INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

INFORMATION TECHNOLOGY

COURSE DESCRIPTOR

Course Title	**MACHINE LEARNING**				
Course Code	ACS014				
Programme	B. Tech				
Semester	VIII	CSE / IT			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Mrs. G Sulakshana, Assistant Professor				
Course Faculty	Mrs. G Sulakshana, Assistant Professor Mr. A Praveen, Assistant Professor Mrs. B Anupama, Assistant Professor				

I. COURSE OVERVIEW:

This covers the concepts of statistics and other advanced algorithms. The core of machine learning algorithms and theory used for learning performance are elaborated. Machine learning tools used to predict future trends and behaviors, allowing businesses to make proactive and knowledge- driven decisions. The course addresses the state-of-the-art machine learning techniques and how to apply them in business related problems. The first, and biggest, part of the course will focus on supervised learning through decision trees, and advanced techniques like neural networks, naive Bayes and support vector machines. In the second part, about Unsupervised learning techniques for extracting actionable patterns from data through clustering.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS010	II	Probability and Statistics	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
MACHINE LEARNING	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the Concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz –Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		**Strength**	**Proficiency assessed by**
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex Engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching	3	Assignment

Program Outcomes (POs)		Strength	Proficiency assessed by
	substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences		
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Assignment
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Mini projects

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.	2	Seminar
PSO 2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	-	-
PSO 3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.	1	Mini projects

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Apply knowledge of computing and mathematics appropriate to the discipline.
II	Illustrate the concepts of machine learning and related algorithms.
III	Understand the dimensionality problems using linear discriminants.
IV	Study various statistical models for analyzing the data.
V	Learn clustering algorithms for unlabeled data.

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand the concept of learning and candidate elimination algorithms	CLO 1	Understand the concept of learning and candidate elimination algorithms
		CLO 2	Explore on different types of learning and explore On tree based learning.
		CLO 3	Understand the construction process of decision trees used for classification problem.
		CLO 4	Understand the concept of perception and explore on forward and backward practices.
CO 2	Understand the	CLO 5	Illustrate on kernel concept and optimal separation used in support vector machines

COs	Course Outcome	CLOs	Course Learning Outcome
	concept of perception and explore on forward and backward practices	CLO 6	Explore on basic statistics like variance, covariance and averages
		CLO 7	Understand the concepts of Gaussian and bias-variance tradeoff
		CLO 8	Understand the concepts of Bayes theorem and Bayes optimal classifiers
CO 3	Explore on basic statistics like variance, covariance and averages	CLO 9	Explore on Bayesian networks and approximate inference on markov models
		CLO 10	Explore on Evolutionary learning techniques used in genetic algorithms
		CLO 11	Illustrate the ensemble learning approaches used in bagging and boosting
		CLO 12	Explain the importance of principal component analysis and its applications
CO 4	Explore on Evolutionary learning techniques used in genetic algorithms	CLO 13	Explore on similarity concept and different distance measures
		CLO 14	Understand the outlier concept and explain about data objects
		CLO 15	Understand the hierarchical algorithms and explain CART
		CLO 16	Understand the partitioned algorithms and explain segmentation
CO 5	Explore on similarity concept and different distance measures	CLO 17	Explore on clustering large database and explain K-means clustering algorithm
		CLO 18	Understand the clustering with categorical Attributes and comparison with other data types.
		CLO 19	Understand the clustering large databases and explain clustering methods
		CLO 20	Describe clustering with categorical attributes and explain KNN

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACS014.01	CLO 1	Understand the concept of learning and candidate elimination algorithms	PO1	3
ACS014.02	CLO 2	Explore on different types of learning and explore on tree based learning.	PO1	3
ACS014.03	CLO 3	Understand the construction process of decision trees used for classification problem.	PO1,PO2	3
ACS014.04	CLO 4	Understand the concept of perception and explore on forward and backward practices.	PO1,PO3	2
ACS014.05	CLO 5	Illustrate on kernel concept and optimal separation used in support vector machines	PO1,PO3, PO4	2
ACS014.06	CLO 6	Explore on basic statistics like variance, covariance and averages	PO1	3
ACS014.07	CLO 7	Understand the concepts of Gaussian and bias-variance tradeoff	PO1	3
ACS014.08	CLO 8	Understand the concepts of Bayes theorem and Bayes optimal classifiers	PO1,PO3	2
ACS014.09	CLO 9	Explore on Bayesian networks and approximate inference on markov models	PO2,PO3,PO4	2
ACS014.10	CLO 10	Explore on Evolutionary learning techniques used in genetic algorithms	PO1	3
ACS014.11	CLO 11	Illustrate the ensemble learning approaches used in bagging and boosting	PO2,PO3	2
ACS014.12	CLO 12	Explain the importance of principal component analysis and its applications	PO2	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACS014.13	CLO 13	Explore on similarity concept and different distance measures	PO1,PO2	2
ACS014.14	CLO 14	Understand the outlier concept and explain about data objects	PO2	3
ACS014.15	CLO 15	Understand the hierarchical algorithms and explain CART	PO2	2
ACS014.16	CLO 16	Understand the partitioned algorithms and explain segmentation	PO2, PO1	2
ACS014.17	CLO 17	Explore on clustering large database and explain K-means clustering algorithm	PO3, PO1,PO4	2
ACS014.18	CLO 18	Understand the clustering with categorical attributes and comparison with other data types.	PO1,PO2	2
ACS014.19	CLO 19	Understand the clustering large databases and explain clustering methods	PO2,PO3	2
ACS014.20	CLO 20	Describe clustering with categorical attributes and explain KNN	PO1,PO3	2

