovery techniques to maintain consistency and reliability in database systems.
6. Create an Inventory Management Database to maintain stock and supplier details. Implement user authentication and access privileges in DBMS.
7. Implement MongoDB database operations including installation, CRUD operations, document modelling, querying, aggregation, indexing, and management of embedded documents and collection relationships.
8. Integrate MongoDB with Python using PyMongo to perform database operations, manage AI/ML datasets, pre-process data, and develop real-world AI/ML applications, MongoDB CRUD Operations using Python MongoDB Connectivity with Node.js.
9. Design a MongoDB database to manage student records including personal details, course information, attendance, and examination marks. Perform CRUD operations and generate reports.
10. Develop a database for managing patient records, doctor details, appointments, prescriptions, and billing information using MongoDB collections.

Textbooks	
1	Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2	Fundamentals of Database Systems, Authors: Ramez Elmasri, Shamkant Navathe
3	Database Management Systems,Authors: Raghu Ramakrishnan, Johannes Gehrke
4	“MongoDB: The Definitive Guide” by Kristina Chodorow, O Reilly Publications
5	Rob J. Hyndman and George Athanasopoulos, Forecasting: Principles and Practice, 3rd Edition, OTexts, 2021.
6	Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 3rd Edition, O'Reilly Media, 2022.

References	
1	Connally T., Begg C., "Database Systems", 4th Edition, Pearson Education, 2002, ISBN 8178088614
2	NoSQL Distilled, Author Pramod J. Sadalage and Martin Fowler
3	● Kristina Chodorow, Michael Dierolf, “MongoDB: The Definitive Guide”, O Reilly Publications, ISBN: 978-1-449-34468-9
4	● Adam Fowler, “NoSQL For Dummies”, John Wiley & Sons, ISBN-1118905628
5	Avrim Blum, John Hopcroft, and Ravindran Kannan, Foundations of Data Science, 1st Edition, Cambridge University Press, 2020.

6	Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman, Mining of Massive Datasets, 3rd Edition, Cambridge University Press, 2020.

Useful Links	
1	https://nptel.ac.in/courses/106105175
2	https://nptel.ac.in/courses/106106220
3	https://nptel.ac.in/courses/106106093
4	https://nptel.ac.in/courses/106106095

CO-PO Mapping

	Programme Outcomes (PO)											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2	1		2							2	
CO2	3	3	3	2	2							3	2
CO3	3	2	3	3	3							3	3
CO4	2	2	2	2	3							3	3

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2026-27

Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class, Semester	Third Year | Semester V
Course Code	1AI353
Course Name	Data Science and Analytics Laboratory
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
	-	30	30	40	100
		Credits: 1			

Course Objectives

1.	To provide hands-on experience in the entire Data Analytics Lifecycle
2.	To develop proficiency in modern data visualization tools (Tableau, Power BI) and programming libraries.
3.	To impart rigorous statistical and mathematical foundations.
4.	To enable the design and optimization of predictive models.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	Lab Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Implement data-wrangling pipelines to clean, transform, and normalize heterogeneous datasets	III	Apply
CO2	Design interactive and insightful dashboards using BI tools.	VI	Create
CO3	Conduct formal statistical analysis and hypothesis testing.	IV	Analyse
CO4	Develop and tune machine learning models	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Lab Assignments:

Part A: Data Science (any 07 from Part A)

1. Using the Titanic Dataset, perform end-to-end data pre-processing. Handle missing values (e.g., age, cabin) using appropriate imputation strategies, detect outliers, and convert categorical variables using one-hot/label encoding. Create visualizations to explore relationships between variables such as passenger class, age, gender, and survival rates.
   https://www.kaggle.com/datasets/yasserh/titanic-dataset
2. Import the Retail Sales Dataset into Power BI. Use Power Query to clean data formats and handle null values. Build an interactive sales dashboard displaying:
   a. Total Sales and Total Units Sold (KPI Cards)
   b. Top 5 Products by Sales (Bar Chart)
   c. Sales by Region (Map Visualization)
   d. Monthly Sales Trend (Line Chart)
   e. Implement slicing and filtering capability for Product Category, Region, and Time Period. Create at least one calculated column and one custom DAX measure.

   https://www.kaggle.com/datasets/mohammadtalib786/retail-sales-dataset

3. Import the COVID-19 Global Dataset into Tableau. Map the geographical spread of cases, total deaths, and vaccination coverage across countries and continents. Leverage advanced visual tools such as custom dual-axis maps, trend lines, actions, and dashboard filters to build an interactive narrative.
https://www.kaggle.com/datasets/josephassaker/covid19-global-dataset

4. Using an academic or medical dataset (e.g., Student Performance or COVID-19 sample subsets):
   - **a.** Compute descriptive statistics measures (Mean, Median, Mode, Variance, and Standard Deviation).
   - **b.** Evaluate correlation matrix using Pearson (parametric) and Spearman Rank (non-parametric) formulations.
   - **c.** Formulate and execute hypothesis tests:
     - **I.** Run a T-Test to verify if a student's preparation courses changes score distributions significantly.
     - **II.** Run a Chi-Square Test of independence to evaluate correlation between categorical elements (e.g., Gender and Attrition/Survival status).

5. Using the Boston Housing Dataset or Uber Fares Dataset, develop a machine learning pipeline to predict continuous targets (House Price / Ride Fare).
   - **a.** Implement baseline Linear Regression and advanced Random Forest Regression algorithms via Scikit-learn.
   - **b.** Check for multi-collinearity using correlation matrices.
   - **c.** Evaluate performance metrics across models, comparing R^2, Mean Absolute Error (MAE), and Root Mean Squared Error (RMSE).

   https://www.kaggle.com/datasets/altavish/boston-housing-dataset

6. Develop an intelligent spam filtering classification model using the SpamBase Dataset. Implement a Logistic Regression and a Decision Tree Classifier. Generate and extract elements from the confusion matrix to evaluate metrics including Precision, Recall, Specificity, and F1-Score. Plot and contrast the AUC-ROC curves for both models to justify the optimal deployment candidate.
https://www.kaggle.com/datasets/colormap/spambase

7. Load a retail transaction or recommendation system dataset (e.g., transactional items or MovieLens Dataset high/low rating configurations). Implement the Apriori Algorithm and FP-Growth Architecture to extract frequent itemsets. Vary thresholds for Support, Confidence, and Lift to extract meaningful transactional associations. Compare execution time differences between Apriori and FP-Growth.
https://grouplens.org/datasets/movielens/

8. Build a textual parsing pipeline using Python (NLTK, SpaCy, or Scikit-learn). Ingest social media posts or product reviews dataset. Apply advanced cleaning: text normalization, removal of stopwords/punctuation, lemmatization, and tokenization. Construct feature matrix variants using TF-IDF formulations. Train a Naive Bayes classifier to run sentiment classification, evaluating performance with cross-validation.

