



# GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3720223

Semester – II

Subject Name: Advance Machine Learning

Type of course: Regular

Prerequisite: Machine Learning, Probability Theory

**Rationale:** This course will introduce key concepts in pattern recognition and machine learning; including specific algorithms for classification, regression, clustering and probabilistic modeling. In summary, this course will provide a broad view of the general issues arising in the application of algorithms to analyzing data, common terms used, and common errors made if applied incorrectly.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	2	4	70	30	30	20	150

**Content:**

Sr. No.	Content	Total Hrs
1	<b>Key concepts</b> , Supervised/Unsupervised Learning, Loss functions and generalization, Probability Theory, Parametric vs Non-parametric methods, Elements of Computational Learning Theory Ensemble Learning, Bagging, Boosting, Random Forest	8
2	<b>Kernel Methods</b> for non-linear data, Support Vector Machines, Kernel Ridge Regression, Structure Kernels, Kernel PCA, Latent Semantic Analysis	8
3	<b>Bayesian methods</b> for using prior knowledge and data, Bayesian inference, Bayesian Belief Networks and Graphical models, Probabilistic Latent Semantic Analysis, The Expectation-Maximisation (EM) algorithm, Gaussian Processes	8
4	<b>Dimensionality Reduction</b> - CCA, LDA, ICA, NMF - Canonical Variates - Feature Selection vs Feature Extraction	10
5	<b>Filter Methods</b> - Sub-space approaches - Embedded methods Low-Rank approaches - Recommender Systems .Application areas - Security - Business - Scientific	9



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<b>6</b>	Recent trends in supervised and unsupervised learning algorithm, dimensional reducibility, feature selection and extraction	<b>5</b>
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## Reference Books:

1. Pattern Recognition and Machine Learning, Christopher M. Bishop
2. John Shawe-Taylor and Nello Cristianini, Kernel Methods for Pattern Analysis.
3. The Elements of Statistical Learning, Springer 2009
4. Machine Learning Algorithms, 2<sup>nd</sup> Edition, Giuseppe Bonaccorso, Packt Publication
5. TensorFlow Machine Learning, Nick McClure, Packt Publication

## Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Key concepts, tools and approaches for pattern recognition on complex data sets	20%
CO-2	Kernel methods for handling high dimensional and non-linear patterns	25%
CO-3	State-of-the-art algorithms such as Support Vector Machines and Bayesian networks.	25%
CO-4	Solve real-world machine learning tasks: from data to inference	15%
CO-5	Theoretical concepts and the motivations behind different learning frameworks	15%

## List of Experiments:

- Minimum 10 experiments based on the above contents.
- Mini Project in a group of max. 3 students
- Writing a research paper on selected topic from content with latest research issues in that topic

## Major Equipments:

- Latest PCs with related software

## List of Open Source Software/learning website:

- <https://www.analyticsvidhya.com/blog/2016/01/complete-tutorial-learn-data-science-python-scratch-2/>
- <https://www.springboard.com/resources/learning-paths/machine-learning-python>
- <https://www.rstudio.com/online-learning/>