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XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes (COs)	Program Outcomes and Program Specific Outcomes						
	PO 1	PO 2	PO 3	PO 4	PSO1	PSO2	PSO3
CO1	3	2	2				
CO2	3		2	2	2		
CO3	3	2	2	2	2		
CO4	2	2	3		2		1
CO5	2	2	2	2	3		1

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XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3														
CLO 2	3														
CLO 3	3	3													
CLO 4	2		2												
CLO 5	2		2	2									2		
CLO 6	3														
CLO 7	3														
CLO 8	2		2												

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 9		2	2	2											
CLO 10	3												2		
CLO 11		2	2												
CLO 12		2													
CLO 13	2	2													
CLO 14		3													
CLO 15		2											2		1
CLO 16	2	2											2		1
CLO 17	2		2	2									2		1
CLO 18	2	2													
CLO 19		2	2										2		1
CLO 20	2		2										2		1

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XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2, PO 3, PO4, PSO 1	SEE Exams	PO 1,PO 2, PO 3, PO4	Assignments	PO 2,PO 3	Seminars	PSO1
Laboratory Practices	-	Student Viva	-	Mini Project	PO4, PSO3	Certification	-

XIV. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

Unit-I	TYPES OF MACHINE LEARNING
Concept learning: Introduction, version spaces and the candidate elimination algorithm; Learning with trees: Constructing decision trees, CART, classification example.	
Unit-II	**LINEAR DISCRIMINANTS**
Perceptron (MLP): Going forwards, backwards, MLP in practices, deriving back; Propagation support vector Machines: Optimal separation, kernels.	
Unit-III	**BASIC STATISTICS**
Averages, variance and covariance, the Gaussian; The bias-variance tradeoff Bayesian learning: Introduction, Bayes theorem, Bayes optimal classifier, naïve Bayes classifier. Graphical models: Bayesian networks, approximate inference, making Bayesian networks, hidden Markov models, the forward algorithm.	

Unit-IV	EVOLUTIONARY LEARNING
Genetic Algorithms, genetic operators; Genetic programming; Ensemble learning: Boosting, bagging; Dimensionality reduction: Linear discriminate analysis, principal component analysis (JAX-RPC).	
Unit-V	**CLUSTERING**
Similarity and distance measures, outliers, hierarchical methods, partitional algorithms, clustering large Databases, clustering with categorical attributes, comparison.	
Text Books:	
1. Tom M. Mitchell, "Machine Learning ", McGraw Hill, 1st Edition, 2013. 2. Stephen Marsland, "Machine Learning - An Algorithmic Perspective ", CRC Press, 1st Edition, 2009.	
Reference Books:	
1. Margaret H Dunham, "Data Mining", Pearson Edition, 2nd Edition, 2006. 2. Galit Shmueli, Nitin R Patel, Peter C Bruce, "Data Mining for Business Intelligence", John Wiley and Sons, 2nd Edition, 2007. 3. Rajjal Shinghal, "Pattern Recognition and Machine Learning", Springer-Verlag, New York, 1st Edition, 2006.	

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1 - 3	Introduction to Concept learning and version spaces representation	CLO1	T1 2.1: 2.3
4 - 7	Candidate elimination algorithm, Learning with trees	CLO1	T1 2.5: 3.2
8 - 9	Constructing decision trees	CLO2	T1 3.2: 3.7
10	CART, classification example	CLO3	T1 3.2: 3.7
11 - 14	Perception (MLP): Going forwards	CLO5	T2 4.3 : 4.4
15 - 16	Backwards, MLP in practices	CLO6	T2 4.6
17	Deriving back Propagation	CLO7	T2 4.6
18 - 20	Support vector Machines: Optimal separation, kernels	CLO8	T2 8.1 : 8.2
21 - 25	Averages, variance and covariance The Gaussian, The bias-variance tradeoff	CLO9	T2 2.4 : 2.5
26 - 29	Bayesian learning: Introduction, Bayes theorem Bayes optimal classifier, naïve Bayes classifier	CLO10	T1 6.2 : 6.9
30 - 35	Graphical models: Bayesian Networks, Approximate inference, Making Bayesian Networks, Hidden Markov models, the forward algorithm.	CLO12	T2 16.1 : 16.4
34 - 36	Genetic Algorithms genetic operators, Genetic programming	CLO13	T2 10.1 : 10.4
37 - 39	Ensemble learning: Boosting, bagging	CLO14	T2 13.1 : 13.2

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
40 - 45	Dimensionality reduction, Linear discriminate analysis, principal component analysis (JAX-RPC).	CLO15	T2 6.1 : 6.2
46 - 47	Similarity and distance measures	CLO16	R1 5.2
48 - 52	Outliers, hierarchical methods	CLO17	R1 5.3 : 5.4
53 - 56	Partitional algorithms, clustering large databases	CLO19	R1 5.5 : 5.6
57 - 60	Clustering with categorical attributes, comparison	CLO20	R1 5.7

XVII GAPS IN THE SYLLABUS-TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with po's	Relevance with PSOs
1	Service Provider Reliability in Cloud Computing	NPTEL	PO 1,PO 3	PSO 1,PSO 2
2	Vendor lock-in Cloud Computing	Assignment	PO 2,PO 3	PSO 1,PSO 2

Prepared by:

Mrs. G Sulakshana, Assistant Professor **HOD, CSE**