The Hong Kong University of Science and Technology (Guangzhou)

UG Course Syllabus

Deep learning for Science and Engineering

DSAA 3074

3 Credits

Pre-requisites

Course Code / Public Exam	Course Title / Exam Subject and Level / Grade attained
DSAA 2011 or DSAA 2012 or AIAA 3111 AND	Machine Learning or Deep Learning or Introduction to Data Mining AND
DSAA 2085 or DSAA 2088	Discrete Mathematics or Mathematics for Data Science

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Course Description

Advances in machine learning and deep machine learning are continuously penetrating computational science and engineering. This course will introduce students to recent advances in data-driven scientific research based on deep learning techniques, enabling next-generation scientists and engineers to leverage deep learning in cross-disciplinary fields. Topics include but not limited to advanced deep neural network models, physics-informed neural networks (PINN), model discovery and prediction, uncertainty quantification, neural operators, and neural differential equations. Applications to diverse scientific and engineering computational tasks aided by deep learning methods will also be introduced.

This course is designed to be project-oriented. Students will be exposed to in-lab demonstrations, and implement taught methods to realistic project problems.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

	Course ILOs	**Nature of the learning outcomes** *(A - Knowledge/Content Related; B - Academic Skills/Competencies; C - Others)*
1	Explain the data-driven paradigm for scientific and engineering problems	A
2	Understand and implement basic deep learning methods	A,B
3	Understand and explain fundamentals of differential equations	A,B
4	Apply neural differential equations to solve computational problems effectively.	A,B

5	Apply the Physics-informed Neural Networks (PINN) to solve computational problems effectively.	A,B
6	Understand and implement neural operators	A, B
7	Apply deep learning techniques to various realistic problems	A, B

Weekly Schedule and Weekly ILOs

Week	Topics	Weekly ILOs
1	Course Introduction, overview of Neural Networks - I	ILO1, ILO2
2	Overview of Neural Networks - II	ILO2
3	Fundamentals of Differential Equations (ODE) - I	ILO3
4	Course Project I: in-lab lecture and data collection	ILO7
5	Neural differentiable equations	ILO4
6	Fundamentals of Differential Equations (PDE) - II	ILO3
7	Course Project II: in-lab lecture and data collection	ILO7
8	Physics-informed Neural Networks (PINN) - I	ILO5
9	Physics-informed Neural Networks (PINN) - II	ILO5
10	Course Project III: in-lab lecture and data collection	ILO7
11	Neural Operators	ILO6
12	Guest lectures: predicting complex weather systems with large models	ILO1, ILO7
13	Final project presentation	ILO7

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Written Assignment	35%	TBA
Final Project	40%	TBA
Final examination	25%	TBA

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs
Written Assignment	ILO1, ILO2, ILO3
Final Project	ILO4, ILO5, ILO6, ILO7
Final examination	ILO1, ILO2, ILO3

Grading Rubrics

Assessment Task	Rubrics for excellent in the task

Written assignment	Correctly answer questions (usually in Q&A with derivations in steps and calculations), if the final answers are not correct, we will check the key steps to give marks.
Final examination	Correctly answer questions (usually in choices and Q&A with derivations in steps and calculations), if the final answers are not correct, we will check the key steps to give marks.
Final Project	- Clearly and accurately solve the assigned project problems - High-quality and rigorous project report - Perform an outstanding presentation for the final project.

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	A+: final grade≥96; A: 96> final grade≥92; A-: 92>final grade≥88;
B	Good Performance	B+: 88> final grade≥84; B: 84>final grade≥80; B-: 80>final grade≥76;
C	Satisfactory Performance	C+: 76> final grade≥72; C: 72>final grade≥68; C-: 68>final grade≥64;
D	Marginal Pass	D: 64> final grade≥52;
F	Fail	F: 52≥ final grade;

Course AI Policy

In this course, students are permitted to use AI tools for their coursework and assignments. However, it is essential that whenever students utilize AI tools, they clearly indicate and acknowledge this in their work. This transparency is crucial to ensure academic integrity and proper credit for the use of such tools. Students should clearly mention in their submissions when AI tools have been employed, and provide relevant details on the purpose and outcomes of using these tools. This practice will help in maintaining honesty and clarity in the academic work produced by students.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include [specific details, e.g., strengths, areas for improvement]. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Late submission

If the submission is after the given deadline, 50% points will be deducted. If you submit after we return the graded assignments to students, 100% points will be deducted. Any reason, such as network issues, submitting the wrong assignment, or missing the deadline, will be deemed a late submission, and all submissions shall be subject to the time displayed on Canvas.

Required Texts and Materials

The teaching materials in this course are lecture notes, and associated demo codes.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST(GZ)'s Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Regulations for Academic Integrity and Student Conduct for the University's definition of plagiarism and ways to avoid cheating and plagiarism.