



SRI VENKATESWARA UNIVERSITY

**4-Year UG Honours in B.Sc. (Artificial Intelligence) as Major in consonance
with Curriculum framework w.e.f. AY 2026-27**

COURSE STRUCTURE (for Semester IV)

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	IV	8	Data Science with R	3	3
			Data Science with R Lab	2	1
		9	Foundation of ML & Supervised Learning	3	3
			Foundation of ML & Supervised Learning lab	2	1
		10	Robotics Principles & Embedded systems	3	3
			Robotics Principles & Embedded systems Lab	2	1



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II Year Syllabus for 4-Year UG Honours in B.Sc. (Artificial Intelligence) as Major in consonance with the Curriculum framework w.e.f. AY 2026-27

II Year IV Semester

Sl. No.	Category	Course No.	Course Name	No. of Hours		Total No. of Hours	No. of Credits		Total No. of Credits
				Theory	Practical		Theory	Practical	
1	Major-Core	8	Data Science with R	3	2	5	3	1	4
2	Major-Core	9	Foundation of ML & Supervised Learning	3	2	5	3	1	4
3	Major-Core	10	Robotics Principles & Embedded systems	3	2	5	3	1	4
4	Minor	2		3	2	5	3	1	4
5	MDC	3		2	0	2	2	0	2
6	SEC	4	SEC: Design Thinking/Problem solving/ others	2	0	2	2	0	2
				16	8	24	16	4	20

SRI VENKATESWARA UNIVERSITY::TIRUPATI
B.Sc. Artificial Intelligence Honours
II year IV Semester
COURSE 9: FOUNDATION OF ML & SUPERVISED MACHINE LEARNING

Theory

Credits: 3

3 hrs/week

Course Objectives

- Provide a comprehensive understanding of supervised machine learning algorithms and their theoretical foundations.
- Enable students to formulate machine learning problems and implement algorithms in Python.
- Introduce fundamental learning theory concepts such as hypothesis, VC dimension, PAC learning, Find-S, and candidate elimination.
- Develop practical skills in model evaluation, tuning, and application to real-world datasets.
- Instill ethical awareness and explainability considerations in supervised learning.

Course Outcomes

On successful completion, students will be able to:

- Describe core supervised learning algorithms and their mathematical foundations.
- Implement and evaluate linear and nonlinear supervised learning models using Python.
- Apply learning theory fundamentals to analyze model complexity and generalization.
- Perform model selection, cross-validation, and hyper parameter tuning.
- Develop end-to-end supervised learning solutions for real-life problems.
- Uphold ethical standards and interpret model results critically.

Unit 1: Introduction to Supervised Machine Learning

What is Machine Learning & Supervised Machine Learning ? - Definitions

Machine learning pipeline: data collection, cleaning, splitting, feature selection Loss functions, cost functions, bias-variance tradeoff

Performance metrics: accuracy, precision, recall, F1 score, ROC-AUC

Introduction to Python libraries (scikit-learn, pandas, matplotlib) for ML

Learning Theory Fundamentals: Hypothesis and hypothesis space, Concept learning: types of concepts, Find-S algorithm, Candidate Elimination algorithm: overview and intuition, VC dimension, PAC (Probably Approximately Correct) learning

Unit 2: Linear Models for Regression and Classification

Introduction to regression problems and applications

Simple linear regression: theory, assumptions, ordinary least squares

Gradient Descent for training linear models,

Multiple and polynomial regression models

Regularization techniques: Ridge, Lasso, Elastic Net

Logistic regression: sigmoid function, decision boundary, training using gradient descent

Evaluation metrics: RMSE, MAE, R^2 , confusion matrix

Unit 3: Classification Algorithms

Concept of classification and categorical data, Decision Trees, Naive Bayes algorithm, Instance based learning, K-Nearest Neighbors (KNN), Support Vector Machines (SVM) with kernel tricks, Evaluation metrics: confusion matrix, ROC curves, cross-validation

Unit 4: Model Selection, Tuning, and Real-World Applications

Data preprocessing: imputation, scaling, encoding categorical variables, Feature engineering and selection techniques, Train-test split, k-fold cross-validation, Hyperparameter tuning: grid search, random search, Case studies in finance, healthcare, retail, Ethics and explainability in supervised learning

Unit 5: Ensemble Learning Methods

Bagging, boosting, stacking, Random Forests: theory, applications, feature importance, Gradient Boosting Machines (GBM), AdaBoost, XGBoost, Comparing ensembles versus single models Avoiding overfitting: cross-validation, hyperparameter tuning

Recommended Textbooks & References

Tom M. Mitchell, Machine Learning, McGraw Hill International Edition

Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer

Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly

Richard O. Duda, Peter E. Hart, David G. Stork, Pattern Classification, Wiley

Online: scikit-learn documentation, Coursera Machine Learning courses, Kaggle tutorials

Activities:

Unit 1: Introduction and Learning Theory Fundamentals

Activities:

- Lecture and discussion on ML fundamentals and pipeline
- Concept learning exercises: Hypothesis space, Find-S, Candidate Elimination
- Concept quizzes on VC Dimension and PAC Learning
- Python intro: Data loading and basic evaluation metrics

Outcomes:

- Understand ML basics and key learning theory concepts.
- Illustrate concept learning algorithms and hypothesis characterization.

