



Semester: V						
MACHINE LEARNING OPERATIONS						
Category: Professional Core (Theory)						
Course Code	:	AI254TA		CIE	:	100 Marks
Credits: L: T: P	:	3:1:0		SEE	:	100 Marks
Total Hours	:	45L+30T		SEE Duration	:	3.00 Hours
Unit-I						9Hrs.
What and Why : Why Now and Challenges: Defining MLOps and Its Challenges - MLOps to Mitigate Risk - MLOps for Scale. People of MLOps: Subject Matter Experts - Data Scientists - Data Engineers - Software Engineers – DevOps - Model Risk Manager/Auditor - Machine Learning Architect						
Unit – II						9Hrs.
Features of MLOps and Developing a Model: Key MLOps Features: A Primer on Machine Learning - Model Development - Productionalization and Deployment – Monitoring - Iteration and Life Cycle - Governance. Developing Models: What Is a Machine Learning Model? - Data Exploration - Feature Engineering and Selection – Experimentation - Evaluating and Comparing Models - Version Management and Reproducibility.						
Unit –III						9Hrs.
Preparation and Deployment of Production Preparing for Production: Runtime Environments - Model Risk Evaluation - Quality Assurance for Machine Learning - Quality Assurance for Machine Learning - Key Testing Considerations - Reproducibility and Auditability - Machine Learning Security - Model Risk Mitigation.						
Unit –IV						9 Hrs
Deploying to Production: CI/CD Pipelines - Building ML Artifacts - Deployment Strategies – Containerization - Scaling Deployments - Requirements and Challenges. Feedback Loop: How Often Should Models Be Retrained? - Understanding Model Degradation - Drift Detection in Practice - The Feedback Loop.						
Unit –V						9 Hrs
Model Governance – Who decides what governance organization needs – Matching governance with Risk Level – Current regulations driving MLOps governance – Key elements of responsible AI – Template of MLOps Governance Monitoring and Logging – Observability for Cloud MLOps - Introduction to Logging – Logging in Python – Monitoring and Observability						

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Identify and apply various ML-Ops techniques to deploy machine learning models for real-world problems.
CO2	Design, deploy and evaluate Machine Learning models, follow the operational practices to benefit society, science, and industry.
CO3	Use modern tools and techniques to organize ML model from development to production for real world problems
CO4	Demonstrate effective communication through team presentations and reports to analyse the impact of the standard MLOPs practices on industry and society.
CO5	Conduct performance evaluation, design, deploy models in accordance with the appropriate Governance for the benefit of the industry and society.



Reference Books	
1	Mark Treveil and the Dataiku Team- Introducing MLOps How to Scale Machine Learning in the Enterprise, O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472 , 1 st Edition ,2020,ISBN : 9781492083290
2	Noah Gift and Alfredo Deza, Practical MLOps, O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472 , 1 st Edition, 2021, ISBN: 9781098103019
3	David Sweenor, Steven Hillion, Dan Rope, Dev Kannabiran, Thomas Hill, Michael O'Connell, "MLOps: Operationalizing Data Science", O'Reilly Media, Inc., 1 st Edition , 2020, ISBN : 9781492074656
4	Emmanuel Raj, Engineering MLOps, Packt Publishing, 1 st Edition, 2021, ISBN : 9781800566323

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 50Marks , 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