Faculty Advisor & Instructor of Record (IOR): [add name and email]
Semester and Year: [add term]
Course: PHYS295 (example)
Office & Office hours: [add room, and times]

This syllabus provides the general course goals, course learning outcomes, relation to program learning outcomes, the evaluation/grading scheme and academic integrity for PHYS295 offered by the IOR.[1] Attached to this syllabus is a template for specifying each student's individual semester objectives, milestones, and deliverables. The template is provided following the general expectations for performing research in the IOR's research group and program requirements. It is the responsibility of each student to work out these specifics with the IOR based on their progress to degree and standing in the program overall at the beginning of the semester. Failure to set objectives, milestones and deliverables at the beginning of the semester (by end of week 3) constitutes unsatisfactory progress during the semester. Failure to act on set objectives and/or to meet set milestones and deliverables may result in unsatisfactory progress during the semester.

Course Goals: Graduate research in Physics under PHYS295 is performed under the supervision of a faculty member, generally the student's major professor. The unit value may range from 1 to 12 depending on the amount of time the student spends on research (see below). Physics graduate students enroll in PHYS295 while carrying out the research that will constitute their masters thesis or doctoral dissertation, or preliminary research directed toward choosing a dissertation topic.

Course Learning Outcomes: Upon completion of PHYS295, students should have designed, carried out, and analyzed experiments or data collection in the laboratory and/or field, or developed theoretical results or calculations, that constitute a new contribution to scientific knowledge, or a step towards such a contribution. The student should have provided evidence, in the form of written proposals, manuscripts, reports, or data summaries, of progress towards their degree, as agreed upon between the instructor and student at the beginning of the semester (more detailed expectations are stated below and a template is attached).

Program Learning Outcomes: Participation in graduate research in my group (PHYS-295 over the course of several terms), requires and aims to expand on the possession of a broad foundation in the fundamentals of physics and a deep understanding of the chosen subfield, which will permit doctoral students to understand and critically evaluate current research (Physics graduate PLO-1). Through participating in graduate research in my group doctoral students will gain the skills necessary to conduct and lead independent responsible ***experimental***, and to some extent the theoretical, and/or computational research and contribute to knowledge in fields including semiconductor optics, nanotechnology, quantum science and technology, etc. (Physics graduate PLO-2). They will gain the ability to ***identify new research opportunities***, which may cross traditional discipline boundaries, plan effective strategies for pursuing these opportunities and ***conduct research that makes a new contribution to knowledge*** in their chosen subfield of physics and solve important problems in society (Physics graduate PLO-3). Furthermore, they will learn to communicate both fundamental concepts of

[1] Parts of this syllabus were adapted from the SNS syllabus template, the PHYS160 syllabus, and other syllabi.

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physics and details of their own research effectively, in written and oral form, including in a classroom setting to expert and non-expert audiences. ***This includes the publication of original research results in peer reviewed scientific journals*** (Physics graduate PLO-4).

Evaluation/Grading System:

The grading mode of PHYS 295 is S/U. To receive a grade of S, the student must spend an average of at least three hours per week per unit on research-related activities. Research activities may include laboratory, computational, or theoretical work, reading related to the research project, searching the scientific literature, participation in research group meetings, participation in group field activities or data collection, research report or manuscript writing, and any other research-related activities. Satisfactory performance also requires adherence to proper professional standards of laboratory safety and ethics in performing the research, maintenance of good records via a physical laboratory notebook and/or electronic files as discussed with the faculty advisor (IOR), and the ability to work with others in a collegial manner. Research activities and progress during the semester will be monitored either weekly or biweekly through consultation meetings with the course instructor (IOR). At these meetings, the student is expected to report research results, summarize research activities performed, provide manuscript drafts, plan new activities with the instructor, and discuss progress toward the degree.

Academic Integrity in Research:

Plagiarism is not tolerated in science or any other academic discipline. Refer to the UC Merced Academic Honesty policy. Additionally, there are a couple aspects of academic integrity that are particular to scientific research.

References: When keeping records and writing up scientific work, it is important to give proper credit to others for their contributions. Your reports should name your lab partner(s) as contributors to the experimental work, and anyone else who contributed should be acknowledged, usually at the end of the report. References are required for all work, data, text, images, etc. taken from an outside source. This is not only to give credit where it is deserved, it is also a very important part of the scientific process because it allows tracking errors or conclusions back to the original source. Without backtracking, the body of scientific knowledge would not be able to effectively build on the work of previous generations.

