# SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

## LECTURE PLAN FOR THE ODD SEMESTER OF THE ACADEMIC YEAR 2025 – 2026

| **Faculty** | **Mr. Keerthan Kumar T G** | **Dept.** | **Information Science and Engineering** |
|---|---|---|---|
| **Class** | **5th Semester (ISE) -F** | **Course** | **Artificial Intelligence and Machine Learning (S5ISI01)** |

| **Course Learning Objectives (CLOs): This course will make to student to:** | |
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| 1 | Understand fundamental concepts in Artificial Intelligence. |
| 2 | Explore basic principles of AI such as problem solving, searching, knowledge representation and learning. |
| 3 | Explain the role of agents in AI and structure of the agents. |
| 4 | Analyze and identify significant characteristics of data sets. |
| 5 | Understand and implement the training, testing, and validation phases of supervised and unsupervised learning algorithms. |

| **Course Code** | **Course Title** | **Teaching & Learning Scheme** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Classroom Instruction (CI) (in hrs / sem )** | | **Lab Instruction (LI) (in hrs / sem)** | **Self-Learning (SL) (in hrs / sem)** | **Term Work (TW) (in hrs / sem)** | **Assessment (hrs / sem)** | **Total no. of Hours per sem** | **Total Credits (C)* (Total Hours/30)** |
| | | **L** | **T** | **P** | **SL** | **TW** | **A** | | |
| **S5ISI01** | **Artificial Intelligence and Machine Learning** | **42** | **-** | **28** | **14** | **29** | **7** | **120** | **3** |

| **Sl. No.** | **Date** | **Topic** | **Remarks** |
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| | | **UNIT 1** | |
| 1. | 1/9/2025 | **INTRODUCTION:** What is AI? | |
| 2. | 1/9/2025 | Acting humanly: The Turing Test approach , Thinking humanly: The cognitive modelling approach, | |
| 3. | 2/9/2025 | Thinking rationally: The “laws of thought” approach, Acting rationally: The rational agent approach, | |
| 4. | 3/9/2025 | Revision of Previous Class Syllabus | SH |

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| 5. | 8/9/2025 | **INTELLIGENT AGENTS:** Agents and Environments, Rationality, Omniscience, learning, and autonomy, | |
| 6. | 8/9/2025 | the nature of Environments: Specifying the task environment, Properties of task environments, | |
| 7. | 9/9/2025 | The Structure of Agents; Agent programs, Simple reflex agents, Model-based reflex agents, Goal-based agents, Utility-based agents, Learning agents | |
| 8. | 15/9/2025 | Revision of Previous Class Syllabus | |
| 9. | 15/9/2025 | **SOLVING PROBLEMS BY SEARCHING:** Problem-solving agents; | |
| 10. | 10/9/2025 | Well-defined problems and solutions, Formulating problems, | |
| 11. | 16/9/2025 | Example problems; Toy problems, Real-world problems, | |
| 12. | 17/9/2025 | Revision of Previous Class Syllabus | |
| **UNIT II** | | | |
| 13. | 29/9/2025 | **SOLVING PROBLEMS BY SEARCHING (CONTD.)** Searching for solution; Infrastructure for search algorithms, | |
| 14. | 29/9/2025 | Measuring problem-solving performance, | |
| 15. | 30/9/2025 | Uninformed search strategies, Uniform-cost search, Depth-limited search, | |
| 16. | 1/10/2025 | Revision of Previous Class Syllabus | |
| 17. | 6/10/2025 | **ADVERSIAL SEARCH:** Games | |
| 18. | 6/10/2025 | Optimal Decisions in Games; | |
| 19. | 8/10/2025 | The minimax algorithm, | |
| 20. | 20/10/2025 | Revision of Previous Class Syllabus | |
| 21. | 21/10/2025 | **CONSTRAINT SATISFACTION PROBLEMS:** Defining Constraint satisfaction | |
| 22. | 27/10/2025 | Problems; Example problem: Map coloring. | |
| 23. | 27/10/2025 | Example problem: Job-shop scheduling, | |
| 24. | 28/10/2025 | Revision of Previous Class Syllabus | |
| **UNIT III** | | | |
| 25. | 29/10/2025 | **INTRODUCTION:** If Data had Mass, The Earth Would Be A Black Hole, Learning; Machine Learning, | |
| 26. | 3/11/2025 | Types of Machine Learning, Supervised Learning; Regression, Classification The Machine Learning Process | |
| 27. | 3/11/2025 | Revision of Previous Class Syllabus | |
| 28. | 4/11/2025 | **PRELIMINARIES:** Some Terminology; Weight Space | |
| 29. | 5/11/2025 | The Curse of Dimensionality, Knowing What You Know; | |
| 30. | 10/11/2025 | Overfitting, Training, Testing, and Validation Sets, | |
| 31. | 10/11/2025 | Revision of Previous Class Syllabus | |
| 32. | 11/11/2025 | The Confusion Matrix, Accuracy Metrics, The Receiver Operator Characteristic (ROC) Curve, | |

