PHYS 420, 01E, 23408, QUANTUM MECHANICS

COURSE SYLLABUS: SPRING 2026

INSTRUCTOR INFORMATION

Instructor: Dr. William Newton
Office Location: STC 236
University Email Address: william.newton@etamu.edu
Class hours: TR 9:30am-10:45pm, STC 135
Office Hours: TR 3-4pm and W 9-11am
Preferred Form of Communication**:** email/chat in person before/during/after class, and during office hours. **When emailing, please put "PHYS 420" in the header. *Note:*** *I will exclusively use your ETAMU university email addresses for email communication.*
Communication Response Time: 24 hours

COURSE INFORMATION

Materials – Textbooks, Readings, Supplementary Readings

Textbook(s) Required: Quantum Mechanics by David McIntyre, Pearson Publishing ISBN-10: 0321765796 ISBN-13: 978-0321765796

Readings Required: My lecture notes

Software Required: Python, Jupyter Notebook, Free account on www.overleaf.com

University Catalogue Description

The Schrödinger equation; one dimensional systems; the Heisenberg uncertainty principle; magnetic moments and angular momentum; two and three dimensional systems; approximation methods; scattering theory. Prerequisites: PHYS 317 or consent of instructor.

The *syllabus/schedule are subject to change.*

Course Description

Quantum theories underpin our modern world. Without quantum mechanics, modern electronic devices such as computers, cell phones, most modern medical imaging and technology, most development in materials science, the internet, and many other things would not exist. It is the most accurately tested physical theory that exists - giving numerical predictions verified by experiments to more decimal places than our theories of gravity, Newton's laws of motion or our laws of thermodynamics (12 decimal places and counting to date!). It also captures the public imagination more than most other scientific theories, and coupled with being one of the most misunderstood physical theories, it is frequently latched onto to sell all manner of "woo". It is therefore also very important to understand what quantum mechanics does and *does not* say.

Student Learning Outcomes

Students will:

- Understand the postulates of quantum mechanics and be able to compare and contrast the formalism of quantum physics with that of classical physics: quantum states and wavefunctions vs position and momentum variables, observables as operators, and the Schrodinger equation versus Newton's laws of motion.
- Demonstrate the postulates of quantum mechanics using spin-1/2 systems as an example.
- Be able to correctly use and explain the meaning of the mathematical formalism and notation of quantum mechanics: Hilbert spaces, Dirac notation, orthonormal bases, Hermitian operators.
- Explain the nature of quantum probability and demonstrate its difference with classical probability.
- Solve the Schrödinger equation in (i) situations where there exists analytical solutions such as the square well potential, the harmonic oscillator and the hydrogen atom, and (ii) in situations where there is no analytical solution, either through perturbation theory or using computational techniques.
- Be able to qualitatively and quantitatively describe the time evolution of the wavefunction
- Be able to solve problems involving angular momentum.
- Be able to correctly physically interpret the solutions to quantum mechanics problems.
- Be able to use AI as a learning tool

COURSE REQUIREMENTS

Minimal Technical Skills Needed

A familiarity with Python is a big advantage but not required. We will be using Python code, so some learning of Python would be required as the class progresses

Instructional Methods

This class is being taught in the student-centered studio environment. The majority of class time will be focused on group activities. Activities will include conceptual tutorials and problem solving. Activities will be completed in groups of 2-3. I will usually not formally lecture in class; my lectures are be recorded and will be posted on D2L. The lectures will be posted at least a week before you need to watch them.

The class work is designed to follow on from lectures you have been assigned to watch – so you need to watch them ahead of time so you know the basics of what you are doing! If you don't, you risk wasting a lot of class time – which is the core time where you gain an understanding of the material.

We encourage you to practice metacognitive skills in your reading and problem solving:

Reading - Many students take the wrong approach to reading textbooks; they try and read and understand every word, refuse to move on until they've understood everything in the present section, refuse to skip passages, and only read the material once. Reading textbooks is a skill: here is one of several good websites with instruction on how to acquire that skill.

http://www.dartmouth.edu/~acskills/success/reading.html

When reading, first preview the chapter (skim through, noting key words, section headings, important boxes), and come up with a few questions. Then read a section at a time, with the goal of answering those questions.

