

SYLLABUS - PHYS 498 Senior Seminar (1 unit) 499 Seniors Honors Project (3 unit)

(Dated: Fall 2018 Syllabus version 2018 v1.0b, [printed August 31, 2018])

Fall 2018 Meeting times - Class meets Friday 2:00-4:30 pm in La Tourette Hall 227. When colloquium are scheduled (3:30-4:30pm), we move to the colloquium room around 3:05 pm for refreshments. When the colloquium does not meet, class ends a bit before 3:00 pm. The colloquium runs 3:30-4:30 pm. Students are required to attend the Friday colloquium even on days when the class may not meet.

Faculty - Professor C. Thompson (815-753-1772)- cthompson@niu.edu - LaTourette Hall 207
<http://sites.google.com/site/profcthompson/home>
Office hours - Mondays 11:00am-12:15pm - but preferred time is appointment by mutual agreement. Please just go ahead and contact me!
Students should plan to meet regularly with their faculty mentor for their project. (Urge the faculty mentor to have a reserved weekly time to meet.)

Textbook -

No Required Textbook - However, students will use the library databases and other options for their independent research project

Table II for Fall semesters lists all potential class meeting dates and the due dates by week in semester. (Note Spring semester week numbers include one more 'week' (due to Spring break taking up one week) Deadlines are FIRM!

The Honors Senior project (3 credits) has same core level requirements as PHYS 498. In addition, the senior project requires the student to complete a more substantial laboratory or theoretical research or inquiry project with a faculty mentor than expected in PHYS 498. The paper and presentation should be based on this project.

All projects and topics require a faculty mentor and the approval and agreement of the mentor to advise the project. If you lose your faculty mentor for reasons related to unsatisfactory progress during the semester, it will lead to a failing grade. Be sure to stay in regular contact with your faculty mentor.

I. CLASS INFORMATION AND CONTEXT

PHYS 498 and PHYS 499 are capstone courses for the physics senior. The course provides a final meaningful engagement opportunity for students in physics. Expectation is that the student will take the course his or her final semester.

The results of the papers, presentations, exams and interviews from this course are also used as part of the Physics Department's assessment data and will be used to improve the quality of the department's programs.

Components of the course are

- Guided inquiry into a research topic of interest to student and faculty mentor
- Written report on the topic - evaluated by faculty
- Oral Presentation on topic during the Senior Symposium - Graded and Evaluated by panel of physics professors
- Participation in a standardized exam or similar department assessment measure, and in an exit interview

- Attendance at the department Friday colloquiums and the class sessions prior to the colloquium.

- Faculty Mentor evaluation

Catalog descriptions:

PHYS 498. SENIOR SEMINAR (1 credit) Topics of current interest in physics and physics education. Attendance at the Department of Physics colloquium series required. PRQ: PHYS 374 and senior standing in physics.

PHYS 499. SENIOR PROJECT IN PHYSICS (3 credits) Program of study and research in a special area of physics selected in consultation with a faculty member and approved by the department chair. Project results evaluated by a faculty panel. A student who receives credit for PHYS 499H may not also receive credit towards the major in PHYS 459. PRQ: PHYS 374 and senior standing in physics.

TABLE I Weights for grading. Note that for both PHYS 498 and PHYS 499, the same non-graded requirements are applied and student may not pass (is given an F automatically) if the colloquium attendance or physics knowledge assessment activity requirements are not met.

Activity	Phys 498(1 unit)	Phys 499(3 units)
Written Report	20	25
Public Presentation	20	20
Other Five assignments	30	25
Meeting Deadlines	20	10
Faculty Mentor Input	10	20

II. DEADLINES FOR MAJOR ASSIGNMENTS

See section IV for more detailed descriptions of the assignments. See Table II and Table III for deadline dates in respective semesters.

- DEADLINE ONE - *Topics signed off by mentors and tentative working title and abstract or work scope and timeline submitted*
- DEADLINE TWO - *Extended outline and listing of primary literature identified with descriptions*
- DEADLINE THREE - *Draft report due*
- DEADLINE FOUR - *Peer Review of classmates's Draft report*
- DEADLINE FIVE - *Final Report Due/Draft of presentation*
- DEADLINE SIX - *Draft of Presentation or Poster*
- DEADLINE SEVEN - *Presentation/Poster at Symposium*

All assignments are to be turned in to the faculty mentor, as well as the instructor. Electronic versions (pdf files) are preferred.