9. Formulate an intervention pipeline to improve outcomes using an institutional student performance tracker or corporate performance metrics.
   - **a.** Complete Data Collection simulation, Outlier Removal, and Feature Engineering.
   - **b.** Implement an ensemble classifier and apply k-Fold Cross-Validation (k=5 or k=10) to prevent overfitting.
   - **c.** Run Hyperparameter Optimization via GridSearchCV or RandomizedSearchCV. Plot the Elbow Plot or validation curves where applicable.

10. Using a retail sales or energy consumption dataset, decompose the series into trend, seasonality, and residual components. Implement a moving-average/Naive baseline alongside Exponential Smoothing (Holt-Winters) or ARIMA. Evaluate forecasts using MAPE and RMSE, and plot actual vs. predicted values.
https://www.kaggle.com/datasets/robikscube/hourly-energy-consumption

Textbooks	
1	Rob J. Hyndman and George Athanasopoulos, Forecasting: Principles and Practice, 3rd Edition, OTexts, 2021.
2	Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 3rd Edition, O'Reilly Media, 2022.
3	Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, An Introduction to Statistical Learning: with Applications in Python, 1st Edition, Springer, 2023.
4	Allen B. Downey, Think Stats: Exploratory Data Analysis, 3rd Edition, O'Reilly Media / Green Tea Press, 2024.

References	
1	Avrim Blum, John Hopcroft, and Ravindran Kannan, Foundations of Data Science, 1st Edition, Cambridge University Press, 2020.
2	Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman, Mining of Massive Datasets, 3rd Edition, Cambridge University Press, 2020.
3	Rafael A. Irizarry, Introduction to Data Science: Data Analysis and Prediction Algorithms with Case Studies, 2nd Edition, CRC Press / Leanpub, 2024.
4	Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models, 3rd Edition, Stanford University (Online Manuscript), 2026.

Useful Links	
1	https://nptel.ac.in/courses/106105175
2	https://nptel.ac.in/courses/106106220
3	https://nptel.ac.in/courses/106106093

CO-PO Mapping

	Programme Outcomes (PO)											PSO	
	PO1	PO2	PO3	PO 4	PO5	PO 6	PO 7	PO8	PO9	PO1 0	PO1 1	PSO1	PSO2
CO1	2	2			3			1			1	2	2
CO2			2		3	1		2	3	2	2		1
CO3	3	3		3					2		1	2	2
CO4	2	3	3	3	3	1	1	2	2		2	3	3

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Walchand College of Engineering, Sangli

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Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class, Semester	Third Year | Semester V
Course Code	1VSAI345
Course Name	Mini Project
Desired Requisites:	Python Programming, Database Management Systems, Machine Learning Basics

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	6 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
	-	30	30	40	100
		Credits: 3			

Course Objectives

1	To identify industry-oriented, interdisciplinary, and socially relevant problems in the domain of Artificial Intelligence and Machine Learning.
2	To introduce AIML project management tools, modern technologies, frameworks, and deployment practices.
3	To emphasize the use of version control systems, collaborative development practices, and technical documentation for AIML projects.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Interpret and analyze AIML problem requirements to convert them into intelligent system specifications.	III	Applying
CO2	Analyze AIML system architecture and project modules to develop efficient and scalable solutions.	IV	Analyzing
CO3	Compare and evaluate the performance of developed AIML models with existing approaches for optimization and improved accuracy.	IV	Analyzing
CO4	Present the findings, outcomes, and innovations of the AIML project through technical reports and seminars.	VI	Creating

List of Experiments / Lab Activities/Topics

Mini Project Guidelines

Mini-project is to be carried out in a group of maximum 3 to 4 students. Each group will carry out a mini-project by developing any application software based on the following areas.

1. Identification and analysis of AIML based problem statements and dataset requirements.
2. Design and develop application based on DBMS, DS and ML.
3. Industry based problem / Sponsored application / Interdisciplinary application /socially useful application / Problem solving of previously learned complex concepts
4. Project group should achieve all the proposed objectives of the problem statement.
5. Literature survey of existing AIML models, algorithms, and intelligent systems.
6. Preparation of AIML project requirement specifications and workflow documentation.
7. Design of AIML system architecture, data pipeline, and model framework.
8. Development of intelligent applications using frontend, backend, and AI integration modules.
9. Implementation of Machine Learning / Deep Learning / Artificial Intelligence based solutions.
10. Use of Git and GitHub for collaborative development and version control of AI projects.
11. Use of project management and collaboration tools for AI project tracking.
12. Implementation of Continuous Integration and Continuous Deployment (CI/CD) practices for AIML applications.
13. Modern tools are to be studied in self-mode for effective project implementation, result analysis, and deployment.
14. Project will be evaluated continuously by the guide/panel as per assessment plan
15. Presentation and report should use standard templates provided by department

Project report (pre-defined template) should be prepared using Latex/Word and submitted along with link of online repository of project. Students should maintain a project log book containing weekly progress of the project.

Text Books	
1	Hofmann, Angelika H., "Scientific Writing and Communication: Papers, Proposals, and Presentations", Oxford Press, 3rd Edition, 2016.
2	Roger Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill.

References Books	
1	Marilyn Deegan, "Academic Book of the Future Project Report", AHRC & the British Library, 2017
2	Suvrit Sra, Sebastian Nowozin and Stephen Wright, "Optimization for Machine Learning", MIT Press

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc25_hs14/preview
2	https://nptel.ac.in/courses/109105115
3	https://www.youtube.com/watch?v=0oSDa2kf5I8

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO11**	**PSO1**	**PSO2**	**PO1**
CO1	1	3	3		3								2	1
CO2		2	2		3								2	2
CO3			3	3			3						3	2
CO4		2	1		2	1	3	3	2	2	3	3	3	2

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

SEM-VI

Walchand College of Engineering, Sangli
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AY 2026-27

Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class | Semester	Third Year | Semester VI
Course Code	1AI321
Course Name	Explainable AI
Desired Requisites:	Machine Learning

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	03 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
		Credits: 03			

Course Objectives

1	Understand concepts of Explainable Artificial Intelligence (XAI) and Learn interpretable machine learning techniques.
2	Apply model explanation methods such as SHAP and LIME.
3	Understand transfer learning concepts and architectures and Implement transfer learning using deep learning models.
4	Analyze fairness, transparency, and ethical issues in AI systems

