

Quantum Mechanics I (6201)

Spring 2023

Meeting time: M/W 8:30am – 9:45am

Room: Physics 127

Textbook:

1. Notes “Quantum Mechanics,” by P.E. Parris
2. “Quantum Mechanics,” by A. Messiah (9780486784557), available on Amazon or from the S&T bookstore
3. Occasionally, additional reading materials will be distributed

Instructor: Dr. A. Yamilov, Email: yamilov@mst.edu

Office: Physics 116

Office hours: Mon/Tue time TBA

Topics to be covered:

I. Introduction

- Brief Historical Background
- Postulates of Wave Mechanics
- Conservative Systems
- Superposition & Spectral Decomposition
- Free Particles & Fourier Transforms

II. The Formalism of Quantum Mechanics

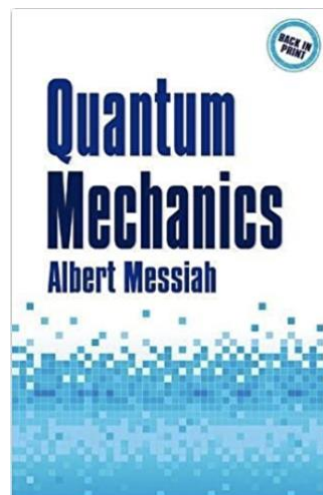
- Specification of State, Linear Vector Spaces
- Bases, Discrete and Continuous
- The Inner Product, Representations
- Observables
- Operators, Multiplicative, Differential, Outer Products
- Projection Operators, Completeness
- Matrix Elements, Hermitian Conjugation
- Hermitian, Anti-Hermitian, Unitary Operators
- Matrices, Commutation Relations
- Eigenvalues and Eigenvectors
- Common Eigenstates of Commuting Observables
- Measurement, Probabilities, Densities, Mean Values
- Uncertainty, Uncertainty Principle, CSCO's
- Evolution of State Vector (Schrödinger Equation)
- Eherenfest's Theorem, Evolution of Mean Values
- Conservative Systems, The Evolution Operator

III. The Harmonic Oscillator

- Algebraic Approach to the Harmonic Oscillator
- Spectrum and Eigenstates of Number Operator
- Energy Representation
- Time Evolution
- Coherent States

IV. Many Particle Systems

- Direct Product of Linear Vector Spaces
- State Space of Many Particle Systems
- Evolution of Many Particle Systems
- Identical Particles, Symmetric & Antisymmetric Subspaces
- Number Operators and Occupation Number States
- Observables, Fock Space, Fermions, Bosons



Course policies

Homework:

- During each Wednesday class (excluding the weeks before exams) you will be assigned a problem set
- Neatly handwritten (or typed) solutions are due in class the Wednesday of the following week
- There will be twelve homework assignments during semester
- At the end of the course, two lowest homework grades will be dropped

Exams:

- Exams 1 and 2 will be given on Mondays, February 20 and April 3 during a regular class; the final exam will be given during the finals' week, time/date TBA
- Final exam will only include the material covered after the second exam
- Both the regular exams and the final will have the same weight
- Tests are in closed-book, closed-notes format. Formula sheet with the key equations will be provided

Final grade:

- Homework 50% (2 lowest out of the total 12 will be dropped)
- Three exams 50% (exams will have equal weight, the final is not cumulative)
- The final letter grades will be assigned according to the following rules:
 - A – 89.5% of total possible points
 - B – 79.5% of total possible points
 - C – 69.5% of total possible points
 - D – 59.5% of total possible points
 - F – below 59.5% of total possible points

Disability:

- If you have a documented disability, please, provide me with the letter from Disability Support Services by the end of the second week of classes.
- I will be happy to work with DSS to accommodate you in this course.
- More resources for students with disabilities are available at <http://dss.mst.edu>

Class Schedule

January (4)

Su Mo Tu We Th Fr Sa
8 9 10 11 12 13 14
15 16 17 **18** 19 20 21
22 **23** 24 **25** 26 27 28
29 **30** 31

Homework #1 is due on Wednesday

February (8)

Su Mo Tu We Th Fr Sa
1 2 3 4
5 **6** 7 **8** 9 10 11
12 **13** 14 **15** 16 17 18
19 **20** 21 **22** 23 24 25
26 **27** 28

Homework #2 is due on Wednesday

Homework #3 is due on Wednesday

Homework #4 is due on Wednesday

Exam 1 (9 Lectures)

March (7)

Su Mo Tu We Th Fr Sa
1 2 3 4
5 **6** 7 **8** 9 10 11
12 **13** 14 **15** 16 17 18
19 **20** 21 **22** 23 24 25
26 27 28 29 30 31

Homework #5 is due on Wednesday

Homework #6 is due on Wednesday

Homework #7 is due on Wednesday

Homework #8 is due on Wednesday

April (8)