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| 33. | 12/11/2025 | Unbalanced Datasets, Measurement Precision,: Testing Machine Learning Algorithms, | |
| 34. | 17/11/2025 | Turning Data into Probabilities; Some Basic Statistics, | |
| 35. | 17/11/2025 | Revision of Previous Class Syllabus | |
| | | **UNIT IV** | |
| 36. | 18/11/2025 | **DIMENSIONALITY REDUCTION**: Linear Discriminant Analysis (LDA), | |
| 37. | 19/11/2025 | Principal Components Analysis (PCA), | |
| 38. | 24/11/2025 | Relation with the Multi-layer Perceptron, | |
| 39. | 24/11/2025 | Revision of Previous Class Syllabus | |
| 40. | 25/11/2025 | Kernel PCA, Methods Comparisons, | |
| 41. | 26/11/2025 | **LEARNING WITH TREES:** Using Decision Trees, | |
| 42. | 1/12/2025 | Constructing Decision Trees | |
| 43. | 1/12/2025 | Revision of Previous Class Syllabus | |
| 44. | 2/12/2025 | Classification and Regression Trees (CART); | |
| 45. | 3/12/2025 | Gini Impurity, Regression in Trees, Classification Examples and Problems. | |
| 46. | 8/12/2025 | Revision of Previous Class Syllabus | |
| | | **UNIT V** | |
| 47. | 8/12/2025 | **PROBABILISTIC LEARNING:** Nearest Neighbour Methods | |
| 48. | 8/12/2025 | k- Nearest Neighbour Algorithm and problem solving | |
| 49. | 9/12/2025 | **UNSUPERVISED LEARNING; CLUSTERING:** Introduction, | |
| 50. | 10/12/2025 | Hierarchical Clustering, and problem solving | |
| 51. | 10/12/2025 | Revision of Previous Class Syllabus | |
| 52. | 11/12/2025 | Agglomerative Clustering and problem solving | |
| 53. | 11/12/2025 | The single Linkage Algorithm, The complete linkage Algorithm, | |
| 54. | 12/12/2025 | The Average Linkage Algorithm, Partitional Clustering, Forgy's Algorithm, | |
| 55. | 12/12/2025 | The k-means Algorithm, Vector Quantization, The *K*-Means Algorithm, | |
| 56. | 13/12/2025 | Revision of Previous Class Syllabus | |

**Important Dates to be remembered:**

| Sl. No. | Important Events | Date |
|---|---|---|
| 1. | I – Test | $13^{th}$-$15^{th}$ Oct. 2025 |
| 2. | Last date for dropping of course | $21^{th}$ Oct. 2025 |
| 3. | ARAS for ISE students --Phase I | $22^{th}$-$24^{th}$ Sep. 2025 |
| 4. | ARAS for ISE students –Phase II | $13^{th}$-$15^{th}$ Nov. 2025 |
| 5. | II – Test | $27^{th}$ -$29^{th}$ Nov. 2025 |
| 6. | Last date for withdrawal of course | $1^{th}$ Dec. 2025 |
| 7. | Last working day | $13^{th}$ Dec. 2025 |
| 8. | Preparation Holidays | $14^{th}$ -$19^{th}$ Dec. 2025 |

