COURSE STRUCTURE

Course Code	**COS3117B**			
Course Category	**Core**			
Course Title	**Introduction to Machine Learning**			
Teaching Scheme and Credits	**L**	**T**	**Laboratory**	**Credits**
Weekly load hrs.	**3**		**--**	**2**

Pre-requisites:

Basic knowledge of Linear algebra, probability and Statistics

Course Objectives:

1. Understanding various learning strategies
2. Mathematical representation of Machine learning problems and solutions

Course Outcomes:

Students will learn to

1. Use Machine learning using linear methods and non linear methods
2. Develop an appreciation for what is involved in learning models from data.
3. Understand a wide variety of learning algorithms.
4. Understand how to evaluate models generated from data.
5. Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Course Contents:

1. Introduction to Learning
2. Linear Regression
3. Classification
4. Neural Networks and Decision Tree
5. Unsupervised Learning
6. Support Vector Machines

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Mr Navanth Shete Assistant Professor Dept of Computer Science & Application	Ms Sheetal Rajapurkar Dept of Computer Science & Application	Prof. Dr. Shubhalaxmi Joshi BoS Chairperson & Associate Dean Dept of Computer Science & Application

Learning Resources:

Reference Books:

1. Introduction to Machine Learning (Second Edition): Ethem Alpaydın, The MIT Press (2010).
2. Pattern Recognition and Machine Learning: Christopher M. Bishop, Springer (2006)
3. Bayesian Reasoning and Machine Learning: David Barber, Cambridge University Press (2012)
4. Machine Learning, Tom Mitchell

Web Resources:

1. https://towardsdatascience.com/
2. https://github.com/josephmisiti/awesome-machine-learning.

Pedagogy:

Participative learning, discussions, experiential learning through practical problem solving, assignments, numerical solving, Tutorial.

Assessment Scheme:

Class Continuous Assessment (CCA): 60 marks

Mid Term Examination (MCQ Online Test /Direct Internal Examination	FAT 1 (Formative Assessment Test 1)	FAT 2 (Formative Assessment Test 1)	Total
30 Marks	15 Marks	15 Marks	60 Marks

Term End Examination : 40 marks

Syllabus

Module No.	Contents	Workload in Hrs		
		Theory	Lab	Assess
1	**Introduction to Learning :** Why Machine learning, Examples of Machine Learning, Problems, Structure of Learning. Supervised, Unsupervised and Reinforcement Learning.	3	-	-

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2	**Linear regression**: SSE; gradient descent; Simple Linear Regression, multiple linear regression Overfitting and underfitting; bias and variance, training, validation, test data	5	-	-
3	**Classification** : decision boundaries; nearest neighbor methods Probability and classification Linear classifiers: Bayes' Rule and Naive Bayes Model Logistic regression decision boundary (linear and non-linear), metrics for logistic regression (accuracy, sensitivity, specificity etcetera concepts), Receiver- operating characteristic (RoC) curve, use of RoC curve to find out optimum decision boundary	10	-	-
4	**Neural Networks & Decision tree:** Concept of neural networks, perceptron, decision tree, random forest	7	-	-
5	**Unsupervised learning:** clustering, k-means, hierarchical agglomeration, Dunn's index	2	-	-
6	**Support vector machines:** Concept of margin, support vectors and large-margin classifiers, kernel tricks	3		

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COURSE STR UCTURE

Course Code				
Course Category	**CORE**			
Course Title	Internet of Things			
Teaching Scheme and Credits	**L**	**T**	**Laboratory**	**Credits**
Weekly load hrs	**3**			**2**

Pre-requisites:

1. Knowledge of networking, sensing, databases, programming, and related technology.
2. Familiarity with business concepts and marketing.

Course Objectives:

1. Vision and Introduction to IoT.
2. Understand IoT Market perspective.
3. Data and Knowledge Management and use of Devices in IoT Technology.
4. Understand State of the Art – IoT Architecture.
5. Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Course Outcomes:

On completion of the course, student will be able to–

1. Students will understand IoT Market perspective.
2. Students will get Data and Knowledge Management and use of Devices in IoT Technology.
3. Students will understand State of the Art – IoT Architecture.
4. Students will get Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Course Contents:

M2M to IoT
M2M to IoT – A Market Perspective
M2M and IoT Technology Fundamentals
IoT Architecture-State of the Art
IoT Reference Architecture

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Learning Resources:

Reference Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.Data Warehousing in the Real World, Anahory, Murray, Pearson Education
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
3. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