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Descriptor**
CO1	Understand the fundamental concepts of Explainable AI, interpretability, transparency, and transfer learning techniques	II	Understand
CO2	Apply explainability methods such as LIME, SHAP, and feature importance techniques for machine learning models.	III	Apply
CO3	Analyze and evaluate pre-trained deep learning models using transfer learning approaches for real-world applications.	IV	Analyze
CO4	Design explainable and ethical AI solutions using transfer learning and visualization techniques such as Grad-CAM.	VI	Create

Module	**Module Contents**	**Hours**
I	**Introduction to Explainable AI** The Black Box Problem, Fundamentals of Explainable AI, Explainability vs. Interpretability Black-box vs. White-box Models, Intrinsic vs. Post-hoc Explainability, Global vs. Local Explainability, Model-specific vs. Model-agnostic Explainability, Interpretable Machine Learning Models, Need and Challenges of Explainability. **Case Study: Auditing an Automated HR Hiring System**	06

II	**Tools for Explaining Any Model** Feature Importance, Partial Dependence Plot (PDP), LIME (Local Interpretable Model-Agnostic Explanations), Shapley Values for Explainability (Conceptual Understanding), SHAP (SHapley Additive exPlanations), Interpretation of SHAP Visualizations (Summary Plot, Force Plot, Waterfall Plot), Counterfactual Explanations. **Case Study: JPMorgan Chase Loan Approvals & Customer Recourse**	07
III	**Explaining Deep Learning & Vision Models** Interpretability Challenges in Deep Neural Networks, Saliency Maps, Integrated Gradients, Grad-CAM, Concept-based Explainability (TCAV – Overview), Attention-based Explainability , Limitations of Deep Explainability Methods. **Case Study: Medical Diagnostics and Pneumonia Detection**	07
IV	**Basics of Transfer Learning** Introduction to Transfer Learning, Fundamentals of Transfer Learning (Source Domain, Target Domain, Source Task, and Target Task), Types of Transfer Learning (Inductive, Transductive, and Unsupervised), Transfer Learning Strategies (Feature Extraction, Fine-Tuning, and Full Model Training), Layer Freezing and Fine-Tuning, Negative Transfer. **Case Study: Crop Disease Detection using Transfer Learning**	06
V	**Model Hubs & Parameter-Efficient Tuning** Foundation Models (Pre-trained Vision and Language Models), Hugging Face Ecosystem, Zero-Shot Learning, Parameter-Efficient Fine-Tuning (PEFT), LoRA (Low-Rank Adaptation), Adapter Tuning, Prompt Tuning, Applications of Transfer Learning in Vision and NLP. **Case Study: Fine-tuning BERT for E-Commerce Customer Sentiment Analysis**	06
VI	**Domain Adaptation, Ethics & Robustness** Dataset Shift and Data Drift, Domain Adaptation, Adversarial Domain Adaptation (Overview), Bias and Fairness in AI, AI Model Auditing Catastrophic Forgetting, AI Ethics, Governance, and Future Trends. **Case Study: Autonomous Delivery Drones and Weather Shift Adaptation**	07

Textbooks	
1	C. Molnar, *Interpretable Machine Learning*, 2nd ed., Munich, Germany: Lulu.com, 2022.
2	Q. Yang, Y. Zhang, W. Dai, and S. J. Pan, Transfer Learning. Cambridge, U.K.: Cambridge University Press, 2020. doi: 10.1017/9781139061773..
3	D. Rothman, Hands-On Explainable AI (XAI) with Python: Interpret, visualize, explain, and integrate reliable AI for fair, secure, and trustworthy models. Birmingham, U.K.: Packt Publishing, 2020.
4	A. J. Simpson, Deep Learning Explainability Cookbook: Practical recipes to deploy visually interpretable and trustworthy AI. Birmingham, U.K.: Packt Publishing, 2023.
5	S. Ji, Applied Machine Learning Explainability Techniques: Make ML models explainable and trustworthy with LIME, SHAP, and Deep SHAP. Birmingham, U.K.: Packt Publishing, 2022.

References	
1	W. Bryant, Transfer Learning with R: Leveraging Pretrained Models for New Problems. Independently Published, 2026.
2	S. Miley, Explainable AI: Making Machine Intelligence Transparent, Trustworthy, and Understandable for Human Decision-Making. Independently Published, 2026.

3	A. Panwar, A. Jain, S. Mallik, A. Li, and K. Cengiz, Eds., Explainable AI in Clinical Practice: Methods, Applications, and Implementation. London, U.K.: Elsevier Science, 2026.
4	P. L. Mazzeo and A. Bruno, Eds., Transfer Learning: Unlocking the Power of Pretrained Models. New York, NY, USA: Springer Nature, 2026..
5	M. D. Tiwari, R. Dhanaraj, and S. Kadry, Eds., Explainable AI (XAI) for Sustainable Development: Trends and Applications. Boca Raton, FL, USA: CRC Press / Routledge, 2024.

Useful Links

1	https://nptel.ac.in/courses/106106472
2	https://nptel.ac.in/courses/106106224
3	https://nptel.ac.in/courses/106108840

CO-PO Mapping

	Programme Outcomes (PO)											PSO's	
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2			2			1				2	1
CO2	2	3	2	2	3			1				3	
CO3	2	3	3	3	3			1				2	3
CO4	2	3	3	2	3	2	1	3	1	1	2	3	3

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

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Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class, Semester	Third Year | Semester VI
Course Code	1AI322
Course Name	Deep Learning
Desired Requisites:	Linear Algebra, Vector Calculus, Probability Theory, Machine Learning

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
		Credits: 3			

Course Objectives

1	To understand the foundational architectures of neural networks and the mathematical mechanics of the backpropagation algorithm.
2	To apply various regularization and normalization techniques.
3	To evaluate the performance of specialized architectures like CNNs and RNNs, in complex environments.
4	To evaluate state-of-the-art models in object detection and generative AI.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Descriptor
CO1	Apply fundamental concepts of deep learning, including neural networks and backpropagation	III	Apply
CO2	Analyze deep neural network architectures using appropriate optimization and regularization techniques.	IV	Analyse
CO3	Implement convolutional and sequence models to solve real-world problems	III	Apply
CO4	Evaluate and utilize advanced deep learning techniques for AI applications.	V	Evaluate

Module	Module Contents	Hours
I	**Foundations of Neural Networks** Introduction to Neural Networks and Deep Learning, Perceptron, Activation Functions, Multi-layer Perceptron (MLP), Backpropagation, Deep Learning Architectures	06
II	**Regularization Techniques** Dataset Augmentation, Noise Robustness, Overfitting in Deep Networks, Classic Regularization, Early Stopping, Dropout, and Sparse Representations, Normalization, Ensemble Methods, Bagging, Model Averaging, Adversarial Training.	07