Problem solving - When solving problems, always ask yourself *why*. What is the purpose of the problem? What does the instructor want you to get out of it?

(Hint: there will never be an occasion where the primary purpose of a question is to get the right answer, the primary purpose will always to

practice a particular skill or set of skills which will enable you to eventually get the right answer consistently when you are no longer in a class environment).

First attempt problems without using your notes, my lectures or the textbook; but set yourself a time limit so you don't waste time working on it if you reach a dead end. Then look at notes or lectures, try it again, look at the textbook, try it again, get together with classmates/come ask me for help, try it again and so on. Learning is an iterative process!

Now advanced AI is in widespread use, you will need to learn how to use it as a tool to gain understanding of concepts, and gain the skills required to assess solutions to problems and creatively analyze physical situations. Although we may both use it extensively, it is still something that both students and instructors are learning to use in the most productive way. A conceptually challenging class like this is a good place for us to explore how to do so together.

A key skill is note taking and *organizing* your notes so the information they contain is ordered in a logical way. Having notes in multiple notebooks, loose paper, random files and photos makes your life a **lot** harder, especially when it comes to studying the material for assessments.

Finally, learn the material as though you have to teach it, not just to make an A on a test.

Finding Help

The **class period** is intended to be the time when you cement your *understanding* of the material by discussing it with myself and your group mates. The laws and equations you can read in the textbook; in the class you will learn the skills to apply them to problems and assess your answers. Outside of class, email me and come to office hours!

To succeed in this class

The biggest predictor for success in this (and any) class is the time, thoroughness, and effort you put into the work and reading set. The harder you work, the better you'll do. Therefore you need to aim to

- Attend all classes, and participate fully in group work
- Complete and turn in all the work on time
- Read the textbook thoroughly, in the most effective way (see above)
- View the lectures on time, take notes.

- Review the lectures and the textbook after we've covered the material.
- Ask for help when needed, and make sure your questions are specific

Student Responsibilities

I expect you to have read the syllabus!

You are expected to attend the majority of classes for the full time. Of course, there will be times you cannot attend for legitimate reasons. In that case, **let me know**. A requirement of being allowed to make up work is that you don't disappear for more than one class without letting me know what's going on. Once I know, I will make every effort to help you make up the material missed.

The majority of class time will be spent working in groups. You are expected to participate fully in group-work.

You are expected to have completed the reading and watched and taken notes on any lectures by the due dates.

You are expected to take notes on all problems you solve in class, and any notes shared by other groups on whiteboards. For work displayed on whiteboards, the easiest thing to do is to just take photos of the work using camera phones, but they will have to be organized later by taking notes on the photos, otherwise you will just end up with a lot of random photos of equations that may only be useful to send to your family to impress them.

You are expected to complete the tutorial worksheets; although the in-class tutorials are not graded, you will need complete worksheets to do the tutorial homework and to study for assessments

I expect you put in a good faith effort to actually understand the material. Although we'll be using AI, using it to just spit out the answer to a question is not a productive use of your time. Many assessments will be done in-class without use of AI.

GRADING

Item	Percentage of Class Grade
Weekly in-class problems - **IC**	24% (12 at 2% each)
Practice with AI - partly **IC**	12% (6 at 2% each)
Problem Solving Homeworks	12% (6 at 2% each)
Tutorial Homeworks	12% (6 at 2% each)
Computational project	20% (5 parts at 4% each)
Mid-term/Final assessments - **IC**	20% (4 at 5% each)

The *syllabus/schedule are subject to change.*

IC means it is done in-class. All assessments must be handwritten, but I will adapt that requirement if necessary depending on accommodations requested from Student Disability Services.

Grading scale: (**NOTE:** Grades are not curved in this class – what you get is what you get!)

90-100%	A
80-89.99%	B
70-79.99%	C
60-69.99%	D
<59.99%	F

Assessments

Weekly in-class questions:
Most weeks, the last 20 minutes of the Tuesday class will be spent working individually on a single problem covering the material we learned in the past week. This will be turned in at the end of class, and returned to you at the start of Thursday's class.

Purpose*:* To assess preliminary understanding of material so you and I get immediate feedback on how your learning is progressing, allowing us to identify areas of difficulty quickly before they impact future work.

