

MATHEMATICAL METHODS IN QUANTUM MECHANICS, TTh 9:30-11:00

Instructor: Răzvan Gelca

Office: 229 Mathematics

Office Phone: 806-834-5499

E-mail: rgelca@gmail.com

Homepages: <http://www.math.ttu.edu/~rgelca>, <http://razvangelca.com>

Office Hours: TTh: 11-12:30, W 2-5.

Description of the course: The instructor intends to make the material accessible to students with various backgrounds. For this reason the course will start with a short overview of classical mechanics, followed by a description of the issues that lead to the discovery of quantum mechanics. Among the topics to be covered are:

- the real- and complex-valued models for the position and momentum operators, the Heisenberg uncertainty principle, and the Stone-von Neumann theorem,
- the problem of quantization and the Groenewold-van Hove theorem, and the model of Weyl quantization,
- the Schrödinger equation solved for several particular examples,
- the harmonic oscillator,
- the quantization of the angular momentum and its relationship to the representation theory of Lie groups, and the spin,
- the hydrogen atom,
- some basic facts about geometric quantization.

All necessary notions and results from differential geometry, representation theory, functional analysis, and differential equations will be introduced and explained. The aim of this course is to display a menagerie of mathematical methods that relevant to quantum theory, to show how combining tricks from various areas of mathematics helps us unlock the secrets of nature.

Learning outcomes: The students should learn the fundamentals of quantum mechanics which, hopefully, will help them become more competitive on the job market.

Assessment of learning outcomes: There will be three easy in class exams over the fundamental concepts and results taught. attendance is mandatory, five missed classes that are not motivated will lead to one drop in the grade.

Other matters:

ADA accommodations (TTU Operating Policy 34.22). Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note: instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, please contact Student Disability Services in West Hall or call 806-742-2405.

Absence for observance of a religious holy day (TTU Operating Policy 34.19). 1. "Religious holy day" means a holy day observed by a religion whose places of worship are exempt from property taxation under Texas Tax Code 11.20. A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. A student who is absent from classes for the observance of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence. A student who is excused may not be penalized for the absence; however, the instructor may respond appropriately if the student fails to complete the assignment satisfactorily.

Academic Honesty (TTU Operating Policy 34.12). It is the aim of the faculty of Texas Tech University to foster a spirit of complete honesty and high standard of integrity. The attempt of students to present as their own any work not honestly performed is regarded by the faculty and administration as a most serious offense and renders the offenders liable to serious consequences, possibly suspension. Scholastic dishonesty includes, but is not limited to, cheating, plagiarism, collusion, falsifying academic records, misrepresenting facts, and any act designed to give unfair academic advantage to the student (such as, but not limited to, submission of essentially the same written assignment for two courses without the prior permission of the instructor) or the attempt to commit such an act.

TTU Resources for Discrimination, Harassment, and Sexual Violence: Texas Tech University is committed to providing and strengthening an educational, working, and living environment where students, faculty, staff, and visitors are free from gender and/or sex discrimination of any kind. Sexual assault, discrimination, harassment, and other Title IX violations are not tolerated by the University. Report any incidents to the Office for Student Rights and Resolution, (806)-742-SAFE (7233) or file a report online at titleix.ttu.edu/students. Faculty and staff members at TTU are committed to connecting you to resources on campus. Some of these available resources are: TTU Student Counseling Center, 806-742-3674, <https://www.depts.ttu.edu/scc/> (Provides confidential support on campus.) TTU Student Counseling Center 24-hour Helpline, 806-742-5555, (Assists students who are experiencing a mental health or interpersonal violence crisis. If you call the helpline, you will speak with a mental health counselor.) Voice of Hope Lubbock Rape Crisis Center, 806-763-7273, voiceofhopelubbock.org (24-hour hotline that provides support for survivors of sexual violence.) The Risk, Intervention, Safety and Education (RISE) Office, 806-742-2110, rise.ttu.edu (Provides a range of resources and support options focused on prevention education and student wellness.) Texas Tech Police Department, 806-742-3931, <http://www.depts.ttu.edu/ttpd/> (To report criminal activity that occurs on or near Texas Tech campus.)

If you cannot take a certain test, please announce the instructor at least three days in advance. After the test, only medical excuses will be accepted.

What to do in case of emergency

If a student encounters a personal problem that affects their ability to attend class or complete their work on time, they should immediately contact the Dean of Students office via phone (806-742-2984) or email (deanofstudents@ttu.edu). The Dean of Students can help with emergencies including COVID, car accidents, death of a family member, inability to afford food, health issues, and more.

In exceptional circumstances, the Dean of Students can authorize exceptions to class policies. That's why it is critically important to immediately inform both your teacher and the Dean of Students office of any emergency. In addition, Title IX reporting and support resources are available at <https://www.depts.ttu.edu/titleix/>.

What to do in case of an issue with your teacher

Should a student encounter an issue in this course, they must follow these steps, in order.

1. First discuss the issue with the teacher. Explaining your concern calmly and clearly will usually resolve the problem.

2. If the issue is not resolved, or the issue is of a matter that the student is not comfortable discussing with the instructor, the student should contact the course coordinator.

3. If you need further assistance, contact Dr. Brock Williams (brock.williams@ttu.edu), the Associate Chair for Undergraduate Studies.

Do not contact the Dean, Provost, Chancellor, etc, without first following these steps.

COVID Pandemic Information

The University will continue to monitor CDC, State, and TTU System guidelines concerning COVID-19. Any changes affecting class policies or temporary changes to delivery modality will be in accordance with those guidelines and announced as soon as possible. Students will not be required to purchase specialized technology to support a temporary modality change, though students are expected to have access to a computer to access course content and course-specific messaging.

This is where students can find information about COVID testing, vaccinations, isolation, and quarantine. <https://www.depts.ttu.edu/communications/emergency/coronavirus/>.

If you test positive for COVID-19, report your positive test through TTU's reporting system: <https://www.depts.ttu.edu/communications/emergency/coronavirus/>. Once you report a positive test, the portal will automatically generate a letter that you can distribute to your professors and instructors.