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| 9. | Semester end examination | 20st -05nd Dec-Jan. 2026 |
| 10. | Announcement of results | 17th Jan. 2026 |

**Activities to meet Teaching Learning Scheme:**

| Sl. No. | Activity Planned | Number of Hours |
|---|---|---|
| 1. | Class Room Teaching | 42 |
| 2. | Lab Related Activities | 28 |
| 3. | Formative Assessment [Test (2 No.) +Quiz (2 No.) + Semester End Exam] | 07 |
| 4. | Student Study Hours—Self Learning | 14 |
| 5. | **Activity Based Learning:**<br>**I. Solving Real time Projects using AI and ML** (20 Hours)<br>1. Identifying areas in which students want to carry out the project by literature survey - 3 Hours.<br>2. Meeting and discussing (online or offline) with the faculty and fixing the problem statement- 2 Hours.<br>3. Designing and implementing the project - 14 Hours<br>4. Presentation and submitting the final report - 1 Hour.<br>**II. Solving Assignment Problems based on different ML algorithms** (9 Hours)<br>1. Submission of the final assignment report.<br>**Total:** | 20+9 = 29<br><br>120 |

**Text Books:**

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| 1. | Stuart J. Russell and Peter Norvig, Artificial Intelligence, A Modern Approach, 3rd Edition, Pearson India Education Services, 2015 (UNIT I and II). |
| 2. | Stephen Marsland, Machine Learning, An Algorithmic Perspective, 2nd Edition, CRC Press, 2015 (UNIT III, IV and V). |

**Reference Books:**

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|---|---|
| 1. | Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2009. |
| 2. | Christopher Bishop, Pattern Recognition and Machine Learning, CBS Publishers & Distributors- New Delhi. 2006 |
| 3. | Tom M Mitchell, Machine Learning, McGraw-Hill, Inc. New York, NY, USA. 2013 |

**Course Outcomes: Upon completion of this course, the student will be able to:**

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| **CO1** | **Identify** knowledge representation techniques and problem-solving strategies to common Artificial Intelligence (AI) applications. (L1) |
| **CO2** | **Discuss** the structure of the agents and different types of agents commonly used in AI. (L2) |
| **CO3** | **Differentiate** between machine learning algorithms based on learning criteria and parameter employed. (L2) |
| **CO4** | **Apply** and **illustrate** the significances of dimensionality reduction techniques for supervised and unsupervised problem solving. (L3) |
| **CO5** | **Design** applications to solve real world problems by **applying** machine learning algorithms such as classification, regression, and clustering. (L3) |

**Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)**

| Course outcomes | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 2 | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO3 | - | - | 3 | - | - | - | - | - | - | - | - | - | 3 | - | - |
| CO4 | - | - | 2 | 2 | - | - | - | - | - | - | - | - | 2 | - | - |
| CO5 | 2 | | 3 | | | | | | | | | | 3 | | |
| CO (Average) | 2 | 2 | 3 | 2 | - | - | - | - | - | - | - | - | 2 | - | - |

Degree of compliance **1**: Low **2**: Medium **3**: High

**Course delivery methods, assessment tools and sample questions:**

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| **CO1** | **Understand** and **Explore** knowledge representation techniques and problem-solving strategies to common Artificial Intelligence (AI) applications. |
| **Delivery Methods** | Blackboard Teaching, Group Activity |
| **Assessment Tools** | Tests and SEE |
| **Sample Questions** | 1. What are the various applications of AI? (L1)<br>2. What are agents? (L1)<br>3. What is an intelligent agent? (L1)<br>4. Describe the goal-based agent with an example. (L2) |

