



## COURSE DESCRIPTION FORM: CS-4085: MLOps

**INSTITUTION** FAST School of Computing, National University of Computer and Emerging Sciences, Islamabad Campus

**PROGRAM TO BE EVALUATED** BS-CS: Fall-2025

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### Course Description

<b>Course Code</b>	CS-4085														
<b>Course Title</b>	MLOps														
<b>Credit Hours</b>	3														
<b>Course Instructors</b>	Dr. Hammad Majeed														
<b>Grading Policy</b>	Absolute grading														
<b>Policy about missed assessment items in the course</b>	Retake of missed assessment items (other than sessional/ final exam) will not be held. Student who misses an assessment item (other than sessional / final exam) is awarded zero marks in that assessment item i.e. late submission will not be accepted. For missed sessional/ final exam, exam retake/ pretake application along with necessary evidence are required to be submitted to the department secretary. The examination assessment and retake committee decides the exam retake/ pretake cases.														
<b>Course Plagiarism Policy</b>	Plagiarism in project or sessional/ final exam will result in F grade in the course. Plagiarism in an assignment will result in zero marks in the whole assignments category. Use of Generative AI as an Coach is allowed. The copying the code from Gen AI based tools will result in zero marks.														
<b>Prerequisites by Course(s) or Topics</b>															
<b>Assessment Instruments with Weights</b> (homeworks, quizzes, sessional exams, final exam, assignments, etc.)	Assessment with the weight. <table border="1"><thead><tr><th>Assessment Type</th><th>Weight</th></tr></thead><tbody><tr><td>Assignments</td><td>20</td></tr><tr><td>Sessional Exams 1</td><td>10</td></tr><tr><td>Sessional Exams 2</td><td>10</td></tr><tr><td>Project</td><td>20</td></tr><tr><td>Final Exam</td><td>40</td></tr><tr><td></td><td></td></tr></tbody></table>	Assessment Type	Weight	Assignments	20	Sessional Exams 1	10	Sessional Exams 2	10	Project	20	Final Exam	40		
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<b>Course Coordinator</b>	Dr. Hammad Majeed														
<b>URL (if any)</b>															
<b>Course Catalog</b>	The course is o help professionals become certified MLOps Engineers and provide an														