Misrepresenting data: Do not fabricate/modify/discard data just to agree with a preconceived conclusion. It is dishonest, the antithesis of the scientific method, and is equivalent to cheating. You can still get an S in the course if, for example, you measure g=9.1 m/s^2, as long as you follow good scientific procedure, but you will fail if you misrepresent data to get the expected answer. Most breakthroughs in science come from understanding why an experimental result differs from an expected hypothesis. Misrepresenting data could cause you to miss an important result. On the other hand, careful recording of every observation (especially the unexpected ones) is good scientific practice because it is more likely to lead to new discoveries and advance science knowledge.

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Research expectations-long term (over the course of your PhD aim to):

- Demonstrate mastery of physics and quantum information science and engineering (QISE).
- Publish at least 3 first author peer reviewed papers in reputable journals.
- Have presented your research at national and international conferences.
- Have developed and realized own ideas. Aim to have at least one of your published, peer reviewed papers based largely on your own ideas.
- Have developed the experimental setup and/or an experimental method.
- You should have developed and submitted applications for fellowship, stipends, and/or grants.
- Have gained skills in working with, advising and mentoring undergrads on your research projects.

Research expectations-day to day:

- Participate in **research meetings (1-on-1, group meetings, project meetings, etc.)**. Be punctual and come prepared!
- Provide advanced notice (at least 24 hours) and (afterwards) a **progress summary** by email if you cannot make a scheduled research meeting.
- Conduct research in a safe and responsible manner. Besides adhering to safety standards, wearing adequate PPE, be up-to-date on safety trainings, be in the lab regularly and coordinate with all team members (especially before and after time away from the lab).
- Be in **the lab and/or office frequently and regularly** even if you are not executing an experiment
  - Always have a plan of what you want to accomplish on a given day
  - Monitor your equipment and supplies (maintain a log for each setup)
  - Analyze, interpret, and draw conclusions from the data
  - Write and revise manuscripts, proposals, abstracts, etc.
  - Make figures and other visualizations of your concepts, measured data, computed simulations, and drawn conclusions and results.
  - Plan new or revise existing experiments/setups.
  - Help keep the lab clean and safe. These efforts include to brief one's lab members and be briefed by them on the status of the lab prior to and upon return from extended periods of time one spends away from the lab (e.g., for attending professional meetings, or going on vacation).
  - Discuss physics with your lab mates (and yes challenge each other intellectually)
- Use non-lab time constructively (**review literature**, perform calculations, write, discuss,…)
- Attempt to **resolve questions independently** and/or in collaboration with other group members and/or collaborators.
- **Efficiently manage your schedule** in order to satisfy all of your professional and personal obligations.
- Repeatedly identify goals (e.g. once a month) and **make progress towards goals on a continuous basis.**
- **Maintain a log (lab notebook)** of your lab related activities in a laboratory book and plan ahead. This includes, but is not limited to:
  - Setup and maintenance of equipment (e.g. note parameters the laser was used at, how long it was running, any irregularities).

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- lab supplies, equipment, and tools that need to be purchased/replaced.
- Preparation and performance of experiments. Note all relevant parameters for your experiments so someone else can redo them later.
- Questions you may come across.
- Papers you read or intend to read.
- Ideas you developed.
- Programs you wrote.
- Note data analysis with conclusions or questions.
- When making notes in your lab notebook pay attention to the following:
  - Date your entries.
  - Write legible.
  - Write in a way that allows you and others later to follow your thoughts, ideas, and procedures.
  - Document progress on your setups with pictures/drawings.
  - Document measurements with plots of raw data
  - Document data analysis with graphs and conclusions
  - Document where data, and software programs (macros) you wrote are stored. (including back-ups)
  - Have a system that allows you and others to identify what entries belong together.

- Share the log with your faculty advisor (IOR). In the weekly 1-on-1 meetings:
  - Show your log to the IOR
  - Provide the carbon copy and a scanned version of the new log entries to the IOR.
- All data taken, must be documented in the log, including where it is located and how it can be accessed.
  - All data generated must be archived in order for publications resulting from this data to be verifiable later. This includes your dissertation.
    - Physical data (samples, specimen, tools, devices, etc.) must be stored in appropriate locations in the lab
    - Digital data (measured data, computed date, scripts, code, graphics, presentations, papers, etc.) must be stored in the IOR's box folders for the group.
  - All data that is used for a publication (scientific paper, conference presentation, dissertation, etc.) is to be packaged with the publication (folder, zip file, or alike), such that it is readily available, and straight forward to understand.
  - Data refers to data taken/computed, code written to take/compute the data, process the data, analyze the data, locations of physical data, blueprints of physical data, schematics describing physical data, recipes used to create physical data…

Schedule:

Group Meetings:

A) [Day, time, room]: Research Progress Meeting: During this meeting students will
- Update the group on their progress, discuss their data, data analysis and interpretations
- Coordinate with the team on measurements, maintenance needs and supply needs

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- Perform short practice presentations, such as for conferences. Longer practice presentations, such as for qualifying exams and defenses, are to be scheduled separately.