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| **CO2** | **Discuss** the structure of the agents and different types of agents commonly used in AI. |
| **Delivery Methods** | Blackboard Teaching, Group Activity, Power point Presentation |
| **Assessment Tools** | Tests and SEE |
| **Sample Questions** | 1. Discuss how an algorithm's performance is evaluated? (L2)<br>2. Explain informed Search Strategies. (L2)<br>3. Illustrate Map-Coloring Problem. (L2)<br>4. Discuss the variations in CSP formalism. (L2) |

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| **CO3** | **Differentiate** between machine learning algorithms based on learning criteria and parameter employed. |
| **Delivery Methods** | Blackboard Teaching, Power Point Presentation, Think-Pair-Share, |
| **Assessment Tools** | Tests and SEE, Assignment |
| **Sample Questions** | 1. Discuss different types of Machine learning algorithms? (L3)<br>2. Illustrate Bias/Variance Dilemma with Example. (L2)<br>3. Give any two suitable examples for supervised algorithms. (L1)<br>4. Illustrate the curse of dimensionality concept. (L3)<br>5. Describe the various metrics used for measuring performances of machine learning algorithms. (L2) |

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| **CO4** | **Apply** and **illustrate** the significances of dimensionality reduction techniques for supervised and unsupervised problem solving. |
| **Delivery Methods** | Blackboard Teaching, Think-pair-share, |
| **Assessment Tools** | Tests and SEE, Assignment |
| **Sample Questions** | 1. Mention the examples of nonlinear dimensionality reduction. (L1)<br>2. What is Principal Component Analysis? (L1)<br>3. Discuss the factors involved in choosing suitable smoothing model for an application. (L2)<br>4. Illustrate the Regression trees with suitable examples. (L2)<br>5. Explain PCA methodology. (L2) |

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| **CO5** | **Design** applications to solve real world problems by **applying** machine learning algorithms such as classification, regression, and clustering. |
| **Delivery Methods** | Blackboard Teaching, Power-point presentation |
| **Assessment Tools** | Tests and SEE, Assignment |
| **Sample Questions** | 1. Explain the geometry of Linear discriminant classes. (L1)<br>2. Explain the various types of clustering techniques. (L2)<br>3. Discuss the K-means clustering algorithm. (L3)<br>4. Illustrate the regression concept with suitable examples. (L2)<br>5. Differentiate between supervised and unsupervised classification algorithms. (L2) |

| **Sl. No.** | **Lab Programs /Topics Covered** |
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| 1. | Write two Python programs to calculate the factorial of a given number n using following approaches:<br>a) Iterative function<br>b) Recursive function |
| 2. | Write a Python function that checks whether a given integer is a prime number or not. |
| 3. | Write a function that takes two lists as input, merges them, and returns a new list with unique elements only, maintaining the original order of first occurrence. |
| 4. | Write a Python Program to perform the following searching functions:<br>a. Linear Search<br>b. Binary Search |
| 5. | Write three separate Python functions to perform the following operations on 2D matrices:<br>a) Addition<br>b) Subtraction<br>c) Transpose |