In addition to a credible effort related to the assignment, please make sure that every assignment includes 1) student full name, 2) mentor name, 3) date or semester, 4) current working title of project (this can evolve over the course of the semester!) 5) Description of 'deadline' being met (e.g., 'workslope', 'extended outline',...)

III. GRADING AND GRADING POLICIES

Assuming that the attendance requirements are met, as well as the assessment participation activities (see Section III.A, the final letter grade will be determined as follows.

- Written report

Written report (Assignment seven) loses one letter grade for every 4 days past due date.

- Public presentation

The Presentation Symposium date or the Poster Symposium is typically the last Friday colloquium of the semester. It is announced during the first class of the semester, as well as being posted on Department Colloquium web. (Unexcused absence = grade of F.).

- The average grade for the other 5 assignments (work scope, outline and literature list and description, draft report, peer review, draft presentation) count together
- Satisfactorily meeting the seven deadlines for the assignments

– Successfully meeting the deadlines for assignments is worth 5 points per assignment. Get at least a credible effort in on time. One point is deducted for each day late. A missing assignment (> 2 weeks late or lacking a minimum of credible effort) gets a zero for meeting deadline and a -5 point penalty. Copies of assignments must be submitted to faculty mentor and to the instructor or they may not be given credit for having met the deadline.

– Grading A \geq 31 pts; B \geq 26 pts; C \geq 21 pts; D \geq 15; F<15 pts;

Assignments over 2 weeks late will not be accepted for credit.

Please provide electronic copy (in PDF format with fonts embedded!) of all assignments to instructor and to faculty mentor. Electronic copy is typically due at 6 pm of the due date unless otherwise specified or unless other arrangements have been made in advance! For any documents where the formatting and pictures are important (typically the draft paper and the final report), the best format to provide is PDF to avoid cross-operating systems issues and incompatibilities. The PPT, ODF, or PDF version of the presentation is due 24 hours before the symposium so that all the presentations are loaded and tested on the presentation computer in time for the symposium.

A. Additional Non-graded Requirements required to receive a Passing grade

Please note that to pass this course, a student is required to:

- Attend 3/4 or more of the scheduled class sessions during the semester.
- Attend 3/4 or more of the scheduled colloquiums during this semester.
- Participate in physics knowledge assessment exams that are given.

TABLE II Timeline - Fall semester

Week 1	Overview of course, discuss potential topics
Week 2	
Week 3	<i>Due date ONE:</i> Topics signed off by mentors and tentative working title and work scope and timeline submitted
Week 4	
Week 5	
Week 6	Department Physics Exam Scheduling session
Week 7	<i>Due date TWO:</i> Extended outline and listing indentifying primary literature is due.
Week 8	
Week 9	
Week 10	
Week 11	<i>Due date THREE:</i> Draft paper is due to mentors and instructor
Week 12	<i>Due date FOUR:</i> Peer review due of draft paper
Week 13	{THANKSGIVING BREAK}
Week 14	<i>Due date FIVE and SIX:</i> Senior Seminar Report due (final report) and Presentation Draft
Week 15	<i>Due date SEVEN:</i> Senior Seminar Symposium {Final Poster for Due Monday}
Week 16	FINALS WEEK, Please complete on-line Exit interviews

Students demonstrate their knowledge of physics by taking a physics examination and this is used in department assessment activities. The format of this assessment is undergoing review and may be changed from a multiple choice exam to something different, however, in the past, this exam consisted of 48 multiple choice questions on topics covered in 200 level courses. The topics covered are split between mechanics, waves, thermal physics, electricity and magnetism, relativity, and quantum physics. The questions are similar to what would appear on a GRE exam.

Students will be asked to share their opinions on their preparation in physics during an on-line exit interview.

B. Outline of course

Table II and Table III lists all potential class meeting dates and the due dates by week in semester. Spring semester has one more 'week' (due to Spring break taking up one week) Deadlines are FIRM!

Deadlines - Typically electronic version of assignments is required. Meeting all the deadlines and submitting appropriate documents related to these assignments are used in the final grade so ignore them at your peril. Meeting deadlines satisfactorily and reporting on their effort, and understanding assignments, is part of what makes someone successful in their profession.

