Course Title	MACHINE LEARNING OPERATIONS				
Course Code	24AM6AEMLO	Credits	1	L-T-P	0-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	2	Total Lecture Hours	12		

1. **Data Ingestion and Pre-processing:**

   Create a pipeline for data ingestion from multiple sources. Perform data cleaning, transformation, and feature engineering.

2. **Model Training and Hyperparameter Tuning:**

   Implement a script to train a machine learning model.Use grid search or random search for hyperparameter tuning.

3. **Model Evaluation and Validation:**

Evaluate model performance using various metrics.Validate the model using cross-validation

techniques.

4. **Model Versioning and Management:**

   Implement model versioning using tools like DVC or MLflow. Manage different versions of models and track changes.

5. **Model Deployment:**

Deploy a trained model using a REST API with Flask or FastAPI.Containerize the

deployment using Docker.

6. **Automated Testing and CI/CD Pipeline:**

   Set up automated testing for the model and data pipeline. Implement a CI/CD pipeline using tools like Jenkins or GitHub Actions.

7. **Monitoring and Logging:**

   Implement monitoring for model performance in production. Set up logging for tracking predictions and errors.

8. **Data Drift and Model Retraining:**

Detect data drift and its impact on model performance. Automate model retraining when significant drift is detected.

9. **Orchestration with Workflow Management Tools:**

   Use tools like Apache Airflow or Kubeflow to orchestrate machine learning workflows. Schedule and manage different stages of the ML pipeline.

10. **Collaboration and Version Control with Git and GitOps:**

    Implement version control for code and model using Git. Utilize GitOps principles to automate deployment and manage infrastructure as code.

Text Books:

1. *Machine* Practical MLOps, by Noah Gift, Alfredo Deza, Released September 2021 Publisher(s): O'Reilly Media, Inc., ISBN: 978109810301

Reference Books:

1. Introducing MLOps, by Mark Treveil, Nicolas Omont, Clément Stenac, Kenji Lefevre, Du Phan, Joachim Zentici, Adrien Lavoillotte, Makoto Miyazaki, Lynn Heidmann, Released November 2020, Publisher(s): O'Reilly Media, Inc. ISBN: 9781492083290
2. ML Ops: Operationalizing Data Science, by David Sweenor, Dev Kannabiran, Thomas Hill, Steven Hillion, Dan Rope and Michael O'Connell, O'Reilly Media, 2021
3. Building Machine Learning Pipelines, by Hannes Hapke, Catherine Nelson, O'Reilly Publications, 2021

CO1: Comprehend the complete process from data preparation, model training, evaluation, and deployment to monitoring and maintenance.

CO2: Leverage MLOps principles and tools to efficiently scale, manage, and automate the deployment of machine learning models in production environments.

CO3: Acquire the skills to select the ideal MLOps stack and leverage Git and GitOps for efficient version control and seamless collaboration in machine learning initiatives.

CO – PO - PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**1**														
CO2		**1**													
CO3			**1**												

Massive Open Online Course (MOOC)

Sl. No	Course	Offered by	Course Link
1.	MLOps | Machine Learning Operations Specialization	Coursera	https://www.coursera.org/specializations/mlops-machine-learning-duke
2.	MLOps Fundamentals - Learn MLOps Concepts with Azure demo	Udemy	https://www.udemy.com/share/104whC/

Assessment Pattern:

Category		Score Split Up	Total
Continuous Internal Evaluation (CIE) Lab	CIE -1	20 M	**50M**
	CIE-2	30 M	
Semester End Examination (SEE)	100 M (50 % Weightage)		**50 M**
Total			**100 M**