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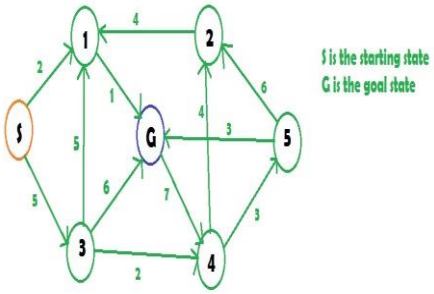
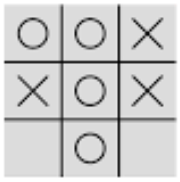
| 6 | Write a Python functions using **Pandas** to implement the following operations:<br>a) Create a DataFrame from a dictionary containing student names and their marks.<br>b) Add a new column for grades (e.g., A/B/C based on marks).<br>c) Filter out students with marks below 50.<br>d) Sort the DataFrame by marks in descending order. |
| 7 | Write a python program to implement the following Uninformed search algorithms:<br>a) Breadth First Search algorithm<br>b) Depth First Search Algorithm |
| 8 | You are given a road network where each road segment between two locations has an associated cost (e.g., time taken, distance travelled, or fuel consumption). You need to implement the Uniform Cost Search (UCS) algorithm to find the least-cost path from a starting location to a destination.<br>The road network is represented as a graph where:<br>• Nodes represent intersections or locations.<br>• Edges represent the road segments connecting those locations, and each edge has a cost associated with it (e.g., travel time or distance).<br>  |
| 9 | Write a python program to implement the Tic-Tac-Toe game and demonstrate the steps. Consider 3X3 board and minimum of two players.<br>  |
| 10 | Write a python program to implement Map coloring problem using either Constraint Satisfaction problem method or by applying Graph coloring algorithm. Also apply the same algorithm to the following Map and validate the answers.<br>a) Australian Map with three colors<br>  |
| 11 | Demonstrate the implementation of the supervised probability based naïve Bayesian classifier and demonstrate the performance of the model with clear interpretation of confusion matrices and other performance metrics. Use IRIS dataset for demonstration of the Model performance. |

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| 12 | Implement a Simple supervised Linear Regression model using the training data set. Assume the appropriate dependent and independent variables for regression analysis. Predict the scores on the test data. Print the MSE and R Squared Score (Coefficient of determination). Interpret the results. Consider Diabetes dataset downloaded from sklearn repository. |
| 13 | Implement a supervised Logistic Regression model using the training data set. Assume the appropriate dependent and independent variables for regression analysis. Predict the scores on the test data. The output should include Confusion Matrix, Accuracy, Error rate, Interpret the results. Consider an USER-DATA dataset downloaded from Kaggle repository. |
| 14 | Demonstrate the implementation of Linear discriminant analysis (LDA) technique for dimensionality reduction. Consider IRIS dataset from Kaggle repository. |
| 15 | Demonstrate the implementation of Principal component analysis (PCA) technique for dimensionality reduction. Consider IRIS dataset from Kaggle repository. |
| 16 | A telecommunications company is looking to predict customer churn (whether a customer will leave the service or not). Currently, the company has a huge dataset containing customer details, including their usage patterns, subscription plans, and support tickets. The company is struggling to identify the key factors contributing to churn, and therefore, struggles to take proactive measures to retain customers.<br>Use the ID3 (Iterative Dichotomiser 3) decision tree algorithm to predict whether a customer will churn or stay, based on features such as:<br>• Customer Age<br>• Subscription Plan<br>• Monthly Spend<br>• Number of Support Tickets<br>• Customer Satisfaction Score<br>Demonstrate the performance of the model. Interpret the significance of Entropy and Information gain on model performance. Plot the complete tree constructed. |
| 17 | A large shopping mall wants to better understand its customer base to improve business performance across its stores. Currently, all customers are treated the same regardless of their spending habits or demographics, leading to missed opportunities for personalized services and promotions. Use k-Means clustering to segment mall customers based on demographic and behavioural attributes such as age, annual income, and spending score. Also provide the distinct customer groups and provide insights for the Personalized marketing. |
| 18 | A weather forecasting company wants to enhance its predictive capabilities by categorizing weather conditions based on historical weather data. Currently, the company only provides general weather forecasts, but there is an opportunity to improve their predictions by identifying patterns in weather data that correspond to specific conditions (such as sunny, rainy, or cloudy). By classifying weather conditions, the company can provide more precise and targeted weather forecasts for different locations and times of day.<br>Use the k-Nearest Neighbors (k-NN) algorithm to classify weather conditions based on historical weather data. The goal is to predict weather conditions (such as Sunny, Rainy, Cloudy) for a given day, based on input features such as temperature, humidity, wind speed, and precipitation. |

Teacher
1/9/25

HOD
01/09/2025

Principal
1/9/2025