TABLE III Timeline - Spring Semester

Week 1	Overview of course, discuss potential topics
Week 2	
Week 3	<i>Due date ONE:</i> Topics signed off by mentors and tentative working title and work scope and timeline submitted
Week 4	
Week 5	
Week 6	Department Physics Exam Scheduling session
Week 7	<i>Due date TWO:</i> Extended outline and listing indentifying primary literature is due.
Week 8	
Week 9	{SPRING BREAK}
Week 10	
Week 11	<i>Due date THREE:</i> Draft paper is due to mentors and instructor
Week 12	<i>Due date FOUR:</i> Peer review due of draft paper
Week 13	<i>Due date FIVE:</i> Senior Seminar Report due (final report)
Week 14	<i>Due date SIX:</i> Presentation Draft
Week 15	<i>Due date SEVEN:</i> Senior Seminar Symposium
Week 16	Friday is always READING DAY, no Friday classes scheduled
Week 17	FINAL WEEKS, please complete on-line Exit interviews

IV. ADDITIONAL DESCRIPTION OF ASSIGNMENTS

While I welcome getting a paper copy in addition to the assignment, all assignments must be turned in as their electronic version. I strongly (practically require) that it be a PDF, particularly for assignments that have visuals and graphics.

Please - all assignments should have a header that includes

- Title
- Student name
- Faculty mentor name
- Date turned in AND assignment description

A. DEADLINE ONE - Topics signed off by faculty mentors and tentative working title and abstract or work scope and timeline submitted

Expectation is an document of about one to two pages. There are THREE parts to this document, the header (discussed above), a summary of the project and what it entails, and a timeline. The summary is a bit like an abstract, but it concentrates on articulating the project as agreed upon between mentor and student. Please avoid a lot of fluff and concentrate on what are the boundaries of the project. The timeline should be a week by week estimate of what activities or jobs need to be completed. Use it to also schedule when there are time conflicts. For example, the week a

student has 3 exams in other classes is NOT going to be a week that realistically also has lots of time for this project.

The faculty mentor and the student should be in agreement!

B. DEADLINE TWO - Extended outline and listing of primary literature identified with description of each source.

Expectation is a document of about two to three pages in length. This document will have FOUR sections; the header, an abstract or summary, a paper outline (very rough), and a listing of the literature and sources identified as important or useful with comments about them.

The abstract can be a tweaked version of the summary of the 1st assignment, since it is likely that at this point, the project may have become more focused and some parts either added or taken away. The Extended outline *should be detailed* and written as an outline - that is, show evidence that the student has started to understand what will fit into the report, what needs to be in the report, and that he/she has made progress!

Primary literature listing MUST include at least one primary source from typical research quality or archival (e.g., peer reviewed, published) literature. This citation should be appropriate to the topic of the paper. While the preprint of an article that satisfies this requirement may be available on arXiv (a preprint server), student MUST give full citation, that is, cite the article with its published coordinates (journal, volume, etc). The arXiv preprint url can also be added in the citation, but alone it is not sufficient to satisfy this requirement.

Note, Physics Today, Scientific American, trade journals and textbooks are important sources of information and should be cited when relevant, but they are not considered archival research articles.

The literature listing must be written using a standard technical formatting scheme (such as in Physical Review Letters, e.g., Authors, Journal name, volume, pages, year). However, because this is a student paper be sure to include the Title of the articles and sources, and avoid abbreviations for the journal title.

In the primary literature listing, For each source, include at least ONE sentence that describes what you expect from this source. This is to demonstrate that you have started scanning (reading) the literature.

C. DEADLINE THREE - Draft report due

The draft is expected to be somewhat 'drafty'. However, by this time, the student should have a pretty good idea of what must be in introduction and background, and what is still needed and can describe what he or she expects to put in various sections. These drafts will be distributed to another student for the peer review exercise.

The expectation is a document of 4 to 8 pages. It is the outline, but filled in. At this point, also attempt to start using citations (as would be standard format in technical report/literature). The draft paper consists of FOUR parts; a header, an abstract, the draft report prose and figures and tables, and finally the references section.

D. DEADLINE FOUR - Peer review of classmates draft report

The peer review usually consists of three parts. 1) A written assessment (a paragraph or two) that also is sent to the instructor, 2) any writeups or notes on the drafty draft 3) a face-to-face meeting between reviewer and author where the reviewer discusses the review (and helps indicate any shorthand comments on the draft)

E. DEADLINE FIVE - Final report due

Expectation is a standard technical formatted report with good organization, good grammar, spelling, and focused on the project. PDF version required (not PPT or ODF or DOCX etc since these will look differently on different computers).

