GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma in Engineering

Level: Diploma

Branch: Computer Engineering / Computer Science and Engineering

Subject Code : DI04000061

Subject Name: Introduction Machine Learning

W.E. F. Academic Year:	2025-26
Semester:	4th
Category of the Course:	Professional Elective - II

Prerequisite:	Familiarity with programming in Python, Mathematical and Statistics
Rationale:	Machine learning focuses on the use of data and algorithms to perform learning similar to the way human learns. To solve recent problems in Computer domain it is important to understand the need of machine learning and apply machine learning methods in efficient ways. Every student of Computer Engineering must therefore understand the blue prints of machine learning approaches and must be able to apply learning methods on available datasets. This course will help students to build up core competencies in understanding machine learning approaches and students will be prepared to apply ML techniques to real-world problems, pursue further study in artificial intelligence and data science, or contribute to innovation in data-driven industries.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Discuss the need for machine learning in solving real-world problems	Understand
02	Practice the Numpy, Pandas, Matplotlib, and sklearn libraries' inbuilt functions required to solve machine learning problems	Apply
03	Prepare machine leaning model and learning the evaluation methods	Apply
04	Apply supervised learning algorithms based on dataset characteristics	Apply
05	Apply unsupervised learning algorithms based on dataset characteristics	Apply

Revised Bloom's Taxonomy (RBT)

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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	**T**	**PR**	**C**	**ESE (E)**	**PA (M)**	**PA (I)**	**ESE (V)**	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Machine Learning** ● Overview of Human Learning and Machine Learning ● Types of Machine Learning: Supervised, Unsupervised, Reinforcement ● Benefits Machine Learning ● Challenges of Machine Learning ● Applications of Machine Learning ● Tools and Technology for Machine Learning	04	12
2.	**Python libraries for Machine Learning** **Numpy** ● Creating and Accessing Array: array(), zeros(), ones(), arange(), reshape() ● Stacking & Splitting: stack(), split() ● Maths Functions: add(), subtract(), multiply(), divide(), power(), sqrt(), ● Statistics Functions: mean(), median(), std(), var() **Pandas** ● Data structure: Series(), DataFrame() ● Manipulating Data: isnull(), sum(), min(), max() drop(), dropna(), duplicated() , loc[], head(), tail(), shape, columns, sort_values()	09	20

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	● Working with CSV File: read_csv(), to_csv() **Matplotlib** ● Functions: plot(), scatter(), bar(), hist(), boxplot() , pie(), title(), xlabel(), ylabel(), grid(), show(), savefig() **Scikit-learn** ● Key concepts and features ● Functions: load_*(), train_test_split()		
3.	**Preparing to Model and Evaluation** ● Machine Learning activities ● Types of data in Machine Learning: Numerical (quantitative) data, Categorical (qualitative) data ● Data quality and remediation ● Data Pre-Processing: Dimensionality reduction, Feature subset selection ● Selecting a Model: Predictive/Descriptive ● Training a Model for supervised learning: Holdout method, K-fold Cross-validation method ● Performance Evaluation of a model: confusion matrix ● Improving Performance of a model	10	22
4.	**Supervised Machine Learning** **Introduction to Supervised Learning** ● Brief explanation of Supervised Machine Learning ● Learning Steps in Supervised Machine Learning ● Real world Applications/Examples of Supervised Machine Learning ● Advantage and disadvantage of Supervised Machine Learning **Classification** ● Define Classification ● Types of classification: Binary, Multi-class ● k-Nearest Neighbor (kNN): Working of k-NN, Need of k-NN algorithm, Select value of k, advantage and disadvantage of k-NN algorithm	10	23

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	● Support Vector Machines: Fundamentals concept **Regression** ● Define Regression analysis ● List types of Regression ● Linear regression: List types of Linear Regression, mathematical equation of linear regression, diagram of linear regression line (positive, negative) ● Simple linear regression: Description, objective ● List real-world examples of regression analysis		
5.	**Unsupervised Machine Learning and Generative AI** **Introduction of Unsupervised Learning** ● Need of unsupervised learning ● Working of unsupervised learning ● Types of unsupervised learning: Clustering, Association rules ● Real-world examples of unsupervised Learning ● Supervised vs. Unsupervised Learning **Generative AI** ● Define Generative AI ● Working of Generative AI ● Applications of Generative AI ● Case Study: Simulate port-wide hydrogen adoption, and forecast emission reductions with Generative AI and Green Hydrogen.	12	23
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
32	**38**	**30**	**0**	**0**	**0**