B) [Day, time, room]: Literature Meeting: During this meeting students will:

a. Write up their notes including
   i. Writing lab reports summarizing their research progress (bi-weekly)
   ii. Create plots.
   iii. Create figures for manuscripts, oral or poster presentations.
b. Present and discuss interesting and relevant papers.

1-on-1 Meetings:

These will take place typically on [weekdays]. These (~30 minute) meetings are used to:

- Go over the lab note (logs and record keeping)
- Discuss research progress (lab reports, follow-up on previously set weekly goals and longer-term milestones)
- Discuss next steps and set specific goals for the next week(s).

General attendance and participation:

Progress in research, experimental research in particular, depends to a large part on interactions between the researchers, and between researchers and others, such as staff (facilities, school, department, etc.), vendors, suppliers, etc. Most others are around primarily during business hours. Consequently, being present during business hours is an excellent way to ensure one's progress in research.

In addition, to ensure one's data is reliable and progress is made requires not just that one uses the equipment but it also requires one to keep one's eyes, ears, nose etc. on the lab equipment, such that irregularities or malfunctions are being noticed and can be mitigated quickly and risk of damage or harm is minimized. If you have equipment running, check it ideally in person on a regular basis (at least daily).

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Template for setting individualized semester objectives, milestones and deliverables

Each student is responsible for working out the specifics in this template with the IOR.

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Summary of Student's Objectives for the Semester

The objective for the next term is to make considerable progress on the research topic, [add descriptive title of your research]. The acquisition and understanding of the relevant background knowledge is essential but not sufficient to demonstrate considerable progress. The goal must be the application of this knowledge with the aim to generate novel insights into the underlying physics.

Over the next term you will generate preliminary results, prepare the results for publication, attend/prepare an abstract for the [add conference]. In preparation for the advancement to candidacy you will form your committee. You will learn and aim to research independently with the guidance of your committee, demonstrate that you are a contributing member of the research group, and prove your "…fitness…to proceed with the doctoral dissertation…general preparedness in the discipline, and specific competence to pursue the proposed dissertation topic." Furthermore, you will demonstrate your competence at the level of PhD, which means that you are able to: generate new ideas, remain aware of the state of the art, conduct research, manage research, communicate results, adhere to the (professional & ethical) standards and the necessary rigor demanded by the scientific community, and teach/train others.

Specific semester milestones:

- **Lab**: Progress towards realization of a measurement for … .
  - Project 1: [add project title]
  - Project 2: [add project title]
  - Project 3: [add project title]
  - …
- Demonstrate a record of improved understanding of **semiconductor optics**, **condensed matter physics, quantum materials, quantum science & technology,…**. Specifically:
  - Topic 1: [add topic]
  - Topic 2: [add topic]
  - Topic 3: [add topic]
  - …
- **Semester paper**: By the end of the semester (fall/spring) have the following 'scientific papers' completed. A 'scientific paper' is first and foremost a manuscript on research under the IOR's instruction that is (to be) submitted for publication in a scientific journal. In

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addition, fellowship applications, qualifying exam proposals, a thesis/dissertation, detailed description of an experimental method you developed/are developing, etc… may count as semester papers, depending on your stage in the degree program.

- **Mandatory:**
  - Research papers: ☐ First author, ☐ co-author on [add tentative titles]
- **Required by program or additional:**
  - Qualifying exam proposal [add tentative title]
  - Dissertation (chapter) [add tentative title]
  - Patent application [add working title]
  - Review paper: ☐ First author, ☐ co-author on [add tentative title]
  - Prepare and submit an abstract for the [add conference name and important dates] (only once the corresponding manuscript has been completed or is very close to being submitted)

- Practice mentoring and leadership skills by training of undergraduate students and/or other team members under the IOR's guidance [add name(s)] on: [add research projects/tasks/skills/processes etc.]

Time Table:

Week #	Week of	Notes	Activities/Tasks	Deliverable	Milestone?
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					