Supplementary Reading:

1. Collaborative Internet of Things (C-IoT): For Future Smart Connected Life and Business
2. By Fawzi Behmann, Kwok Wu

Weblinks:

www.tutorialspoint.com

Pedagogy:

Participative learning, discussions, Problem Solving, experiential learning through practical problem solving, assignment, PowerPoint presentation

Assessment Scheme:

Class Continuous Assessment (CCA) 60 Marks

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Mid Term Examination (MCQ Online Test /Direct Internal Examination	FAT 1 (Formative Assessment Test 1)	FAT 2 (Formative Assessment Test 1)	Total
30 Marks	15 Marks	15 Marks	60 Marks

Term End Examination: 40 Marks

Syllabus:

Module No.	Contents	Workload in Hrs		
		Theory	*Lab*	*Assess*
1	**M2M to IoT** The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics	4		
2	**M2M to IoT – A Market Perspective** Introduction, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations	4		
3	**M2M and IoT Technology Fundamentals** Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management	7		
4	**IoT Architecture-State of the Art**	7		

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	Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, CICSO Reference Model			
5	**IoT Reference Architecture** Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control. Industrial Automation- Service-oriented architecture-based device integration,	8		

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Sign
(< Name >
<(Dean / Director / Principal)>

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COURSE STR UCTURE

Course Code				
Course Category	*B.Sc. Computer Science*			
Course Title	Theoretical Computer Science			
Teaching Scheme and Credits	**L**	**T**	**Laboratory**	**Credits**
Weekly load hrs	**3**			**2**

Pre-requisites:

1. Basic understanding of mathematical concepts

Course Objectives:

1. To understand concept of Regular languages and Finite Automata
2. To understand concepts of Context free languages and Pushdown Automata
3. To understand concepts of Turing Machine

Course Outcomes:

On completion of the course, student will be able to– functioning, capabilities, computability, complexity as well as the limitations of different mathematical models

Course Contents:

Introduction
Symbol, Alphabet, String, Prefix & Suffix of Strings
Regular Expression, Regular Language and Finite Automata
Regular expression: Definition & Example, Regular Expressions Identities.
Context Free Grammar and Languages
Grammar-Definition and Examples, Derivation, Reduction, Definition and Examples.
Push Down Automaton
Definition of PDA and examples, Construction of PDA using empty stack and final State method
Turing Machine
Model and Definition of TM, Design of Turing Machines

Learning Resources:

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Reference Books:

1. Introduction to Automata theory, Languages and computation By John E. Hopcroft and Jeffrey Ullman –Narosa Publishing House.
2. Theory of Computer Science (Automata, Language & Computation) K. L. P. Mishra & N. Chandrasekaran, PHI Second Edition
3. Introduction to Automata theory, Languages and computation By John Hopcroft, Rajeev Motwani and Jeffrey Ullman –Third edition Pearson Education

Pedagogy:

Participative learning, discussions, algorithm, Flowchart & Program writing, experiential learning through practical problem solving, assignment, PowerPoint presentation.

Assessment Scheme:

Class Continuous Assessment (CCA) 60 Marks

Mid Term Examination (MCQ Online Test /Direct Internal Examination	FAT 1 (Formative Assessment Test 1)	FAT 2 (Formative Assessment Test 1)	Total
30 Marks	15 Marks	15 Marks	60 Marks

Term End Examination : 40 Marks

Syllabus:

Module No.	Contents	Workload in Hrs		
		Theory	Lab	Assess

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1	**Unit 1: Introduction** Symbol, Alphabet, String, Prefix & Suffix of Strings, Formal Language, Operations on Languages.	1	-	-
2	**Unit 2: Regular Expression, Regular Language and Finite Automata** Regular expression: Definition & Example Regular Expressions Identities. Finite Automata Deterministic finite Automaton -Definition, DFA as language recognizer, DFA as a pattern recognizer. Nondeterministic finite automaton- Definition and Examples. NFA TO DFA NFA with ε-transitions- Definition and Examples. NFA with ε-Transitions to DFA & Examples Finite automaton with output-Mealy and Moore machine, Definition and Examples Minimization of DFA-Algorithm & Problem using Table Method. Regular Languages-Definition and Examples. Conversion of RE To FA-Examples. Pumping lemma for regular languages and applications. Closure properties of regular Languages (Union, Concatenation, Complement, Intersection and Kleene closure)	9	-	-
3	**Unit 3: Context Free Grammar and Languages** Grammar-Definition and Examples Derivation, Reduction, Definition and Examples. Chomsky Hierarchy. CFG- Definition & Examples. LMD, RMD, ,Parse Tree Ambiguous Grammar- Concept & Examples. Simplification of CFG : Removing Useless Symbols, Removing unit productions	8	-	-