III	**Convolutional Neural Networks (CNNs)** Introduction, Convolution Operation, Kernels, Filters, Feature Maps, 2D Convolutions, Convolutional Layers, Activation Layers, Fully-connected Layers, Padding, Stride, Pooling Layers, CNN architecture design. ShallowNet, LeNet, MiniVGGNET, AlexNet, VGG 16-19, ResNet.	07
IV	**Sequence Modeling with RNNs** Sequence Data, Text Embedding's, Word2Vec, and GloVe, RNN Architecture, Recurrent Neurons, Backpropagation Through Time, Vanishing & Exploding Gradients, Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), Advanced Sequences, Bidirectional RNNs.	06
V	**Deep Learning-based Object Detection** Fundamentals of Object Detection, Bounding Boxes, Region-based CNNs, R-CNN, Fast R-CNN, and Faster R-CNN, Region Proposal Networks, Single Shot Detectors (SSD), YOLO (You Only Look Once), Architecture, Grid Cells, Real-time Detection Trade-Offs, Performance Metrics.	07
VI	**Generative Models and Emerging Trends** Language Modelling, Encoder - Decoder (seq2seq) Model, Attention Mechanism, Transformers, Ethical Considerations in Deep Learning (Deepfakes and Data Privacy), Energy Efficiency and Sustainability, State-of-the-art Case Studies / Applications.	06

Textbooks	
1	Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016
2	Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn & TensorFlow", O'REILLY, Dec 2017
3	Chollet, François, "Deep Learning with Python," 2nd Edition, Manning Publications, 2021, ISBN 978-1617296864.
4	Géron, Aurélien, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow," 3rd Edition, O'Reilly Media, 2022, ISBN 978-109812597.

References	
1	R. Rojas, "Neural networks: a systematic introduction". Springer Science and Business Media, 2013.
2	C. M. Bishop and N. M. Nasrabadi, "Pattern recognition and machine learning", vol. 4, no. 4. Springer, 2006. ISBN: 978-0387310732
3	J. Krohn, G. Beyleveld, and A. Bassens, "Deep learning illustrated: a visual, interactive guide to artificial intelligence". Addison-Wesley Professional, 2019. ISBN: 978-0135116692

Useful Links	
1	https://nptel.ac.in/courses/106106224
2	https://nptel.ac.in/courses/106106184
3	https://www.cse.iitm.ac.in/~miteshk/CS6910.html
4	https://lena-voita.github.io/nlp_course.html
5	https://www.coursera.org/specializations/deep-learning
6	Transformer: https://huggingface.co/course/chapter1/1?fw=pt

CO-PO Mapping													
	Programme Outcomes (PO)											PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1		2						1	2	2
CO2	3	3	2	2	2						2	2	3
CO3	2	2	3	2	3	1					2	3	3
CO4	2	3	2	3	3	2	1				3	3	3

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli
(Government Aided Autonomous Institute)

AY 2026-27

Course Information	
Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class, Semester	Third Year | Semester VI | Core Program Elective
Course Code	1AI323
Course Name	Computer Vision and Image Processing
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
		Credits: 2			

Course Objectives	
1	Understand fundamentals of image processing and computer vision.
2	Apply spatial and frequency domain image processing techniques.
3	Understand object detection, motion analysis, and 3D vision concepts.
4	Develop solutions for real-world computer vision applications.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Descriptor
CO1	Explain digital image fundamentals, color models, and geometric transformations.	II	Understand
CO2	Apply image enhancement, spatial filtering, and edge detection techniques for image analysis	III	Apply
CO3	Analyze images using frequency domain processing and segmentation methods	IV	Analyse
CO4	Explain object detection, motion analysis, and basic 3D vision concepts in computer vision applications	II	Understand

Module	Module Contents	Hours
I	**Foundations of Computer Vision and Imaging** Introduction to Computer Vision, Digital Image Fundamentals, Color Image Processing, Image Operations, Histogram Processing, Geometric Transformations,	05
II	**Visual Enhancement Methods** Image Enhancement Basics, Spatial Domain Filtering, Noise models and basic noise removal	04

III	**Transform Domain Processing and Edge Detection** Frequency Domain Concepts: Fourier Transform, DCT, DFT, Frequency spectrum (magnitude & phase), Frequency filtering: Low-pass, High-pass, Band-pass, Edge Detection	05
IV	**Segmentation Techniques** Thresholding (global, adaptive, Otsu), Region-based methods, Clustering Morphological operations, Shape representation & descriptors : Boundary Descriptors Region Descriptors	05
V	**Feature Extraction** Feature extraction concepts: Edge-based features, Corner detection (Harris, Shi-Tomasi) Texture analysis: Types of Texture, Statistical Texture Features, Frequency-Based Texture Analysis (Conceptual).	05
VI	**Advanced Computer Vision Applications** Object Detection Techniques: sliding window approach, region proposal methods. Motion Analysis, 3D Vision Basics, Applications of Computer Vision	04

Textbooks	
1	Digital Image Processing-Rafael C. Gonzalez and Richard E. Woods, 4th Edition, Pearson Education, 2018.
2	Computer Vision: Algorithms and Applications-Richard Szeliski, Springer, 2022.
3	Computer Vision: A Modern Approach-David A. Forsyth and Jean Ponce, 2nd Edition, Pearson,2011.

References	
1	A. Rosebrock, Deep Learning for Computer Vision with Python. PyImageSearch, 2023.
2	J. R. Parker, Algorithms for Image Processing and Computer Vision, 3rd ed. Indianapolis, IN, USA: Wiley, 2021.
3.	S. J. Prince, Computer Vision: Models, Learning, and Inference, 2nd ed. Cambridge, U.K.: Cambridge University Press, 2023..
4	G. Bradski and A. Kaehler, Learning OpenCV 4 Computer Vision with Python 3, Birmingham, U.K.: Packt Publishing, 2020.
5	D. Forsyth and J. Ponce, Computer Vision: A Modern Approach, 2nd ed. Boston, MA, USA: Pearson, 2015.