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Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:
1. Machine Learning, Saikat Dull, S. Chjandramouli, Das, Pearson
2. Machine Learning with Python for Everyone, Mark E. Fenner, Pearson
3. Machine Learning, Anuradha Srinivasaraghavan, Vincy Joseph, Wiley
4. Machine Learning with Python, U Dinesh Kumar Manaranjan Pradhan, Wiley
5. Python Machine Learning, Sebastian Raschka, Vahid Mirjalili, Packt Publishing
6. Machine Learning, Mitchell T, McGraw-Hill, 1997
7. A first course in Machine Learning, S. Rogers and M. Girolami, CRC Press, 2011

(b) Open source software and website:
1. https://www.geeksforgeeks.org/machine-learning/
2. https://www.tutorialspoint.com/machine_learning_with_python/index.htm
3. Andrew Ng,"Machine Learning",Stanford University https://www.coursera.org/learn/machine-learning/home/info
4. Sudeshna Sarkar, "Introduction to Machine Learning", IIT Kharagpur.
   https://nptel.ac.in/courses/106105152/1
5. Prof. BalaramanRavindran,"Introduction to Machine Learning", IIT Madras.
   https://nptel.ac.in/courses/106106139/1
6. https://scikit-learn.org/
7. https://www.javatpoint.com/machine-learning
8. https://www.geeksforgeeks.org/artificial-intelligence/what-is-generative-ai/
9. https://bioenergytimes.com/deendayal-port-authority-commissions-indias-first-make-in-india-1-mw-green-hydrogen-plant-at-kandla/

Suggested Course Practical List:
1. Explore any one machine learning tool. (like Weka, Tensorflow, Scikit-learn, Colab, etc.)
2. Write a NumPy program to implement following operation

   ● to convert a list of numeric values into a one-dimensional NumPy array

   ● to create a 3x3 matrix with values ranging from 2 to 10

   ● to create another shape from an array without changing its data (3*2 to 2*3)

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- to split an array of 14 elements into 3 arrays, each with 2, 4, and 8 elements in the original order

- to stack arrays horizontally (column-wise)

3. Write a NumPy program to implement following operation

- to add, subtract, multiply, divide arguments element-wise

- to round elements of the array to the nearest integer

- to calculate the difference between neighboring elements, element-wise of a given array

4. Write a NumPy program to implement following operation

- to find the maximum and minimum value of a given flattened array

- to compute the mean, standard deviation, and variance of a given array along the second axis

5. Write a Pandas program to implement following operation

- to convert a NumPy array to a Pandas series

- to create the mean and standard deviation of the data of a given Series

- to sort a given Series

6. Write a Pandas program to implement following operation

- to create a dataframe from a dictionary and display it

- to sort the DataFrame first by 'name' in ascending order

- to delete the one specific column from the DataFrame

- to write a DataFrame to CSV file using tab separator

- to convert the first column of a DataFrame as a Series

7. Write a Pandas program to implement following operation

- to find and drop the missing values from the given dataset

- to remove the duplicates from the given dataset

- drop rows with any NaNs

8. Write a Pandas program to create a plot of Open, High, Low, Close, Adjusted Closing prices and Volume of given company between two specific dates.

9. Write a Python program to read csv file and using Scikit-learn to print the keys, number of rows-columns, shape, top 5 rows, feature names and the description of the given data.

10. Write a Python program that uses Scikit-learn to split a dataset into training and testing sets using train_test_split.

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11. Write a Python program to implement k-Nearest Neighbour supervised machine learning algorithm for given dataset.
12. Write a Python program to implement simple regression using Scikit-learn.
13. Prepare a case study on Unsupervised Machine Learning.
14. Explore any one Generative AI Model.
15. Simulate Green Hydrogen v/s Ammonia Fuel Requirement for Cargo Ships using necessary python libraries.

List of Laboratory/Learning Resources Required:

1. Computer with basic configuration with windows or Unix OS
2. Open Source: Anaconda Navigator
3. Python versions: 2.7.X, 3.6.X
4. Python IDEs and Code Editors (Jupyter Notebook, Spyder, Google Colab, PyCharm)

Suggested Activities for Students:

1. Mini Project on Machine Learning techniques with Real Data to understand how Machine learning works.
2. Encourage students to participate in different coding competitions like Hackathon, online competitions on code chef etc.
3. Students are encouraged to register themselves in various MOOCs such as: SWAYAM, edx, Coursera, Udemy etc. to further enhance their learning.
4. Prepare charts to explain use/process of the identified topic.
5. https://www.codechef.com/, in this website very elementary programs are available, students are expected to solve those programs
6. Encourage students to form a coding club at institute level.
7. https://code.org/, an hour of coding event may be organized and students are encouraged to participate.

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