<b>Description</b>	opportunity to build a career in the field. Our goal is to spread knowledge and help professionals learn the most critical skills in the MLOps sphere.																						
<b>Textbook</b>	<b>Practical MLOps: Operationalizing Machine Learning Models 1st Edition</b> by Noah Gift, Alfredo Deza																						
<b>Reference Material</b>																							
<b>Course Goals</b>	<p><b>A. Course Learning Outcomes (CLOs)</b></p> <p>After course completion, the students shall be able to:</p> <ol style="list-style-type: none"> <li>1. Manage ML infrastructure on the multi-cloud and on-premises environments</li> <li>2. Containerize ML applications</li> <li>3. Optimize and refactor machine learning code and understand data scientists' challenges</li> <li>4. Deploy CI/CD pipelines for machine learning workflow</li> <li>5. Orchestrate machine learning pipelines using Kubeflow</li> <li>6. Create data engineering pipelines using Airflow</li> <li>7. Deploy ML models in REST API using Flask and FastAPI</li> <li>8. Prototype end-to-end ML application with a modern stack</li> <li>9. Work with a team to tackle production problems in MLOps</li> </ol> <p><b>B. Program Learning Outcomes (PLOs)</b></p> <table border="1"> <tr> <td><b>PLO 1</b></td> <td>Computing Knowledge</td> <td>Apply knowledge of mathematics, natural sciences, and a computing specialization to the solution of complex problems.</td> </tr> <tr> <td><b>PLO 2</b></td> <td>Problem Analysis</td> <td>Identify, formulate, research literature, and analyze complex problems, reaching substantiated conclusions using first principles of mathematics, natural sciences, and computing sciences</td> </tr> <tr> <td><b>PLO 3</b></td> <td>Design/Develop Solutions</td> <td>Design solutions for complex computing problems and components, and processes that meet specified needs with consideration for public health and safety, cultural, social, and environmental considerations.</td> </tr> <tr> <td><b>PLO 4</b></td> <td>Investigation &amp; Experimentation</td> <td>Conduct investigation of complex computing problem knowledge and research based methods</td> </tr> <tr> <td><b>PLO 5</b></td> <td>Modern Tool Usage</td> <td>Create, select, and apply appropriate techniques, resources, and computing tools, including prediction and modelling for problems.</td> </tr> <tr> <td><b>PLO 6</b></td> <td>Society Responsibility</td> <td>Apply reasoning informed by contextual knowledge to identify safety, legal, and cultural issues relevant to context of problems.</td> </tr> <tr> <td><b>PLO 7</b></td> <td>Environment and Sustainability</td> <td>Understand and evaluate sustainability and impact of work in the solution of complex computing problems</td> </tr> </table>		<b>PLO 1</b>	Computing Knowledge	Apply knowledge of mathematics, natural sciences, and a computing specialization to the solution of complex problems.	<b>PLO 2</b>	Problem Analysis	Identify, formulate, research literature, and analyze complex problems, reaching substantiated conclusions using first principles of mathematics, natural sciences, and computing sciences	<b>PLO 3</b>	Design/Develop Solutions	Design solutions for complex computing problems and components, and processes that meet specified needs with consideration for public health and safety, cultural, social, and environmental considerations.	<b>PLO 4</b>	Investigation & Experimentation	Conduct investigation of complex computing problem knowledge and research based methods	<b>PLO 5</b>	Modern Tool Usage	Create, select, and apply appropriate techniques, resources, and computing tools, including prediction and modelling for problems.	<b>PLO 6</b>	Society Responsibility	Apply reasoning informed by contextual knowledge to identify safety, legal, and cultural issues relevant to context of problems.	<b>PLO 7</b>	Environment and Sustainability	Understand and evaluate sustainability and impact of work in the solution of complex computing problems
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	<b>PLO 8</b>	Ethics		Apply ethical principles and commit to professional ethics and norms of computing practice.								
	<b>PLO 9</b>	Individual and Team Work		Function effectively as an individual, and as a member of teams and in multi-disciplinary settings.								
	<b>PLO 10</b>	Communication		Communicate effectively on complex computing activities within the computing community and with society at large.								
	<b>PLO 11</b>	Project Management and Finance		Demonstrate knowledge and understanding of management and economic decision making and apply these to one's own team.								
	<b>PLO 12</b>	Life Long Learning		Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of changes.								

**C. Mapping of CLOs to PLOs**

(CLO: Course Learning Outcome, PLOs: Program Learning Outcomes)

		PLOs											
		1	2	3	4	5	6	7	8	9	10	11	12
CLOs	1			✓		✓				✓		✓	✓
	2					✓				✓		✓	✓
	3									✓		✓	✓
	4			✓		✓				✓	✓	✓	✓
	5			✓		✓				✓		✓	✓
	6				✓	✓				✓		✓	✓
	7	✓	✓	✓	✓	✓	✓			✓		✓	✓
	8	✓	✓	✓	✓	✓	✓			✓		✓	✓
	9	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓

<b>Topics covered in the course</b>  (assume 15-week instruction and 3 contact hours per week)	<b>Topics to be covered:</b>			
	List of Topics		No. of Weeks	Contact Hours
	<b>Introduction to MLOps</b>		<b>1</b>	<b>3</b>
	<b>Basics of Machine Learning and Data Science</b>		<b>1</b>	<b>3</b>
				<b>1,3</b>

	<b>Software Development for Machine Learning Apps</b>	1	3	1,3
	<b>Containerizing ML application</b>	1	3	2,7
	<b>Microservices and REST API for ML Deployment</b>	1	3	1,2
	<b>Container Orchestration and environment concepts</b>	1	3	2, 4
	<b>Continuous Delivery: CI/CD Pipelines</b>	2	6	4,5,6,7,8
	<b>Data Pipelines</b>	2	6	4,6
	<b>Automated ML Pipelines</b>	2	6	7,8,9
	<b>Capstone project</b>	3	9	7,8,9
		15	45	
<b>Programming Language for Assignments</b>	Python, YAML			
<b>Class Time Spent (in percentage)</b>	<b>Theory</b>	<b>Problem Analysis</b>	<b>Solution Design</b>	<b>Social and Ethical Issues</b>
	20	30	40	10
<b>Oral and Written Communications</b>	Every student is required to submit at least <u>5</u> written reports of typically <u>5</u> pages each and to make <u>1</u> oral presentation of typically <u>10</u> minutes' duration.			