Useful Links	
1	https://nptel.ac.in/courses/106105216
2	https://nptel.ac.in/courses/108103174
3	https://nptel.ac.in/courses/106106224

CO-PO Mapping

	Programme Outcomes (PO)											**PSO**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2			2			3			1	2	1
CO2	3	3	2		3		2		1	2	1	3	2
CO3	3	3	2	2	3			2	1		1	3	3

CO4	2	3	3	2	3	1			1		1	3	3

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli
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AY 2025-26

Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class | Semester	Third Year | Semester VI
Course Code	1AI371
Course Name	Explainable AI Laboratory
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	LA 1	LA 2	ESE	Total
Tutorial		30	30	40	100
		Credits: 1			

Course Objectives

1	To understand the need and significance of explainability in machine learning models.
2	To apply model-agnostic techniques such as LIME and SHAP to interpret machine learning model predictions.
3	To implement explainability techniques for deep learning models using Saliency Maps and Grad-CAM.
4	To apply transfer learning and parameter-efficient fine-tuning techniques for image and text classification tasks.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Descriptor
CO1	Implement interpretable machine learning models and analyze feature importance to explain model predictions.	III	Apply
CO2	Apply and evaluate model-agnostic and deep learning explainability techniques (LIME, SHAP, Saliency Maps, Grad-CAM) to interpret model predictions.	IV	Analyze
CO3	Implement transfer learning using pretrained CNN architectures (MobileNetV2, ResNet50) for image classification tasks.	III	Apply
CO4	Apply parameter-efficient fine-tuning (PEFT/LoRA) and contrast transfer learning strategies based on accuracy, training time, and resource efficiency.	IV	Analyze

List of Experiments / Lab Activities/Topics

Part A: Explainable AI (XAI) (any Five from Part A)

1. **Implementation of Interpretable Machine Learning Models**
   Implement inherently interpretable models such as Linear Regression, Logistic Regression, and Decision Trees on a benchmark dataset, and analyze model coefficients and decision rules to understand how predictions are derived. Technology: Python, scikit-learn, pandas, matplotlib. (Module I)

2. **Feature Importance Analysis for Machine Learning Models**
   Train tree-based ensemble models (Random Forest, XGBoost) and compute feature importance using Gini importance and permutation importance. Compare the rankings and visualize the most influential features. Technology: Python, scikit-learn, XGBoost, matplotlib. (Module II)

3. **Local Model Explanation using LIME**
   Use LIME to generate local, instance-level explanations for predictions made by a black-box classifier, and visualize the contribution of individual features to a specific prediction. Technology: Python, LIME, scikit-learn. (Module II)

4. **Model Explainability using SHAP**
   Apply SHAP to compute Shapley values for a trained model and generate summary, force, and dependence plots to interpret both global and local feature contributions. Technology: Python, SHAP, scikit-learn. (Module II)

5. **Explainability for Deep Learning using Saliency Maps and Grad-CAM**
   Generate saliency maps and Grad-CAM visualizations for a pretrained MobileNetV2 image classifier to highlight the image regions most responsible for a prediction. Technology: Python, TensorFlow/Keras, OpenCV, MobileNetV2 (pretrained). (Module III)

6. **Comparative Analysis of Explainability Techniques**
   Consolidate and compare the explanations produced by feature importance, LIME, SHAP, and Grad-CAM (Experiments 2-5) on a common model/dataset, and discuss the consistency, strengths, and limitations of each technique. Technology: Python, pandas (synthesis of Exp. 2-5 outputs). (Module II, III)

Part B: Transfer Learning (any Five from Part B)

1. **Image Classification using Transfer Learning (Feature Extraction)**
   Use a pretrained MobileNetV2 as a fixed feature extractor by freezing its convolutional base and training a new classifier head on a custom image dataset. Technology: Python, TensorFlow/Keras, MobileNetV2. (Module IV)

2. **Feature Extraction vs Fine-Tuning: Accuracy and Time Comparison**
   Fine-tune the top layers of the MobileNetV2 model from Experiment 7 and compare the training time and accuracy against the pure feature-extraction approach. Technology: Python, TensorFlow/Keras, MobileNetV2. (Module IV)

3. **Transfer Learning using ResNet50 on the Flowers Dataset**
   Apply transfer learning using a pretrained ResNet50 model to classify images from the Flowers dataset, evaluating accuracy improvements over training from scratch. Technology: Python, TensorFlow/Keras, ResNet50. (Module V)

4. **Zero-Shot and One-Shot Text Classification using Pretrained Models**
   Use pretrained Hugging Face Transformer and Sentence-Transformer models to perform zero-shot and one-shot text classification without any task-specific training. Technology: Python, Hugging Face Transformers, Sentence-Transformers. (Module V)

5. **Parameter-Efficient Fine-Tuning (PEFT) using LoRA**
   Fine-tune a pretrained DistilBERT model on a downstream text classification task using Low-Rank Adaptation (LoRA), comparing performance and trainable-parameter count against full fine-tuning. Technology: Python, Hugging Face Transformers, PEFT, Datasets, DistilBERT. (Module V)

6. **Explainable Transfer Learning Pipeline: Fine-Tune, Predict, Explain**
   Build an end-to-end pipeline that reuses/fine-tunes the model from Experiment 7/8, generates predictions on new images, and produces Grad-CAM based explanations for those predictions. Technology: Python, TensorFlow/Keras, OpenCV (reuses Exp. 7/8 model). (Module IV, V)

Textbooks	
1	C. Molnar, Interpretable Machine Learning, 2nd ed., Munich, Germany: Lulu.com, 2022.
2	Q. Yang, Y. Zhang, W. Dai, and S. J. Pan, Transfer Learning. Cambridge, U.K.: Cambridge University Press, 2020. doi: 10.1017/9781139061773.
3	D. Rothman, Hands-On Explainable AI (XAI) with Python: Interpret, visualize, explain, and integrate reliable AI for fair, secure, and trustworthy models. Birmingham, U.K.: Packt Publishing, 2020.
4	A. J. Simpson, Deep Learning Explainability Cookbook: Practical recipes to deploy visually interpretable and trustworthy AI. Birmingham, U.K.: Packt Publishing, 2023.
5	S. Ji, Applied Machine Learning Explainability Techniques: Make ML models explainable and trustworthy with LIME, SHAP, and Deep SHAP. Birmingham, U.K.: Packt Publishing, 2022.

References	
1	W. Bryant, Transfer Learning with R: Leveraging Pretrained Models for New Problems. Independently Published, 2026.
2	S. Miley, Explainable AI: Making Machine Intelligence Transparent, Trustworthy, and Understandable for Human Decision-Making. Independently Published, 2026.
3	A. Panwar, A. Jain, S. Mallik, A. Li, and K. Cengiz, Eds., Explainable AI in Clinical Practice: Methods, Applications, and Implementation. London, U.K.: Elsevier Science, 2026.
4	P. L. Mazzeo and A. Bruno, Eds., Transfer Learning: Unlocking the Power of Pretrained Models. New York, NY, USA: Springer Nature, 2026.
5	M. D. Tiwari, R. Dhanaraj, and S. Kadry, Eds., Explainable AI (XAI) for Sustainable Development: Trends and Applications. Boca Raton, FL, USA: CRC Press / Routledge, 2024.

