

# PHYS 403: Quantum Mechanics II

Fall 2022

**Course description:** Additional topics in Quantum Mechanics, including angular momentum, perturbation theory, and scattering.

**Prerequisites:** Undergraduate level PHYS 402 Minimum Grade of C or Undergraduate level PHYS 402 Minimum Grade of XS.

**Scheduled Meeting Times:** 10:30 am - 11:45 am TR Planetary Hall 127

**Instructor:** Karen L. Sauer  
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**Office Hours:** Planetary Hall Room 263  
Mondays 4:30 – 5:30 pm (or by appointment, including virtual)

**Textbook:** “*Introduction to Quantum Mechanics*” 3<sup>rd</sup> edition by David J. Griffiths and Darrell F. Schroeter

**Grading:** Homework = 20%, Exams = 20% each, Final = 35%, In-class quizzes = 5%.

## Tentative Schedule:

Date	Topic	Read <i>before</i> class
8/23	<i>Symmetries &amp; Conservation Laws:</i> Introduction	6.1
8/25	Translation Operator	6.2
8/30	Conservation Laws & Parity	6.3-6.4
9/1	Rotational Symmetry	6.5
9/6	Degeneracy & Rotational Selection Rules	6.6-6.7
9/8	Translations in Time	6.8
9/13	<i>Time-Independent Perturbation Theory:</i> Nondegenerate & Degenerate	7.1-7.2
9/15	Fine Structure of Hydrogen	7.3
9/20	Zeeman Effect	7.4
9/22	Hyperfine Splitting in Hydrogen	7.5
9/27	<b>Exam 1</b>	-----
9/29	<i>The Variational Principle:</i> Theory	8.1
10/4	Ground State of Helium	8.2
10/6	Hydrogen Molecule Ion	8.3
10/11	<b>No class</b>	-----
10/13	Hydrogen Molecule	8.4
10/18	<i>The WKB Approximation:</i> “Classical” Regime	9.1

10/20		Tunneling	9.2
10/25		Connection Formulas	9.3
10/27	<i>Scattering:</i>	Introduction	10.1
11/1		Partial Wave Analysis	10.2
11/3		Phase Shifts	10.3
11/8	<b>Exam 2</b>		-----
11/10		Born Approximation	10.4
11/15	<i>Quantum Dynamics:</i>	Two-level systems	11.1
11/17		Emission & Absorption of Radiation	11.2
11/22		Spontaneous Emission	11.3
11/24	<b>No class - Thanksgiving</b>		-----
11/29		Fermi's Golden Rule	11.4
12/1		Adiabatic Approximation	11.5
12/13	<b>Final:</b>	10:30 am – 1:15 pm	

**Exams:** In-class exams are closed-book and without calculators, but an equation sheet containing equations from the front and back pages of the textbook will be provided. It is the responsibility of each student to attend classes during scheduled examinations as listed in the syllabus regardless of work or family considerations. Make-up exams will be given only to students with a VALID medical excuse and they should contact the instructor as soon as possible.

**Final:** Tuesday, 12/13, 10:30 am - 1:15 pm, Planetary Hall 127. The final exam will be comprehensive, with greater emphasis placed on the material covered after second exam.

**Homework Assignments:** Homework problems will be assigned in Blackboard and are due at 10:30 am on Tuesdays in person. You are encouraged to work on your homework assignments together in small groups, BUT copying homework from each other is not permitted. Full marks will only be given for homework where the full work is shown. Because solutions will be given out at the same time as the homework is handed in, no late homework will be accepted, except with a VALID medical excuse. The lowest homework grade will be dropped.

Note: You can email to a fellow student through Blackboard by going to Tools on the side bar and choosing "Send email."

### **Homework computation:**

Some of the homework may require numerical computation. Include the code for the computation in your homework. You can choose the language/platform in which to do the computation. The appropriate *Matlab* commands, however, will be given in class. Matlab can be gotten for free through Mason: <https://www.mathworks.com/academia/tah-portal/george-mason-university-31483444.html>.

**If you are a student with a disability and you need academic accommodations:** please see me and contact the Office of Disability Services at 703.993.2474. All academic accommodations must

be arranged through that office. Students must inform the instructor at the beginning of the semester, and the specific accommodation will be arranged through ODS.

**Academic Integrity:** GMU is an Honor Code university; please see the University Catalog for a full description of the code and the honor committee process. Honor Code: To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set forth this honor code: *Student members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.*