Practice with AI:
Some weeks we will have activities that explore how to use AI as a tool to further our understanding. Some of these activities will make use of the typesetting mark-up language LaTeX. Don't worry if you don't know it: you won't be required to have any in-depth knowledge, and I will go through everything you need to know in class. We will use LaTeX via the LaTeX document preparation website Overleaf. You need to register for a free account, and I will email you access to the document you will be using.

Purpose: To develop strategies to use AI as a tool for learning.

Textbook problem sets:
6 problem sets featuring traditional textbook problems (some from the textbook, some of my own devising!) will be assigned throughout the semester.

***Purpose**:* assess ability to do quantum mechanics problems and assess the solutions.

Tutorial Homework:
6 homework assignments following on from in-class tutorials will be assigned throughout the semester.

Purpose: assess conceptual understanding (VERY important in quantum mechanics!)

Computational project:
The computational project comes in 5 parts and will be spread over the last 10 weeks of the semester. The projects will use Python and Jupyter Notebooks. And there are several tutorials on Python and Jupyter notebook, easily found via popular search engines. You need to download and install a python compiler, editor and Jupyter notebook before the first computational activity starts. I can help if you need some troubleshooting.

When it comes to coding problems, finding bugs, etc: this is where AI is exceptionally useful.

Purpose: assess ability to implement material computationally, and use computation to solve problems that cannot be solved analytically, and to visualize their solutions to more deeply understand the fundamental concepts.

Mid-term and Final Assessments:
There will be three mid-terms and a final. Some or all of them will be based on real-world applications of quantum mechanics.

***Purpose**:* Assess ability to combine concepts and calculations at the end of a block of material.

In any and all work, you are free to use any physical or online resources at your disposal: BUT DO see the University AI policy later in this syllabus.

In any assignment it will be clearly stated whether or not use of AI is allowed, and if it is, what you must do to document its use.

COURSE OUTLINE

This schedule is tentative and will almost certainly change!

Week	Topic	Chapter/Sections
1	Introduction to Dirac notation and quantum states via the Stern-Gerlach experiment and the spin-1/2 system.	1
2		
3		
4	Operators and Measurement, Entanglement, Bell's theorem	2,4
5		
6		
7	The Schrödinger equation of motion; time evolution of spin-1/2 systems, precession	3
8		
9		
10	The position basis and the wave-function, quantum wells and quantized energy	5
11		
12		
13	Unbound States: scattering and tunneling	6
14	Angular momentum	7
15	The Harmonic Oscillator and The Hydrogen Atom	8

TECHNOLOGY REQUIREMENTS

LMS

All course sections offered by East Texas A&M University have a corresponding course shell in the myLeo Online Learning Management System (LMS). Below are technical requirements

LMS Requirements:
https://community.brightspace.com/s/article/Brightspace-Platform-Requirements

LMS Browser Support:

https://documentation.brightspace.com/EN/brightspace/requirements/all/browser_support.htm

ACCESS AND NAVIGATION

You will need your campus-wide ID (CWID) and password to log into the course. If you do not know your CWID or have forgotten your password, contact the Center for IT Excellence (CITE) at 903.468.6000 or helpdesk@etamu.edu

Note: Personal computer and internet connection problems do not excuse the requirement to complete all course work in a timely and satisfactory manner. Each student needs to have a backup method to deal with these inevitable problems. These methods might include the availability of a backup PC at home or work, the temporary use of a computer at a friend's home, the local library, office service companies, Starbucks, a ETAMU campus open computer lab, etc.

COMMUNICATION AND SUPPORT

If you have any questions or are having difficulties with the course material, please contact your instructor.

Technical Support

If you are having technical difficulty with any part of Brightspace, please contact Brightspace Technical Support at 1-877-325-7778. Other support options can be found here:

https://community.brightspace.com/support/s/contactsupport

Interaction with Instructor Statement

COURSE AND UNIVERSITY PROCEDURES/POLICIES

Course Specific Procedures/Policies

Syllabus Change Policy

The syllabus is a guide. Circumstances and events, such as student progress, may make it necessary for the instructor to modify the syllabus during the semester. Any changes made to the syllabus will be announced in advance.