Useful Links	
1	https://nptel.ac.in/courses/106106472
2	https://nptel.ac.in/courses/106106224
3	https://nptel.ac.in/courses/106108840

CO-PO Mapping

	Programme Outcomes (PO)											PSO's	
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	2		3				1			3	1
CO2	2	3	2	3	3				1			3	2
CO3	3	2	3		3				1			3	2
CO4	2	3	3	3	3		1		1		1	3	3

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. (min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates the starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Walchand College of Engineering, Sangli

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AY 2026-27

Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class, Semester	Third Year | Semester VI
Course Code	1AI372
Course Name	Deep Learning Laboratory
Desired Requisites:	Machine Learning

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
	-	30	30	40	100
		Credits: 1			

Course Objectives

1.	To provide hands-on experience in implementing deep learning models using modern frameworks like TensorFlow and PyTorch.
2.	To develop the ability to design, train, and optimize neural network models.
3.	To apply deep learning techniques such as CNNs and sequence models to real-world datasets.
4.	To analyze model performance using appropriate evaluation metrics and improve results through tuning.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Implement fundamental deep learning models using frameworks like Tensor Flow/PyTorch.	III	Apply
CO2	Apply optimization and regularization techniques to improve model performance.	III	Apply
CO3	Design and develop CNN and sequence models for real-world datasets.	IV	Analyse
CO4	Evaluate deep learning models using appropriate metrics and interpret results.	V	Evaluate

List of Experiments / Lab Activities/Topics
List of Lab Assignments: 1. Demonstrate Python-based deep learning environment using TensorFlow or PyTorch, and perform basic tensor operations, matrix manipulations, and data visualization 2. Demonstrate a single-layer perceptron for binary classification on linearly separable data and measure its performance. 3. Build a Multi-Layer Perceptron (MLP) using back propagation for classification on a standard dataset (e.g., Iris/MNIST). 4. Apply different activation functions (ReLU, Sigmoid, Tanh) and loss functions on model convergence and accuracy. 5. Develop a neural network using different Gradient De scent variants (SGD, Mini-batch, Adam, RMSProp) and observe convergence behaviour. 6. Apply Dropout, Batch Normalization, and Early Stopping to control overfitting and measure model performance. 7. Design a Convolutional Neural Network for image data (e.g., MNIST/CIFAR-10) and visualize feature maps. 8. Examine a model (e.g., ResNet/VGG) for image classification and compare its performance with a custom CNN. 62 9. Analyse object detection using a YOLO model on images/videos and assess detection performance. 10. Design an auto encoder or GAN for image reconstruction or generation and assess output quality. **Activity:** Course Specific Mini Project.

Textbooks	
1	Good fellow, Y. Bengio, and A. Courville, “Deep learning” MIT press, 2016. ISBN 978 0262035613
2	Aggarwal, Charu C., “Neural Networks and Deep Learning: A Textbook,” 1st Edition, Springer, 2006, ISBN 978-3319944623.
3	Chollet, François, “Deep Learning with Python,” 2nd Edition, Manning Publications, 2021, ISBN 978-1617296864.
4	Géron, Aurélien, “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow,” 3rd Edition, O’Reilly Media, 2022, ISBN 978-109812597.

References	
1	R. Rojas, “Neural networks: a systematic introduction”. Springer Science and Business Media, 2013
2	C. M. Bishop and N. M. Nasrabadi, “Pattern recognition and machine learning”, vol. 4, no. 4. Springer, 2006. ISBN: 978-0387310732

3	J. Krohn, G. Beyleveld, and A. Bassens, “Deep learning illustrated: a visual, interactive guide to artificial intelligence”. Addison-Wesley Professional, 2019. ISBN: 978-0135116692

Useful Links	
1	https://nptel.ac.in/courses/106106224
2	https://nptel.ac.in/courses/106106184

CO-PO Mapping

	Programme Outcomes (PO)											PSO	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO 11**	**PSO 1**	**PSO 2**
CO1	3	2	1		2						2	2	
CO2	3	3	3	2	2						2	3	2
CO3	3	2	3	3	3				1	1	2	3	3
CO4	2	2	2	2	3				1	1	2	3	3

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Walchand College of Engineering, Sangli

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AY 2024-25

Course Information

Programme	B.Tech. (AIML)
Class, Semester	T.Year B. Tech., Sem VI
Course Code	1AI373
Course Name	Computer Vision and Image Processing Lab
Desired Requisites:	Python, Prolog Programming

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
	-	30	30	40	100
		Credits: 1			

Course Objectives

1.	To apply image enhancement, filtering, edge detection, and segmentation techniques for image analysis.
2.	To Implement feature extraction and object detection methods to solve basic computer vision problems
3.	To Develop simple computer vision applications using classical image processing and pre-trained deep learning models.
4.	To Analyze experimental results and interpret the performance of different computer vision techniques for real-world applications.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply image enhancement, filtering, edge detection, and segmentation techniques to analyze digital images	III	Apply
CO2	Implement feature extraction and object detection algorithms for solving computer vision tasks.	III	Apply
CO3	Develop simple computer vision applications using classical techniques and pre-trained deep learning models	IV	Analyze
CO4	Evaluate the performance of computer vision techniques and interpret experimental results for real-world applications.	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Lab Assignments:
Lab assignment must be implemented in Python/OpenCV

1. Implementation of Basic Image Operations.
2. Implementation of Image Enhancement and Histogram Processing Techniques.
3. Implementation of Image Filtering and Noise Removal Techniques.
4. Implementation of Edge Detection Techniques using Sobel, Prewitt, and Canny Operators.
5. Implementation of Frequency Domain Image Processing using Fourier Transform.
6. Implementation of Image Segmentation using Thresholding and Morphological Operations.
7. Implementation of Feature Extraction using Harris and Shi-Tomasi Corner Detection.
8. Implementation of Color-Based Object Detection using HSV Color Space.
9. Implementation of Object Detection using Haar Cascade Classifier.
10. Implementation of Motion Detection using Video Frames.

Mini-Project :- Development of a Mini Computer Vision Application (e.g., Face Detection, Number Plate Detection, Color Object Tracking, or Document Scanner).

Textbooks	
1	R. C. Gonzalez and R. E. Woods, Digital Image Processing, 4th ed. Hoboken, NJ, USA: Pearson, 2018.
2	*J. Howse and J. Minichino, Learning OpenCV 4 Computer Vision with Python, 3rd ed. Birmingham, U.K.: Packt Publishing, 2020.*
3	*R. Szeliski, Computer Vision: Algorithms and Applications, 2nd ed. Cham, Switzerland: Springer, 2022.*

References	
1	S. J. D. Prince, Computer Vision: Models, Learning, and Inference, 2nd ed. Cambridge, U.K.: Cambridge University Press, 2023.
2	M. Nixon and A. Aguado, Feature Extraction and Image Processing for Computer Vision, 4th ed. Cambridge, MA, USA: Academic Press, 2020.
3	A. Rosebrock, Deep Learning for Computer Vision with Python, 3rd ed. PyImageSearch, 2024.
4	D. Forsyth and J. Ponce, Computer Vision: A Modern Approach, 2nd ed. Boston, MA, USA: Pearson.