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	Removing ϵ productions & Nullable symbols Normal Forms: Chomsky Normal Form (CNF) Method & Problem Greibach Normal form (GNF) Method & Problem Regular Grammar: Definition Left linear and Right Linear Grammar-Definition and Example. Equivalence of FA & Regular Grammar Construction of regular grammar equivalent to a given DFA Construction of a FA from the given right linear grammar Closure Properties of CFL's (Union, concatenation and Kleen closure) Method and examples			
4	**Unit 4: Push Down Automaton** Definition of PDA and examples Construction of PDA using empty stack and final State method : Examples using stack method Definition DPDA & NPDA Examples of DPDA & NPDA CFG (in GNF) to PDA : Method and examples	6	-	-
5	**Unit 5: Turing Machine** Model and Definition of TM Design of Turing Machines Problems on language recognizers. Language accepted by TM Types of Turing Machines Introduction to LBA (Basic Model) & CSG(Without Problems) Recursive Languages and Recursively enumerable Languages. Turing Machine Limitations	6	-	-

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COURSE STRUCTURE

Course Code				
Course Category	**Core Computer Science**			
Course Title	**Lab on ML**			
Teaching Scheme and Credits	**L**	**T**	**Laboratory**	**Credits**
Weekly load hrs.	**-**	**-**	**3**	**1**

Pre-requisites:

1. Knowledge of Python
2. Desirable: Knowledge of Jupyter Notebook, Scikit-Learn

CourseObjectives:

1. To implement Machine Learning algorithms in Python.
2. To use the algorithm to solve real life problems

Course Outcomes:

Student will be able to

1. Construct and implement Python codes for Machine learning algorithms.
2. Implement the Python codes on real life data.
3. Analyze and improve the performance of the Python codes for better solutions.

Course Contents:

1. Linear Regression
2. Classification
3. Neural Networks and Decision Tree
4. Unsupervised Learning
5. Support Vector Machines

Learning Resources:

Reference Books:

1. Introduction to Machine Learning with Python, Andreas C. Müller & Sarah Guido, O'reilly.
2. Hands-on Machine Learning with Scikit-Learn & TensorFlow, Aurélien Géron, O'reilly.
3.

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Data Resources:

1. https://www.kaggle.com/
2. https://github.com/

Weblinks:

1. https://www.tutorialspoint.com/android/index.htm
2. https://www.javatpoint.com/android-tutorial
3. https://www.tutorialspoint.com/ios/index.htm
4. https://www.raywenderlich.com/ios

Pedagogy:

1. Practical development of Python codes for Machine Learning algorithms
2. Analyzing and improving the performance of the Python codes using Scikit-Learn.
3. Implementing on real life data.
4. Participative learning, discussions, algorithm, programming concepts, experiential learning through practical problem solving, assignments, Tutorial

Assessment Scheme: (LCA & END TERM):

Laboratory Continuous Assessment (LCA): 60 marks

Mid Term Lab Test (MCQ Online Test /Direct Internal Examination	Lab Performance	Lab Assignment / Lab Book	Total
30 Marks	20 Marks	10 Marks	60 Marks

Term End Examination: 40 marks

Syllabus:

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Module	Lab Work	No. of Labs
1	Practice visualization using matplotlib, seaborn. Implement simple linear regression model on a standard data set and plot the least square regression fit. Comment on the result. [One may use inbuilt data sets like Boston, Auto etc]	02
2	Implement multiple regression model on a standard data set and plot the least square regression fit. Comment on the result. [One may use inbuilt data sets like Carseats, Boston etc].	02
3	Fit a classification model using following: (i) logistic regression (ii) k-nearest neighbour (iii) Naïve Bayes (iv) Decision tree (v) Perceptron on a standard data set and compares the results based on standard metrics. [Inbuilt datasets like Smarket, Weekly, Auto, Boston etc may be used for the purpose].	10
4	Implement clustering with the following: (i) K-means (ii) Hierarchical clustering On a standard data set like Iris, etc.	10
5	Implement SVM on a standard data set by selecting different kernels like RBF, Linear, Polynomial. Comment on result based on standard metrics.	06

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