DSC6030: QUANTUM MACHINE LEARNING

Effective Term
Semester A 2026/27

Part I Course Overview

Course Title
Quantum Machine Learning

Subject Code
DSC - Data Science
Course Number
6030

Academic Unit
Data Science (DS)

College/School
College of Computing (CC)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
SDSC6030 Quantum Machine Learning

Exclusive Courses
Nil

Part II Course Details

Abstract
This course introduces fundamental concepts and practical techniques in quantum machine learning (QML), an interdisciplinary field bridging quantum computing and classical machine learning. By leveraging the computational

advantages of quantum systems - including superior runtime efficiency and scalability - QML promises novel solutions that may surpass classical approaches. This course begins with an introduction to the basics of quantum computing and classical machine learning, then explores major quantum machine learning frameworks. Both the methodology description and the theoretical analysis are presented for a comprehensive understanding, reinforced through hands-on projects demonstrating practical applications.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the fundamental principles of quantum computing and machine learning	20	x	x	
2	Describe the methodology of quantum machine learning	20	x	x	
3	Analyze and understand the behavior of quantum machine learning models with the tools of statistical learning	20	x	x	x
4	Apply quantum machine models to solve several problems	20		x	x
5	Use Python and PennyLane to implement quantum machine models on practical datasets	20		x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Students will participate in formal lectures to acquire a comprehensive understanding of quantum computing, machine learnng and their combination.	1, 2, 3, 4	33 hours/Semester
2	Survey and Presentation	Students will select a topic in quantum machine learning, conduct in-depth research on recent advanced techniques, synthesize findings into a survey, and deliver a presentation.	1, 2, 3, 4	3 hours/Semester

3	Lab	Students will implement a quantum machine learning model using Python, conduct performance comparisons with classical machine learning approaches, and analyze the results.	1, 2, 3, 4, 5	3 hours/Semester

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Survey and Presentation	1, 2, 3, 4	35	-	Yes
2	Lab	1, 2, 3, 4, 5	35	-	Yes

Continuous Assessment (%)

70

Examination (%)

30

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

50

Minimum Examination Passing Requirement (%)

50

Additional Information for ATs

The examination assesses students' mastery of fundamental knowledge about quantum computing and machine learning models and their underlying principles.

Assessment Rubrics (AR)

Assessment Task

Survey and Presentation (for students admitted in Semester A 2026/27 & thereafter)

Criterion

Based on the oral presentation and the submitted survey to evaluate understanding of the subject matter, capacity to analyse and summarize, and evidence of original and critical thinking

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Lab (for students admitted in Semester A 2026/27 & thereafter)

Criterion

Based on the submitted experimental report to evaluate understanding of subject matter, evidence of knowledge base, capacity to analyse and synthesize, and evidence of original and critical thinking

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Examination (for students admitted in Semester A 2026/27 & thereafter)

Criterion

Based on submitted written work to evaluate understanding of subject matter, evidence of knowledge base, capacity to analyse and synthesize, and evidence of original and critical thinking

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- Basics of machine learning and quantum computing, e.g., superposition, entanglement, and statistical learning.
- Understanding of the framework of quantum machine learning, e.g., quantum kernel and quantum neural networks.
- Analysis of the properties of quantum machine learning models, e.g., expressivity and generalization.
- Application of quantum machine learning, e.g., classification.
- Introduction of the software platform for quantum machine learning, e.g., PennyLane.

Reading List

Compulsory Readings

	Title
1	Lecture note

Additional Readings

	Title
1	Quantum Computation and Quantum Information, Isaac Chuang and Michael Nielsen, Cambridge University Press
2	Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer
3	Lecture notes for the theory of quantum information and quantum computation, John Preskill, https://www.preskill.caltech.edu/ph229/