

## Course Syllabus

### Physics 489: Senior Seminar

Fall Semester, 2023

|                        |   |
|------------------------|---|
| <b>Instructor:</b>     | Dr. Steven Sahyun   |
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| <b>Course WWW:</b>     | <a href="http://sahyun.net/courses/physcs489">http://sahyun.net/courses/physcs489</a>   |
| <b>Office Hours:</b>   | M W 9:00 am – 9:50 am; M 3:30 – 4:30 pm; T 11:00 – 11:50 am<br>and 3:00 – 4:00 pm or by appointment.  |
| <b>Class Meetings:</b> | M W 12 noon – 12:50 pm  |
| <b>Exams:</b>          | <b>Major Field Test : Wed, Nov. 1, 12 noon - 1:50 pm (or by special arrangement)</b>  |
| <b>Required Texts:</b> | <i>Conquering the Physics GRE 2<sup>nd</sup> Ed</i> , Kahn and Anderson. Text Rental.<br><i>OpenStax University Physics</i> , Ling, Sanny, and Moebbs. Vols. 1, 2, and 3. Free PDF available on the course D2L and at<br><a href="https://openstax.org/details/books/university-physics-volume-1">https://openstax.org/details/books/university-physics-volume-1</a><br><a href="https://openstax.org/details/books/university-physics-volume-2">https://openstax.org/details/books/university-physics-volume-2</a><br><a href="https://openstax.org/details/books/university-physics-volume-3">https://openstax.org/details/books/university-physics-volume-3</a><br><br>You should also have your introductory physics text available (Moore), to review and compare material (to OpenStax) the relevant sections before each quiz. |
| <b>Pre-requisites:</b> | <b>PHYSICS 344</b> OR CONSENT OF DEPARTMENT   |

#### Course Description:

The course will train students in making scientific presentations, summarize the concepts and methods taught in the physics major curriculum, and prepare them for the Physics Major Field Test as the final exam in the course. Two one-hour sessions a week for approximately one-half semester. (The end of course MFT exam is approximately one week after the Fall GRE date.)

#### Course Objectives:

This course has the following objectives:

- *Review topics learned during the entire course of study in physics* and to help you do your best on the Physics Major Field Test (MFT) and the GRE Physics Test (if applying for graduate school) by practicing with tests.

These objectives will be reached by assigning research work, making and evaluating presentations and proposals, and working selected homework problems as a review of your overall physics understanding.

### Course Structure:

#### (a) Review of Undergraduate Physics and MFT Preparation

This course is a preparation for the MFT and GRE. We will review all the material from undergraduate physics through HW and tests. During that period, every Monday and Wednesday you will be taking in-class tests/quizzes each 20-30 mins.

The quiz/HW grades may be curved. Each late assignment (HW or presentations) will lose 25% of the grade.

Each week you will have a homework assignment for the next class (due in class). The solutions should be handwritten, clear and thorough in order to receive full credit. In each class you may be asked to present a random question from your homework. You will be graded based on your presentation of the question. Answers like “have no idea”, will be points deduction from your HW.

#### MFT Exam:

After completing the review section, a 2-hour block for the Physics Major Field Test (MFT) will be scheduled and conducted. This exam is a multiple choice, standardized exam from Educational Testing Service. The results of this exam help the Physics Department determine curricular and course needs and changes. We rely on your serious attempt at this exam to determine how we teach our courses to our majors.

- **The MFT date is tentatively set for Wednesday, November 3.**

### Grading:

Course grades will be determined by the percentage of total points assigned for the course. A tentative grading table is the following:

|    |         |  |    |        |
|----|---------|--|----|--------|
| A  | 91-100% |  | C+ | 69-71% |
| A- | 83-90%  |  | C  | 66-68% |
| B+ | 76-82%  |  | C- | 63-65% |
| B  | 73-75%  |  | D  | 60-62% |
| B- | 71-73%  |  | F  | < 60%  |

If you miss a class or turn in your assignment late, you need to provide an official documentation (doctor's note, etc.) in order to claim your missed credits/points.

The **approximate** distribution of points will be as follows.

|                   |      |
|-------------------|------|
| HW and Quizzes    | 43%  |
| Major Field Test* | 17%  |
| Attendance        | 9%   |
|                   | 100% |

\*Based on the MFT, your MFT score will be:     100%, if you get above the mean  
    90 %, if you get below the mean  
    80 %, if your score is very low.

### **Tentative Schedule and topics:**

- **Classical Mechanics - 20%**  
Kinematics, Newton's laws, work and energy, oscillatory motion, rotational motion about a fixed axis, dynamics of systems of particles, central forces and celestial mechanics, three-dimensional particle dynamics, Lagrangian and Hamiltonian formalism, noninertial reference frames, elementary topics in fluid dynamics.
- **Electromagnetism - 18%**  
Electrostatics, currents and DC circuits, magnetic fields in free space, Lorentz force, induction, Maxwell's equations and their applications, electromagnetic waves, AC circuits, magnetic and electric fields in matter.
- **Optics and Wave Phenomena - 9%**  
Wave properties, superposition, interference, diffraction, geometrical optics, polarization, Doppler effect.
- **Thermodynamics and Statistical Physics - 10%**  
Laws of thermodynamics, thermodynamic processes, equations of state, ideal gases, kinetic theory, ensembles, statistical concepts and calculation of thermodynamic quantities, thermal expansion of heat transfer.
- **Quantum Mechanics - 12%**  
Fundamental concepts, solutions of the Schrodinger equation (including square wells, oscillators, and hydrogenic atoms), spin, angular momentum, wave function symmetry, elementary perturbation theory.
- **Atomic Physics - 10%**  
Properties of electrons, Bohr model, energy quantization, atomic structure, atomic spectra, selection rules, black-body radiation, x-rays, atoms in electric and magnetic fields.
- **Special Relativity - 6%**  
Introductory concepts, time dilation, length contraction, simultaneity, energy and momentum, four-vectors and Lorentz transformation, velocity addition.
- **Laboratory Methods - 6%**  
Data and error analysis, electronics, instrumentation, radiation detection, counting statistics, interaction of charged particles with matter, lasers and optical interferometers, dimensional analysis, fundamental applications of probability and statistics.