Use standard technical report citation formatting. That is, all references are CITED within the report, and at the end (or as footnotes) are the details of those references. Because this is a student report, TITLES of all articles and books are required.

It is expected that the student will reference the research literature and that the bibliography will include scholarly research literature from refereed (archival) journals appropriate to the topic of the paper. **At least one citation must be from a primary source from typical research quality or archival (e.g., original, peer reviewed, published) literature.** While the preprint of an article that satisfies this requirement may be available on arXiv (a preprint server), student MUST give full citation, that is, cite the article with its formal published coordinates (journal, title, volume, etc). The arXiv preprint url can also be added in the citation, but alone it is not sufficient to satisfy this requirement.

Citation format must use a standard formatting from typical technical literature (e.g., from Physical Review B or Journal of Applied Physics, etc.) **However, because this is a student paper, the title of each source must be included in full, and the journal should be written out (not abbreviated or shortened).**

The literature listing must be written using a standard technical formatting scheme (such as in Physical Review Letters, e.g., Authors, Journal name, volume, pages, year). However, because this is a student paper be sure to include the Title of the articles and sources, and avoid abbreviations for the journal title.

The paper should be of sufficient length to document the

student's understanding of the topic covered. The department is looking for *understanding of physics*, particularly of the topics as covered at the UG level, and the students ability to apply those topics to explain his or her project. The body of the paper (excluding diagrams, graphs or appendices) might average 6-10 pages for typical student effort.

Particular attention must be paid to providing proper credit and references for any figures or graphs used from the literature, (this includes using figures from web pages).

F. DEADLINE SIX - Draft of presentation

Typical format is powerpoint or a pdf of slides. Turn in a PDF version, please.

G. DEADLINE SEVEN - Final Oral Presentation or Poster

The department may have a Poster Presentation or an Oral Presentation. The final choice will be announced by the first few weeks of the course. (Typical reasons to do one or the other depend on number of students in class and other department events scheduled for that day).

For an Oral Presentation: Follow a conventional scientific presentation format (similar to what students have been observing in the colloquiums!). Typical format is powerpoint, open or libreoffice, or a pdf. Particular attention must be paid to providing proper credit and references for any figures or graphs used from the literature, (this includes using figures from web pages).

Presentations, with questions, will be limited to 15 minutes in length and be structured in a standard symposium format and performed during the Senior Seminar Symposium. This means that speakers should prepare a 12 minute presentation, leaving time for about 2 1/2 minutes for questions, and about 30 seconds for one speaker to sit down and the next to take his or her place and be introduced. (And time for the applause!).

For a Poster Presentation: Students prepare in advance a poster (usually in portrait orientation, 32 inches x 42 inches) with figures and text. The department will have the posters printed (assuming the student meets the deadline for printing). Students and faculty will attend the Poster Symposiums session, which usually is scheduled for about 1 to 1 1/2 hours. The Phys 498/499H students stand by their posters to answer questions and discuss the poster with the graduate students, faculty, and other undergraduates who are attending the event.

Both events will have refreshments, and family and friends are welcome and encouraged to attend.

V. FACULTY MENTOR ROLE

The single most important task of all faculty mentors is to provide guidance during the initial decisions that outline the topic and boundaries of a project. The project should be appropriately challenging, yet also have a good chance of successful completion by the student in 8 to 10 weeks. The topic need not be new topic for the student and mentor (for example, if the student and faculty have been working on a URAP project or undergraduate research, the additional research and writing for the report can be on the same topic.). The report should not be submitted for credit in another class however it may be an article (first author student) that is being published for a conference or in the literature as long as the student was responsible for the writing, and that the mentor and student describe honestly and transparently how much was altered by the mentor to make it publication ready.

Please set up a 'standing' appointment time with your mentor to meet weekly. This ensures that you and your mentor have a mutually agreeable time that works. And - Meet or talk with your mentor and give an update of your progress even if there is NO progress that particular week. Make them stay in the loop!

A very active role would entail the mentor providing ongoing suggestions and resources for laboratory or theoretical work to support the topic, and multiple critiques, and advice on the paper and presentation preparation. Most mentors will provide less active guidance. This level of interaction is between the student and the mentor. At minimum during the project, the mentor will encourage the student to make the deadlines and will be available for questions to help understand the material.

