PHYS575/CHEM575/ECE587: Principles and Platforms of Quantum Technology

Spring 2026 Syllabus and Schedule

Class time/location: 10-11:15 am in PAIS 1160
Instructors: Tara Drake (Instructor of Record), Victor Acosta, F. Elohim Becerra, Keith Lidke
Email: drakete@unm.edu
Office Location: PAIS 2234 and CHTM 118B
Office Hours: by appointment, requested by email
Class website: https://drakelab.unm.edu/courses/physics-575/index.html

Course Goals

Quantum Technology harnesses the unique features of quantum mechanical systems, such as quantum superposition and entanglement, for devices that hold the promise to revolutionize future technologies in computing, communication, and sensing and deepen our understanding of the universe. This course provides an overview of the platforms used by practicing researchers to conduct Quantum Technology research, with three goals:

1. Building familiarity with and general knowledge of quantum science and technology platforms and experimental techniques. Special emphasis is given to the role of light in quantum technologies.
2. Understanding the advantages and challenges of quantum systems for communication, sensing, computation, and metrology and the implementation in real physical systems.
3. Preparing students to participate in research in experimental quantum research at UNM and in the quantum photonics and technology community.

Course Structure

This course is team-taught by four UNM faculty, each of whom conducts research in a sub-discipline of quantum information technology. The course is organized into four units of three weeks each, taught by each instructor, followed by student-led instruction.

This course is required for the QPAQT certificate and all QPAQT program students.

Textbooks, Supplies, Technology/Technical requirements

There is no required textbook. Students should have access to a computer that can run Mathematica or similar software to perform calculations and plot data.

Individual instructors may give students reading and may suggest useful reference texts related to their unit.

Prerequisites for this course:

Completed with a minimum grade of B- or concurrently enrolled in at least 1 of the following:

- CHEM573 - Introduction to Quantum Technology for Chemists and Engineers (3)
- ECE445 - Introduction to Quantum Information Science (3)
- ECE545 - Introduction to Quantum Information Science (3)
- ECE573 - Introduction to Quantum Technology for Chemists and Engineers (3)
- PHYS445 - Introduction to Quantum Information Science (3)
- PHYS492 - Intermediate Quantum Mechanics II (3)
- PHYS521 - Graduate Quantum Mechanics I (3)
- PHYS545 - Introduction to Quantum Information Science (3)
- PHYS566 - Quantum Optics (3)

Grading:

The contribution to the final grade is as follows:

- Class participation (preparation and attendance): **15%**
- 4 Assignments (one per module): **10% each**
- Reports on 3 quantum talks: **10% (total)**
- Final Presentation: **35%**

Attendance is required and will be part of the class participation grade. However, you should of course not come in the case of contagious illness. In the event of illness, please let Drake know by email before class if you will not attend. These absences will be excused, within reason and if not in excess.

Homework:

This course is taught by four instructors, each of whom teach a 3-week-long module. **Each module has one graded assignment associated with it, due on the first day (Monday) of the next module BEFORE CLASS.** Late homework will lose a letter grade for each day late and will not be accepted after five days. Please plan accordingly.

External quantum-related talks/reports:

Students are required to find three seminars to attend this semester related to some aspect of quantum technology, quantum science, quantum information, etc. You are required to turn in a report when you do so with the following information:

- Before the talks: Write down a short list of 5 common threads and questions that you think will be relevant to any quantum technology seminar. (A good example: How does decoherence affect this system?)
- During the talk: Take notes on how these questions/threads were answered/addressed. You can ask a question at the end of the talk to better understand.
- After the talk: Write up a paragraph (~5 sentences) summarizing the talk. (Don't use the talk announcement blurb.) Then, write the answers to your questions. If you don't know, do some research in the literature and make an educated guess.
- Turning in your assignment: Schedule a time with Prof. Drake to talk about the three seminars you attended. You will hand in your written report at this time as well. You should schedule this with Prof. Drake no later than 1 week after you attend the talks.

There are many options for finding quantum seminars at UNM this semester. Opportunities will be announced regularly in class and through email by Drake, but students may find their own. (The Quantum Photonics seminar, which many of you are also taking, does NOT count.)

