



Semester: V						
MATHEMATICAL ALGORITHMS FOR ARTIFICIAL INTELLIGENCE						
Category: Professional Core Elective (Theory)						
Course Code	:	AI255TBC		CIE	:	100 Marks
Credits: L: T: P	:	3:0:0		SEE	:	100 Marks
Total Hours	:	40L		SEE Duration	:	3.00 Hours

Unit-I	8Hrs
Matrix Computations: Recap of Vector Spaces and subspaces, basis and dimension, Subspaces associated with a linear transformation, Projections, LU Decomposition, Cholesky Decomposition, Eigen Decomposition, Real Symmetric Matrices, Singular value decomposition, Pseudo inverse	
Unit – II	8Hrs
Dimensionality Reduction Techniques: Subspaces with inner product, Orthonormal basis, Gram-Schmidt Orthonormalization, QR Factorization and least squares, Dimensionality reduction, Principal Component Analysis, Independent Component Analysis	
Unit –III	8Hrs
Statistical Techniques: Least Mean Square Algorithm, Weighted least squares, Recursive least squares, Kalman Filter, Statistical version of Kalman Filter , Gaussian Mixture Models, Expectation Maximization Algorithm, Monte Carlo methods	
Unit -IV	8Hrs
Vector Calculus and Matrix Differentiation - Partial derivatives and Gradients, Directional derivatives, Jacobian, Hessian, Gradients of vector valued functions, Matrix Derivatives - Ax , $AT Ax$, Trace, Norm	
Unit -V	8Hrs
Optimization - Maxima, Minima, Notion of objective/cost functions, Least Squares solutions and pseudo inverse, Curve fitting through least squares, Gradient Descent algorithm, Constrained Optimization and Lagrangian Multipliers	

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyse the working of AI solutions at their core
CO2	Optimize AI solutions and also justify mathematically the choice of algorithm chosen
CO3	Identify the areas for innovation and research, and contribute to the development of new AI techniques
CO4	Develop more reliable AI solutions by incorporating various Mathematical concepts

Reference Books	
1	Mathematical Methods and Algorithms for Signal Processing, Todd Moon and Striling, Prentice Hall, 2000. ISBN, 0201361868 ...
2	Mathematics for Machine Learning, Deisenroth, Cambridge university Press, 2019, ISBN: 9781108470049
3	Matrix Computations ,Golub, 4th Edition,TRIM Series, Hindustan Book Agencies,ISBN: 9789380250755, 9380250754
4	Essential Math ,Alby Hala Nelson, O'Reilly Media, Inc.ISBN: 9781098107635



RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	QUIZZES: Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.	20
2.	TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks , adding upto 100 Marks. FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.	40
3.	EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS.	40
MAXIMUM MARKS FOR THE CIE THEORY		100

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	CONTENTS	MARKS
PART A		
1	Objective type questions covering entire syllabus	20
PART B (Maximum of TWO Sub-divisions only)		
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
TOTAL		100