- Provide guidance during topic choice and initial title and draft abstract construction.
- Encourage students to stay on top of the deadlines.
- Be available for student's questions.
- Help read the paper drafts and provide feedback during the process
- Attend the presentations.

Faculty mentor: If the student is not showing up for meetings, and is not doing the work, please contact the Phys 498/499 instructor and discuss the issues.

Note that a student who goes 'ghost' and misses multiple meetings with the faculty mentor (and cannot be contacted after repeated attempts) will be removed from his/her presentation slot at the symposium, and will be dropped from the course.

Student: If a student is having problems with his/her faculty mentor that might be helped with mediation (personality mismatch, miscommunications, (or if the mentor goes 'ghost'!), please, be proactive and contact the Phys

498/499 instructor or the chair of the department with the concerns. If the situation is outside of mediation (i.e., unprofessional behavior) please contact the instructor or chair as soon as possible.

VI. USEFUL LINKS

The class meeting times before the colloquium, and on days with no colloquium, will be used to assess and discuss students progress on the course requirements and deadlines and any issues related to that. It also will be used for short discussion on themes of professionally relevant interest such as those in the following.

- “Ethics and professional conduct in science and education”
www.aps.org/programs/education/ethics/resources.cfm
- “Writing and presenting for the audience”
- “Making the switch from apprentice to master”
- “Using the library and finding sources”
- others as suggested by students

TABLE IV Faculty and their suggestions for topics. For faculty who have not suggested topics, please check their recent scholarly publications to find their interests and expertise.

Jahred Adelman	The Higgs boson: Why was it needed, and how was it discovered? The Standard Model: Why is it incomplete, and where might we find new physics?
Gerald Blazey	<i>Not available</i> (on administrative assignment assignment)
Dennis Brown	Mossbauer Spectroscopy.
Dhiman Chakraborty	The mysteries of dark matter and/or dark energy. The universal preponderance of matter over antimatter. What is the origin of mass?
Omar Chmaissem	Neutron Scattering techniques.
George Coutrakon	Medical Physics. Quantum Computing.
Mike Eads	Muon $g-2$ Experiment
Bela Erdelyi	Particle Accelerators: Their Science and Applications.
Andreas Glatz	Simulation techniques in condensed matter physics.
David Hedin	Detecting particles and searching for new phenomena.
Yasuo Ito	Electron Tomography.
Laurence Lurio	X-ray lasers. Thermodynamics of membranes.
Stephen Martin	Supersymmetry and the frontiers of physics. Beyond the minimal Higgs boson. Triggers for new physics discoveries at the Large Hadron Collider.
Susan Mini	<i>Not available</i> (on administrative assignment assignment)
Philippe Piot	Photon and Electron beams: Interactions, Synergies and Applications.
Carol Thompson	Green droop problem in InGaN LED's. Are bananas ferroelectric? - a cautionary tale; (also see) Ferroelectrics, multiferroics and artifacts: Lozenge-shaped hysteresis and things that go bump in the night Atomic Force Microscopy studies of surfaces (requires some time at Argonne and can include a laboratory component using the AFM at Argonne). X-ray reflectivity as a probe of film structure (requires use of matlab). Kinetic Monte Carlo simulations of atoms dancing on a crystal.
Michel van Veenendaal	Observing changes with X-rays in a split picosecond. X-ray absorption and X-ray scattering.
Roland Winkler	Aharonov-Bohm effect (a "quantum paradox": tuning the interference of electrons by means of a magnetic field though the electrons never "see" the field) Berry phase (another "quantum paradox": if we "rotate" a quantum system by 2π , it can be different from the system before the rotation). Schrodinger's cat (another "quantum paradox": Why is Schrodinger's cat dead and alive at the same time?). Datta-Das spin transistor (a transistor that uses the electrons' spin degree of freedom instead of the electric charge of the electron). Coulomb blockade and single-electron tunneling (in the nanoworld, one electron more or less on a device can make a big difference). Giant magnetoresistance (tuning electric resistance by means of a magnetic field, useful for modern harddisk read heads).
Zhili Xiao	Nanoscale Superconductors. Nanomaterials-based gas sensors. New superconductors.
Vishnu Zutshi	Detectors in HEP and medical physics.