Name of Faculty	:	Faculty of Engineering & Technology
Name of Program	:	Masters of Technology (M.Tech.) - Artificial Intelligence and Data science
Course Code	:	2MAI04
Course Title	:	Statistical Foundation for Machine Learning
Type of Course	:	Professional Core
Year of Introduction	:	2023-24

Prerequisite	:	Machine Learning, Probability Theory
Course Objective	:	Equip students with the ability to analyze and compare different statistical learning methods, interpret analysis results critically, and proficiently implement these methods for practical applications.
Course Outcomes	:	At the end of this course, students will be able to:
	CO1	Compare the fundamentals of various statistical learning methods
	CO2	Interpret and critically evaluate the outcomes of statistical analysis
	CO3	Implement statistical leaning methods

Teaching and Examination Scheme

Teaching Scheme (Contact Hours)			Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	SEE	CIA	SEE	CIA	
4	0	2	5	70	30	30	20	150

Legends: ***L****-Lecture;* ***T****–Tutorial/Teacher Guided Theory Practice;* ***P*** *– Practical,* ***C*** *– Credit,* ***SEE*** *– Semester End Examination,* ***CIA*** *- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.))*

Course Content

Unit No.	Topics	Teaching Hours	Weightage	Mapping with CO
1	**Introduction:** What is Statistical Learning?, Assessing Model Accuracy	05	10%	CO1
2	**Overview of supervised learning**: Introduction, Simple approaches to prediction, statistical decision theory, local methods in high dimensions, supervised	10	12%	CO1

	learning and function approximation, model selection and bias - variance trade-off			
3	**Linear method for regression and classification**: Linear regression models and least squares, subset selection, shrinkage methods, methods using derived input directories, computational considerations, linear discriminant analysis, logistic regression, separating hyperplanes, piecewise polynomials and splines, regularization, general linear modelling	08	16%	CO2
4	**Kernel smoothing methods:** One – Dimensional kernel smoothers, selecting the width of the kernel, local likelihood and other methods, kernel density estimation and classification, radial bias function and kernels, mixture models for density estimation and classification, computational consideration	10	20%	CO2
5	**Model assessment, Selection, Inference and Averaging**: Bias, Variance and model complexity, cross-validation, Bootstrap and bagging, EM Algorithm	10	15%	CO3
6	**Additive, Models, Trees, SVM and Nearest Neighbours:** Generalized additive models, Tree – based methods, Boosting Methods, Random Forests SVM and kernels, k- nearest neighbour classifiers, adaptive nearest neighbour methods	07	15%	CO3
7	**Unsupervised Learning:** K-means, self – Organizing maps, non – negative matrix, factorization, Independent component analysis	10	10%	CO3

Suggested Distribution of Theory Marks Using Bloom's Taxonomy						
Level	Remembrance	Understanding	Application	Analyse	Evaluate	Create
Weightage	**20**	**30**	**30**	**20**	**0**	**0**

NOTE: This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Suggested List of Experiments/Tutorials

Sr. No.	Name of Experiment/Tutorial	Teaching Hours
1	Demonstrate supervised learning and function approximation	04
2	Demonstrate linear discriminant analysis, logistic regression, separating hyper planes, piecewise polynomials and splines	04
3	Demonstrate any example of radial bias function and kernels	04
4	Demonstrate cross- validation	04
5	Demonstrate k- nearest neighbour classifiers	04
6	Demonstrate adaptive nearest neighbour methods	06

Major Equipment/ Instruments and Software Required

Sr. No.	Name of Major Equipment/ Instruments and Software
1	Python
2	Jupyter notebook

Suggested Learning Websites

Sr. No.	Name of Website
1	https://tivadardanka.com/blog/the-statistical-foundations-of-machine-learning
2	https://www.researchgate.net/publication/242692234_Statistical_foundations_of_machine_learning_the_handbook

Reference Books

Sr. No.	Name of Reference Books
1	Statistical learning from a regression perspective by Berk, R.A – Springer
2	Statistical in plain English by Urdan – Routledge
3	Introduction to Statistics with Python by Haslwanter T - Springer