Final presentations:

In pairs, students will give final presentations in the last two weeks of class and during finals week on a quantum technology NOT covered by the instructors.

You will be required to give a practice presentation to Prof. Drake outside of class time during the weeks of April 8th - 24th. Details on the expectations and grading of the presentations will be given in class and posted on the class website.

Schedule

Week	Day	Topic	Instructor	Assignments due
1	1/21	Introduction	Drake	
2	1/26, 1/28	NV Centers I	Acosta	
3	2/2, 2/4	NV Centers II	Acosta	
4	2/9, 2/11	NV Centers III	Acosta	
5	2/16, 2/18	Laser Cooling I	Becerra	Assignment 1
6	2/23, 2/25	Laser Cooling II	Becerra	
7	3/2, 3/4	Laser Cooling III	Becerra	
8	3/9, 3/11	Time and frequency metrology	Drake	Assignment 2
SPRING BREAK				
9	3/23, 3/25	Optical clocks and frequency combs	Drake	
10	3/30, 4/1	Noise and stability	Drake	
11	4/6, 4/8	Classical Bounds	Lidke	Assignment 3, practice talks
12	4/13, 4/15	Quantum Bounds	Lidke	practice talks
13	4/20, 4/22	Examples of Optimal Measurements	Lidke	practice talks
14	4/27, 4/29	Final presentations		Assignment 4
15	5/4, 5/6	Final presentations		(all reports on quantum talks turned in by week 15)
finals week	TBD	Final presentations		

Note: The schedule and topics listed are subject to reasonable change.

Policy on Use of AI: In this class (and in many graduate-level electives), we expect and require you to do your own reading and research on relevant topics outside of the material we provide. Doing this is a responsible part of being a researcher, and it is part of the PhD candidate's transformation from student to scientist-peer.

AI Large Language Models (LLMs) are useful tools for learning concepts and finding resources, in a similar way that Wikipedia, HyperPhysics, and other second-party sources of information are useful. While you can use them to get started when learning a new concept, you should not rely on any of these tools without checking the primary sources they draw from.

Additionally, any copying of text or material from such sources is not allowed. If not cited, this is academic dishonesty and punishable by heavy disciplinary actions; but copied material from AI or Wikipedia should not be use even if cited. Instead, cite only primary or peer-reviewed sources and only in appropriate situations (i.e. for a presentation on the work in question, but not for a problem set solution).

Acceptable use of AI includes: clarifying concepts, checking your grammar, debugging a code (that you already wrote), finding peer-reviewed publications on a topic, etc.

Prohibited use of AI includes: Writing any assignment for you (including code), solving homework problems for you, creating false references, etc. Per UNM, prohibited use of AI is considered academic dishonesty and carries standard disciplinary consequences.

As faculty, we the instructors most want to see you grow and mature as a scientist and researcher into a peer that we'd like to work with. We assume this is your goal as well. The instructors will adopt a policy of good faith, assuming that you are working towards this goal and therefore not engaging in dishonest behavior that jeopardizes your personal development, your classmates' chances of earning fair grades honestly, and the credibility of our PhD programs' reputations.

Accommodations: UNM is committed to providing equitable access to learning opportunities for students with documented disabilities. As your instructor, it is my objective to facilitate an inclusive classroom setting, in which students have full access and opportunity to participate. To engage in a confidential conversation about the process for requesting reasonable accommodations for this class and/or program, please contact Accessibility Resource Center at arcsrvs@unm.edu or 505-277-3506.

UAP 2720 and 2740. Our classroom and university should foster mutual respect, kindness, and support. If you have concerns about discrimination, harassment, or violence, please seek support and report incidents. Find confidential services at LoboRESPECT Advocacy Center, the Women's Resource Center, and the LGBTQ Resource Center. UNM prohibits discrimination on the basis of sex (including gender, sex stereotyping, gender expression, and gender identity). All instructors are "responsible employees" who must communicate reports of sexual harassment, sexual misconduct, and sexual violence to Compliance, Ethics and Equal Opportunity. For more information, please see UAP 2720 and UAP 2740.