Useful Links	
1	https://nptel.ac.in/courses/108103174
2	https://nptel.ac.in/courses/106105216
3	https://nptel.ac.in/courses/117105079

CO-PO Mapping

	Programme Outcomes (PO)											**PSO**	
CO	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1		3	2		3							3	2
CO2			3		3	2						3	3

CO3				2	2			2		2		3	2
CO4		3	3		3	2	2	3		3		2	3

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates the starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

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AY 2026-27

Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class, Semester	Third Year | Semester VI
Course Code	1VSIA346
Course Name	Minor Project
Desired Requisites	Deep Learning, Adaptive AI

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	12 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
	-	30	30	40	100
		Credits: 6			

Course Objectives

1	To identify industry-oriented, interdisciplinary, and socially relevant problems in the domain of Artificial Intelligence and Machine Learning.
2	To introduce AI/ML project management tools, modern technologies, frameworks, and deployment practices.
3	To emphasize the use of version control systems, collaborative development practices, and technical documentation for AI/ML projects.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Interpret and analyze AI/ML problem requirements to convert them into intelligent system specifications.	III	Applying
CO2	Analyze AI/ML system architecture and project modules to develop efficient and scalable solutions.	IV	Analyzing
CO3	Compare and evaluate the performance of developed AI/ML models with existing approaches for optimization and improved accuracy.	IV	Analyzing
CO4	Present the findings, outcomes, and innovations of the AI/ML project through technical reports and seminars.	VI	Creating

List of Experiments / Lab Activities/Topics

Mini Project Guidelines

Mini-project is to be carried out in a group of maximum 3 to 4 students. Each group will carry out a mini-project by developing any application software based on the following areas.

1. Identification and analysis of AIML based problem statements and dataset requirements.
2. Design and develop application based on Emerging AI, Deep Learning and Optimization techniques.
3. Industry based problem / Sponsored application / Interdisciplinary application /socially useful application / Problem solving of previously learned complex concepts
4. Project group should achieve all the proposed objectives of the problem statement.
5. Literature survey of existing AIML models, algorithms, and intelligent systems.
6. Preparation of AIML project requirement specifications and workflow documentation.
7. Design of AIML system architecture, data pipeline, and model framework.
8. Development of intelligent applications using frontend, backend, and AI integration modules.
9. Implementation of Machine Learning / Deep Learning / Artificial Intelligence based solutions.
10. Use of Git and GitHub for collaborative development and version control of AI projects.
11. Use of project management and collaboration tools for AI project tracking.
12. Implementation of Continuous Integration and Continuous Deployment (CI/CD) practices for AIML applications.
13. Modern tools are to be studied in self-mode for effective project implementation, result analysis, and deployment.
14. Project will be evaluated continuously by the guide/panel as per assessment plan
15. Presentation and report should use standard templates provided by department

Project report (pre-defined template) should be prepared using Latex/Word and submitted along with link of online repository of project. Students should maintain a project log book containing weekly progress of the project.

Textbooks	
1	Hofmann, Angelika H., "Scientific Writing and Communication: Papers, Proposals, and Presentations", Oxford Press, 3rd Edition, 2016.
2	Roger Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill.

References	
1	Marilyn Deegan, "Academic Book of the Future Project Report", AHRC & the British Library, 2017
2	Suvrit Sra, Sebastian Nowozin and Stephen Wright, "Optimization for Machine Learning", MIT Press

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc25_hs14/preview
2	https://nptel.ac.in/courses/109105115
3	https://www.youtube.com/watch?v=0oSDa2kf5I8

CO-PO Mapping		
	Programme Outcomes (PO)	**PSO**

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PO1
CO1	1	3	3		3								2	1
CO2		2	2		3								2	2
CO3			3	3			3						3	2
CO4		2	1		2	1	3	3	2	2	3	3	3	2

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Walchand College of Engineering, Sangli
(Government Aided Autonomous Institute)

AY 2026-27

Course Information

Programme	B. Tech. (Artificial Intelligence and Machine Learning)
Class | Semester	Third Year | Semester VI
Course Code	1AI331
Course Name	Optimization for Machine Learning
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
		Credits: 2			

Course Objectives

1	To understand the core principles of optimization techniques.
2	To analyse the linear programming, to solve diverse computational problems.
3	To analyze the convergence, efficiency, and limitations of first-order, second-order, and non-smooth methods.
4	To optimize the machine learning paradigms.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Descriptor
CO1	Explain core concepts of convexity, duality, and optimality conditions in constrained environments.	II	Understand
CO2	Implement adaptive learning rate optimizers (Adam, AdamW, RMSprop) to ensure stable convergence in deep learning pipelines.	III	Apply
CO3	Analyze performance, stability, and convergence rates of deep learning and line search optimizers.	IV	Analyze
CO4	Apply metaheuristics and stochastic schemes for automated hyperparameter tuning in neural networks.	III	Apply

Module	Module Contents	Hours
I	**Foundations of Optimization and Convexity** Introduction to Optimization, Classification of Optimization Problems, Mathematical Fundamentals, Convex Geometry, Structural Role of Convexity, Non-Convex Landscape Intro, Saddle Points in Deep Networks, Flat vs Sharp Minima.	04
II	**Unconstrained and Linear Programming Methods** One Dimensional Optimization, Modern Line Search Frameworks, Linear Programing Problems (LPP), Real-world LPP Application, Conjugate Gradient, Trust-region Methods.	04

III	**Gradient-Based Optimization** First-Order Methods, Convergence Analysis, Second-Order Algorithms, Newton's Method, Quasi-Newton Frameworks, Quasi-Newton, Stochastic Gradient Descent, Mini-Batch Optimization, Adaptive Learning Rates, Adam Optimizer, AdamW and Weight Decay, Gradient Clipping, Learning Rate Schedules and Warmup	05
IV	**Constrained Optimization and Duality** Introduction to Constrained Spaces, Theory of Lagrange Multipliers, Karush-Kuhn-Tucker (KKT) Conditions, Lagrangian Duality Foundations, Hard-Margin SVM, Soft-Margin SVM, Kernel Trick	04
V	**Non-Smooth and Discrete Optimization** Non-Smooth Calculus, Optimization over Non-Differentiable Functions, Proximal Operator Theory, Proximal Gradient Method, Coordinate Descent (LASSO, Elastic Net), ADMM for Distributed ML	04
VI	**Advanced ML Applications and Metaheuristics** Empirical Risk Minimization (ERM), Bayesian Optimization for Hyperparameter Tuning, Gaussian Process Surrogates and Acquisition Functions, Hyperband and Successive Halving, Genetic Algorithms, Particle Swarm Optimization, Metaheuristics vs Bayesian Optimization, LoRA and Parameter-Efficient Fine-Tuning.	05