### **Related Information:**

#### **2022–2023 GRE Subject Test Dates (For testing in the US):**

| Test Dates      | Regular Deadline | Late Deadline | Supp. Test Center and Monday Administration Deadline | Online score | Score mailing date (approx.) |
|-----------------|------------------|---------------|--|--------------|------------------------------|
| 09/17/22        | 08/12/22         | 08/19/22      | 07/29/22   | 10/17/22     | 10/28/22                     |
| <b>10/29/22</b> | 09/23/22         | 09/30/22      | 09/09/22   | 11/28/22     | 12/10/22                     |
| 04/08/23        | 03/03/23         | 03/10/23      | 02/17/23   | 05/08/23     | 05/19/23                     |

Please see <https://www.ets.org/gre/subject/about/content/physics> for further/updated information.

**Workload:** The University sets a minimum level of effort that each student must devote per credit earned for all courses at the university, a minimum found in Section V-C, page 1 (revised 1992 August 1), of the University Handbook. Effectively, you should be spending two to three times as much time on this course outside of class as you do in class, this is approximately four to six hours of work for this two credit class. If you find that you are spending significantly more than that, please discuss it with me to see if I can help you study more effectively.

**Special needs statement:** Students with special needs should contact the instructor to make appropriate arrangements.

The University of Wisconsin-Whitewater is dedicated to a safe, supportive and non-discriminatory learning environment. It is the responsibility of all undergraduate and graduate students to familiarize themselves with University policies regarding [Special Accomodations](#), [Misconduct](#), [Religious Beliefs Accomodation](#), [Discrimination](#) and [Absence for University Sponsored Events](#). (For details please refer to the Undergraduate and Graduate Timetables; the [Rights and Responsibilities](#) section of the [Undergraduate Catalog](#); the [Academic Requirements and Policies](#) and the [Facilities and Services](#) sections of the [Graduate Catalog](#); and the [Student Academic Disciplinary Procedures](#) [UWS Chapter 14]; and the [Student Nonacademic Disciplinary Procedures](#) [UWS Chapter 17].)

| <b>Tentative Physics 489 Sche Fall 2023</b> |              |            |              |                        |                          |                                      |
|---|--------------|------------|--------------|------------------------|--------------------------|--------------------------------------|
| <b>Week</b>                                 | <b>Class</b> | <b>Day</b> | <b>Date</b>  | <b>Topic</b>           | <b>Reading</b>           | <b>Homework DUE</b>                  |
| 1   | 1            | Wed        | 6-Sep        | Course Overview        |                          |                                      |
| 2   | 2            | Mon        | 11-Sep       | MFT Sample             |                          | MFT sample solutions                 |
|   | 3            | Wed        | 13-Sep       | GRE Sample Exam 1      |                          | GRE sample Exam 1 solutions          |
| 3   | 4            | Mon        | 18-Sep       | Advice for MFT and GRE | CP 9 p. 273-285; article | Comments on readings. CP 9 problems. |
|   | 5            | Wed        | 20-Sep       | Classical Mechanics I  | CP 1 p. 1 - 24           | Selected CP 1 problems.              |
| 4   | 6            | Mon        | 25-Sep       | Classical Mechanics II | CP 1 p. 24 - 58          | Selected CP 1 problems.              |
|   | 7            | Wed        | 27-Sep       | E&M I                  | CP 2 p. 59 - 81          | Selected CP 2 problems.              |
| 5   | 8            | Mon        | 2-Oct        | Magnetism              | CP 2 p. 83 - 98          | Selected CP 2 problems.              |
|   | 9            | Wed        | 4-Oct        | Optics                 | CP 3 p. 105 - 126        | Selected CP 3 problems.              |
| 6   | 10           | Mon        | 9-Oct        | Thermo and Stat Mech.  | CP 4 p. 131 - 152        | Selected CP 4 problems.              |
|   | 11           | Wed        | 11-Oct       | Quantum Mechanics      | CP 5 p. 155 - 187        | Selected CP 5 problems.              |
| 7   | 12           | Mon        | 16-Oct       | Atomic Physics         | CP 5 p. 187 - 206        | Selected CP 5 problems.              |
|   | 13           | Wed        | 18-Oct       | Relativity             | CP 6 p. 217 - 232        | Selected CP 6 problems.              |
| 8   | 14           | Mon        | 23-Oct       | Lab methods            | CP 7 p. 235 - 252        | Selected CP 7 problems.              |
|   | 15           | Wed        | 25-Oct       | Special Topics         | CP 8 p. 255 - 270        | Selected CP 8 problems.              |
| 9   | 16           | Mon        | 30-Oct       | GRE Sample Exam 2      |                          | GRE sample Exam 1 solutions          |
|   | <b>19</b>    | <b>Wed</b> | <b>1-Nov</b> | <b>MFT</b>             |                          |                                      |