Evaluation Method:

- Quiz on theory concepts: 8%
- Assignment on implementing Find-S algorithm: 7%

Unit 2: Linear Models for Regression and Classification

Activities:

- Coding lab: Linear regression and logistic regression models in Python
- Visualization of model fits and decision boundaries
- Experiment with gradient descent and regularization parameters

Outcomes:

- Implement and interpret linear regression and logistic regression.
- Explain optimization and regularization for generalization.

Evaluation Method:

- Practical lab report: 10%
- Coding assignment (regression/classification): 7%

Unit 3: Classification Algorithms

Activities:

- Implement KNN, Decision Trees, SVM, and Naive Bayes classifiers
- Performance evaluation via confusion matrix, ROC, and cross-validation
- Group discussion on algorithm strengths and weaknesses

Outcomes:

- Train and evaluate various classification algorithms.
- Select appropriate classifiers for varied contexts.

Evaluation Method:

- Lab submission and class presentation: 12%

Unit 4: Model Selection, Tuning, and Applications

Activities:

- Feature engineering workshop and data preprocessing in Python
- Hyperparameter tuning using GridSearch and RandomizedSearch
- Mini project based on real-world dataset with ethical evaluation
- Presentation and peer review of project findings

Outcomes:

- Master data preparation, model tuning, and performance assessment.
- Demonstrate a full ML pipeline with ethical considerations.

Evaluation Method:

- Mini project and presentation: 16%
- Final written exam: 20%

Unit 5: Ensemble Learning Methods

Activities:

- Ensemble methods lab: Random Forest, AdaBoost, and XGBoost implementation
- Hyperparameter tuning exercises and cross-validation applications
- Case study: Comparing ensemble vs base models

Outcomes:

- Develop ensemble models and understand boosting/bagging concepts.
- Apply model tuning to improve performance.

Evaluation Method:

- Practical lab and report: 10%

Recommended Textbooks & References

- Tom M. Mitchell, Machine Learning, McGraw Hill International Edition
- Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer
- Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly
- Richard O. Duda, Peter E. Hart, David G. Stork, Pattern Classification, Wiley
- Online: scikit-learn documentation, Coursera Machine Learning courses, Kaggle tutorials

SEMESTER-IV

COURSE 9: FOUNDATION OF ML & SUPERVISED MACHINE LEARNING

Practical

Credits: 1

2 hrs/week

Note: This lab has to be executed using interactive computing environments like Jupyter Notebook or Google Colab.

1. Data Loading, Exploration, and Preprocessing - Load datasets (e.g., Iris, Boston Housing) using pandas - Perform exploratory data analysis: summary statistics, visualization - Handle missing data, categorical encoding, feature scaling
2. Implement Simple Linear Regression - Fit linear regression to sample data - Visualize regression line and residuals - Compute evaluation metrics (RMSE, R^2)
3. Gradient Descent from Scratch - Implement gradient descent algorithm for linear regression - Experiment with learning rate and convergence
4. Logistic Regression for Classification - Train logistic regression model on binary classification dataset - Evaluate classification metrics: confusion matrix, accuracy, ROC curve
5. Decision Tree Classifier - Train decision tree on classification datasets - Visualize tree structure - Analyze feature importance and pruning effects
6. Naive Bayes Classifier - Train Naive Bayes on text or classification datasets - Performance comparison with other classifiers
7. K-Nearest Neighbors (KNN) Algorithm - Implement KNN classification using scikit-learn - Experiment with different values of k - Visualize decision boundaries
8. Support Vector Machine (SVM) Classifier
 - Train SVM with linear and RBF kernel - Understand margin and support vectors - Parameter tuning and performance evaluation
9. Model Evaluation and Hyperparameter Tuning - Perform train-test split and K-fold cross-validation - Use GridSearchCV or RandomizedSearchCV - Evaluate final model performance on unseen data
10. Random Forest and Ensemble Methods - Train Random Forest classifier - Understand bagging and feature randomness - Compare ensemble performance with base classifiers
11. Gradient Boosting Machine (GBM) - Train GBM model using popular libraries (XGBoost or sklearn) - Visualize feature importance

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II year IV Semester
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MODEL QUESTION PAPER

Time: 3 Hours

Max. Marks: 75

PART-A

Answer any **FIVE** of the following. Each Question Carries 3 marks.

(5X3=15)

- 1. Short answer question from unit-I**
- 2. Short answer question from unit-I**
- 3. Short answer question from unit-II**
- 4. Short answer question from unit-II**
- 5. Short answer question from unit-III**
- 6. Short answer question from unit-III**
- 7. Short answer question from unit-IV**
- 8. Short answer question from unit-IV**
- 9. Short answer question from unit-V**
- 10. Short answer question from unit-V**

PART-B

Answer **FIVE** of the following. Each Question Carries 12 marks.

(5X12=60)

- 11. a) Essay question from Unit-I**
OR
b) Essay question from Unit-I
- 12. a) Essay question from Unit-II**
OR
b) Essay question from Unit-II
- 13. a) Essay question from Unit-III**
OR
b) Essay question from Unit-III
- 14. a) Essay question from Unit-IV**
OR
b) Essay question from Unit-IV
- 15. a) Essay question from Unit-V**
OR
b) Essay question from Unit-V