Course Code	18AIE339T	Course Name	Matrix Theory for Artificial Intelligence	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Artificial Intelligence*	Data Book/Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*		Learning		Program Learning Outcomes(PLO)

Course Objective:	*The purpose of learning this course is to:*
1	*Understand the basic concepts of linear algebra through computer science and Engineering applications*
2	*Learn the basic concepts of matrix calculus*
3	*Perform matrix analysis for various optimization algorithms*
4	*Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering*
5	*Solve problems in computer vision using optimization algorithms with single and multi-variables for large datasets*

		Learning			Program Learning Outcomes (PLO)														
		1-6			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CO-1:	*Solve the basic concepts of linear algebra through computer science and Engineering applications*	*3*	*70*	*75*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-	-
CO-2:	*Interpret the basic concepts of matrix calculus*	*3*	*70*	*75*	*3*	*2*	*2*	-	-	-	-	-	-	-	-	*3*	-	-	-
CO-3:	*Use various matrix analysis methods for solving optimization problems*	*4*	*70*	*75*	*3*	*2*	*2*	-	-	-	-	-	-	-	-	*3*	-	-	-
CO-4:	*Relate the basic concepts of inner product space, norm, angle, Orthogonality and projection and implementing the Gram- Schmidt process, to obtain least square solution and SV in engineering*	*4*	*70*	*75*	*3*	*2*	*2*	-	-	-	-	-	-	-	-	*3*	-	-	-
CO-5:	*Interpret the concept of multi-variable optimization techniques*	*3*	*70*	*75*	*3*	*2*	*2*	-	-	-	-	-	-	-	-	*3*	-	-	-

Duration(hour)		***Linear Systems***	***Matrix Calculus***	***Matrix Analysis***	***Matrix Solutions***	***Optimization***
S-1	SLO-1	*Linear Systems - IntroductiontoLinear Algebra*	*MatrixCalculus*	*Jacobian Matrix*	*GaussElimination*	*Basics of Optimization*
	SLO-2		*MatrixDecomposition*			
S-2	SLO-1	*LinearAlgebraandAI*	*Operation and Properties of Matrix(Identity -Diagonal-Transpose-Symmetric-Trace-Norms)*	*GradientMatrix*	*ConjugateGradientMethods*	*Univariate-Bivariate-Multivariate*
	SLO-2	*Examples of Linear AlgebrainAI*				
S-3	SLO-1	*From Fundamental System ofSolutionstoLinearSpace*	*Operation and Properties of Matrix(Rank-Inverse- Orthogonal - Range -Determinant))*	*RealMatrixDifferential*	*SingularValueDecomposition*	*ConvexObjectiveFunctions*
	SLO-2					
S4	SLO-1	*SystemofLinear Equations*	*CramersRule*	*ComplexGradientMatrices*	*LeastSquareMethod*	*MinutiaeofGradientDescent*
	SLO-2					

S-5	SLO-1	*Matrices*	*EigenvaluesandEigenVectors*	*Gradient of Complex variablefunction*	*GradientComputation*	*OptimizationinAI*
	SLO-2	*Solving Systems of LinearEquations*	*CholeskyDecomposition*			
S-6	SLO-1	*VectorSpaces*	*QRdecomposition*	*Gradient Method for smooth convexoptimization*	*GradientDescending*	*OptimizationinAI*
	SLO-2					
S-7	SLO-1	*Linear Independence - BasisandRank*	*LUdecomposition*	*Gradient Method for smooth convexoptimization*	*TikhonovRegularization*	*ApplicationsofMatrixinAI*
	SLO-2					
S-8	SLO-1	*LinearMapping*	*Eigen decomposition andDiagonalization*	*Non-smoothconvexoptimization*	*Gauss-Seidelmethod*	*ApplicationsofMatrixinAI*
	SLO-2					
S-9	SLO-1		*SingularvalueDecomposition*	*ConstrainedConvexOptimization*	*Application: Gradient Explosion andGradientVanishing*	*CaseStudy*
	SLO-2		*PCA*			
S-10	SLO-1		*MatrixApproximation*			
	SLO-2		*Matrixcalculus*			

Learning Resources

1. *Xian-DaZhang,AMatrixAlgebraApproachtoArtificialIntelligence,Springer,2021*
2. *Xian-DaZhang,MatrixAnalysisandApplications-CambridgeUniversityPress,2017*
3. *CharuC.Aggarwal,LinearAlgebraandOptimizationforMachineLearning,Springer,2020.*
4. *StephenBoyd,LievenVandenberghe,IntroductiontoAppliedLinearAlgebra-Vectors,Matrices,andLeastSquares,CambridgeUniversityPress,2018*
5. *LinearAlgebra-KennethHoffmanandRayKunze,PrenticeHallIndia,2013.*
6. *LinearAlgebra-CheneyandKincaid,JonesandBartlettlearning,2014*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	15%	-	15%	-		-	15%	-
Level 2	Understand	20%	-	25%	-	25%	-		-	20%	-
Level 3	Apply	25%	-	35%	-	20%	-	25%	-	35%	-
Level 4	Analyze	15%	-	15%	-	20%	-	30%	-	20%	-
Level 5	Evaluate		-		-	10%	-	25%	-		-
Level 6	Create	20%	-	10%	-	10%	-	20%	-	10%	-
	Total	100 %	-	100 %	-	100 %	-	100%	-	100%	-

#CLA–4canbefromanycombinationofthese:Assignments,Seminars,TechTalks,Mini-Projects,Case-Studies,Self-Study,MOOCs,Certifications,Conf.Paperetc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr.Marriappan Vaithilingam, Senior Director of Engineering, Freshworks	*Dr.Udendran,Dept.ofCSE.,Bharathidasan University,Tiruchirappalli*	Mr.C.Arun,Asst Prof, SRM Institute of Science and Technology