Su Mo Tu We Th Fr Sa
1
2 **3** 4 **5** 6 7 8
9 **10** 11 **12** 13 14 15
16 **17** 18 **19** 20 21 22
23 **24** 25 **26** 27 28 29
30

Exam 2 (9 Lectures)

Homework #9 is due on Wednesday

Homework #10 is due on Wednesday

Homework #11 is due on Wednesday

May (2)

Su Mo Tu We Th Fr Sa
1 2 **3** 4 5 6
7 8 9 10 11 12 13
14 15 16 17 18 19 20

Homework #12 is due on Wednesday

Final Exam TBA (9 Lectures)

Key: Lectures, **Exams**, **Homework due**

Course policies (continued)

Title IX

- Missouri University of Science and Technology is committed to the safety and well-being of all members of its community. US Federal Law Title IX states that no member of the university community shall, on the basis of sex, be excluded from participation in, or be denied benefits of, or be subjected to discrimination under any education program or activity. Furthermore, in accordance with Title IX guidelines from the US Office of Civil Rights, Missouri S&T requires that all faculty and staff members report, to the Missouri S&T Title IX Coordinator, any notice of sexual harassment, abuse, and/or violence (including personal relational abuse, relational/domestic violence, and stalking) disclosed through communication including but not limited to direct conversation, email, social media, classroom papers and homework exercises.
- Missouri S&T's Title IX Coordinator is interim chief diversity officer Neil Outar. Contact him (naoutar@mst.edu; (573) 341-6038; Temporary Facility A-1200 N. Pine Street) to report Title IX violations. To learn more about Title IX resources and reporting options (confidential and non-confidential) available to Missouri S&T students, staff, and faculty, please visit <http://titleix.mst.edu>

Student Honor Code and Academic Integrity

- Please take a few minutes to stress the importance of academic integrity in class. Discuss why it should matter to the student, why it matters to you and your discipline, why it matters to Missouri S&T, and why it matters to future employers. Include a statement on your syllabus about the Honor Code developed and endorsed by the Missouri S&T Student Council: the Honor Code can be found at this link: <http://stuco.mst.edu/honor-code/>. Encourage students to read and reflect upon the Honor code and its emphasis on HONESTY and RESPECT.
- Page 30 of the Student Academic Regulations handbook describes the student standard of conduct relative to the University of Missouri System's Collected Rules and Regulations section 200.010, and offers descriptions of academic dishonesty including cheating, plagiarism or sabotage (<http://registrar.mst.edu/academicregs/index.html>). Additional guidance for faculty, including the University's Academic Dishonesty Procedures, is available on-line at <http://academicsupport.mst.edu>. Other informational resources for students regarding ethics and integrity can be found online at <http://academicsupport.mst.edu/academicintegrity/studentresources-ai>

S&Tconnect: <https://canvas.mst.edu/>

- S&Tconnect provides an enhanced system that allows students to request appointments with their instructors and advisors via the S&Tconnect calendar, which syncs with the faculty or staff member's Outlook Exchange calendar. S&Tconnect will also facilitate better communication overall to help build student academic success and increase student retention. S&Tconnect Early Alert has replaced the Academic Alert system used by Missouri S&T. If training is needed, please contact Rachel Morris at rachelm@mst.edu or 341-7600

Classroom Egress Maps

- Faculty should explain where the classroom emergency exits are located. Please include a statement in your course syllabus asking the students to familiarize themselves with the classroom egress maps posted on-line at: <http://designconstruction.mst.edu/floorplan/>

Course policies (continued)

Accessibility and Accommodations

- It is the university's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please contact Student Disability Services at (573) 341-6655, sdsmst@mst.edu, visit <http://dss.mst.edu/> for information, or go to mineraccess.mst.edu to initiate the accommodation process

LEAD Learning Assistance <http://lead.mst.edu>

- The Learning Enhancement Across Disciplines Program (LEAD) sponsors free learning assistance in a wide range of courses for students who wish to increase their understanding, improve their skills, and validate their mastery of concepts and content in order to achieve their full potential. LEAD assistance starts no later than the third week of classes. Check out the online schedule at <http://lead.mst.edu/assist>, using zoom buttons to enlarge the view. Look to see what courses you are taking have collaborative LEAD learning centers (bottom half of schedule) and/or Individualized LEAD tutoring (top half of the schedule). For more information, contact the LEAD office at 341-7276 or email lead@mst.edu

The Student Success Center

- The Student Success Center is a centralized location designed for students to visit and feel comfortable about utilizing the campus resources available. The Student Success Center was developed as a campus wide initiative to foster a sense of responsibility and self-directedness to all S&T students by providing peer mentors, caring staff, and approachable faculty and administrators who are student centered and supportive of student success. Visit the SSC at 198 Toomey Hall; 573-341-7596; success@mst.edu; facebook: www.facebook.com/SandTssc; web: <http://studentsuccess.mst.edu/>