University Specific Procedures

Student Conduct

All students enrolled at the University shall follow the tenets of common decency and acceptable behavior conducive to a positive learning environment. The Code of Student Conduct is described in detail in the Student Guidebook.
https://inside.etamu.edu/admissions/onestopshop/undergraduateAdmissions/studentGuidebook.aspx

Students should also consult the Rules of Netiquette for more information regarding how to interact with students in an online forum:
https://www.britannica.com/topic/netiquette

ETAMU Attendance

For more information about the attendance policy please visit the Attendance webpage and Procedures 13.99.99.R0.01

https://inside.etamu.edu/admissions/registrar/generalInformation/attendance.aspx

Academic Integrity

Students at East Texas A&M University are expected to maintain high standards of integrity and honesty in all of their scholastic work. For more details and the definition of academic dishonesty see the following procedures:
https://inside.etamu.edu/aboutus/policiesproceduresstandardsstatements/rulesprocedures/13students/graduate/13.99.99.R0.10.pdf

https://inside.etamu.edu/academics/graduateSchool/faculty/GraduateStudentAcademicDishonestyForm.pdf

Students with Disabilities-- ADA Statement

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, please contact:

Office of Student Disability Resources and Services
East Texas A&M University
Velma K. Waters Library Rm 162

Phone (903) 886-5150 or (903) 886-5835
Fax (903) 468-8148
Email: studentdisabilityservices@etamu.edu

Website: Student Disability Services

https://www.etamu.edu/student-disability-services/

Nondiscrimination Notice

East Texas A&M University will comply in the classroom, and in online courses, with all federal and state laws prohibiting discrimination and related retaliation on the basis of race, color, religion, sex, national origin, disability, age, genetic information or veteran status. Further, an environment free from discrimination on the basis of sexual orientation, gender identity, or gender expression will be maintained.

Campus Concealed Carry Statement

Texas Senate Bill - 11 (Government Code 411.2031, et al.) authorizes the carrying of a concealed handgun in East Texas A&M University buildings only by persons who have been issued and are in possession of a Texas License to Carry a Handgun. Qualified law enforcement officers or those who are otherwise authorized to carry a concealed handgun in the State of Texas are also permitted to do so. Pursuant to Penal Code (PC) 46.035 and ETAMU Rule 34.06.02.R1, license holders may not carry a concealed handgun in restricted locations.

For a list of locations, please refer to the Carrying Concealed Handguns On Campus
document and/or consult your event organizer.
Web url:
http://www.etamu.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/34SafetyOfEmployeesAndStudents/34.06.02.R1.pdf

Pursuant to PC 46.035, the open carrying of handguns is prohibited on all ETAMU campuses. Report violations to the University Police Department at 903-886-5868 or 9-1-1.

East Texas A&M University Supports Students' Mental Health

The Counseling Center at ETAMU, located in the Halladay Building, Room 203, offers counseling services, educational programming, and connection to community resources for students. Students have 24/7 access to the Counseling Center's crisis assessment services by calling 903-886-5145. For more information regarding Counseling Center events and confidential services, please visit **www.etamu.edu/counsel**

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Mental Health and Well-Being

The university aims to provide students with essential knowledge and tools to understand and support mental health. As part of our commitment to your well-being, we offer access to Telus Health, a service available 24/7/365 via chat, phone, or webinar. Scan the QR code to download the app and explore the resources available to you for guidance and support whenever you need it.

http://telusproduction.com/app/5108.html

AI use policy

East Texas A&M University acknowledges that there are legitimate uses of Artificial Intelligence, ChatBots, or other software that has the capacity to generate text, or suggest replacements for text beyond individual words, as determined by the instructor of the course.

Any use of such software must be documented. Any undocumented use of such software constitutes an instance of academic dishonesty (plagiarism). Individual instructors may disallow entirely the use of such software for individual assignments or for the entire course. Students should be aware of such requirements and follow their instructors ’guidelines. If no instructions are provided the student should assume that the use of such software is disallowed.

In any case, students are fully responsible for the content of any assignment they submit, regardless of whether they used an AI, in any way. This specifically includes cases in which the AI plagiarized another text or misrepresented sources.

13.99.99.R0.03 Undergraduate Academic Dishonesty

13.99.99.R0.10 Graduate Student Academic Dishonesty