Textbooks	
1	Stephen Boyd and Lieven Vandenberghe, Convex Optimization, 1st Edition, Cambridge University Press (Author's Open Access Repository), 2004.
2	Mykel J. Kochenderfer and Tim A. Wheeler, Algorithms for Optimization, 1st Edition, MIT Press (Author's Open Access Edition), 2019.
3	Sébastien Bubeck, Theory of Convex Optimization for Machine Learning, 1st Edition, Foundations and Trends in Machine Learning (arXiv Open Archive), 2015.
4	Joaquim R. R. A. Martins and Andrew Ning, Engineering Design Optimization, 1st Edition, Cambridge University Press (Open Access Version), 2021.
5	David G. Luenberger and Yinyu Ye, Linear and Nonlinear Programming, 4th Edition, Springer (Stanford University Academic Archive), 2016.

References	
1	Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, 1st Edition, Cambridge University Press (Author's Open Access Edition), 2014.
2	Yurii Nesterov, Lectures on Convex Optimization, 2nd Edition, Springer (Academic Pre-print Repository), 2018.
3	David G. Luenberger, Optimization by Vector Space Methods, 1st Edition, John Wiley & Sons (Oregon State University Open Archive), 1969.
4	Jean-Yves Audibert, Sébastien Bubeck, and Rémi Munos, Optimization for Machine Learning, 1st Edition, Imagine/ENPC Open Text Repository, 2010.

Useful Links	
1	nptel.ac.in/courses/106106245
2	nptel.ac.in/courses/111104068
3	nptel.ac.in/courses/112101298
4	nptel.ac.in/courses/108104112

CO-PO Mapping

	Programme Outcomes (PO)											PSO's	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO 1**	**PSO 2**
CO1	3	2									1		2
CO2	3	2	2		3						2	3	3
CO3	3	3		3	2						2	2	3
CO4	2	3	3	2	3						3	3	3

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli (Government Aided Autonomous Institute)					
AY 2026-27					
Course Information					
Programme	B. Tech. (Artificial Intelligence and Machine Learning)				
Class | Semester	Third Year | Semester VI | Program Core Elective				
Course Code	1AI332				
Course Name	Cloud Native AI				
Desired Requisites:					

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
		Credits: 03			

Course Objectives	
1	To provide a comprehensive understanding of cloud infrastructure, virtualization, and the strategic migration.
2	To equip students with the skills to manage diverse data architectures.
3	To explore the AI services, AutoML, and containerization techniques for prototyping and scalable model deployment.
4	To examine cloud-native deployment strategies, security frameworks and privacy-preserving technologies in a cloud environment.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Descriptor
CO1	Explain cloud infrastructure and migration strategy.	2	Understand
CO2	Deploy scalable AI prototypes and managed services.	3	Apply
CO3	Analyze diverse data architectures and movement.	4	Analyze
CO4	Examine containerization and serverless architectures.	4	Analyze

Module	Module Contents	Hours
I	**Cloud Foundations for AI** Introduction, Need for Cloud in AIML, Characteristics, Seven-step migration of ML workloads, Service Models: IaaS, PaaS, SaaS, and AIaaS (AI-as-a-Service), Types of Cloud, Virtualization Basics.	07
II	**Cloud Data Management for AI** Cloud Data Storage, Object Storage, Databases for Predictions, AWS S3 (Object Storage), DynamoDB (NoSQL), and RDS; Data Movement using AWS Glue; Data Lake (AWS Lake Formation) vs. Data Warehouse (Amazon Redshift); Managing unstructured data for training.	07
III	**Managed AI Services & AutoML** Pre-trained Cloud APIs, Vision, NLP, and Speech, Simple API Calls, AutoML, Beyond Pre-trained, Drag-and-Drop Training, Rapid Prototyping, One-Click Deployment, Cloud Marketplace, Pre-built Solutions, Buy vs. Build, Deployment Governance.	06
IV	**Practical Containerization for AI Models** Docker Essentials, Dockerfile for AI, Image Management, Cloud Registries, Pushing and Pulling Images, Containers vs. Virtual Machines, Scaling AI Models.	06

V	**Model Deployment and Web Integration** Web Frameworks, FastAPI or Flask, Serverless Computing, Event-Driven Inference, Cloud Deployment, Self-Hosted vs. Managed Deployment, Deployment Best Practices.	06
VI	**Security, Privacy, and Risk in Cloud AI** AI Risk Management, Model IP Protection, Privacy Paradox, Membership Inference Attacks, Privacy-Preserving Tech., Differential Privacy, Federated Learning, Homomorphic Encryption, Digital Persona, Identity Security, Encryption & Secure API Testing, Cloud Encryption Standards, Secure Software Testing, AI Rest, Vulnerability Scanning, Fuzz Testing.	07

Textbooks

1	Thomas Erl, Cloud Computing: Concepts, Technology & Architecture, Pearson (Open Access via Archive), 1st Edition, 2013
2	James Turnbull, The Docker Book: Containerization is the new virtualization, Docker Press, 1st Edition, 2014
3	Kush R. Varshney, Trustworthy Machine Learning, IBM Research, 1st Edition, 2022
4	Zhang, Lipton, Li, Smola, Dive into Deep Learning (Cloud & Deployment Chapters), D2L.ai, 2nd Edition, 2023

References

1	Rajkumar Buyya, James Broberg, and Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, 1st Edition, Wiley, 2011.
2	Noah Gift, Pragmatic AI: An Introduction to Cloud-Based Machine Learning, 1st Edition, Pearson / Addison-Wesley Professional, 2018.
3	Brett McLaughlin, Cloud Migration For Dummies, Special Edition, John Wiley & Sons, 2020.
4	Packt Publishing (Collective Authorship), Docker for AIML, 1st Edition, Packt Publishing, 2025.
5	Somanath Tripathy, Harsh Kasyap, and Minghong Fang, Federated Learning: Security and Privacy, 1st Edition, CRC Press / Routledge, 2026.

Useful Links

1	https://nptel.ac.in/courses/106105167
2	https://nptel.ac.in/courses/106104182
3	https://nptel.ac.in/courses/106106238
4	https://nptel.ac.in/courses/106105223
5	https://nptel.ac.in/courses/106106146
6	https://nptel.ac.in/courses/106106248

CO-PO Mapping

	Programme Outcomes (PO)											PSO's	
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	2										1	1	2
CO2	3	2	2		3						2	2	3
CO3	2	3			2						1	2	2
CO4	2	2				3	2				1	1	2

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High
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Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)