

# PHYSICS F400 - CAPSTONE PROJECT

Spring 2016

0 credits

Prerequisites: PHYS F220; PHYS F301; or permission of the course coordinator

## **Course Coordinator**

Physics Department Chair,

Renate Wackerbauer

Office hours: by appointment, [rawackerbauer@alaska.edu](mailto:rawackerbauer@alaska.edu)

## **Overview**

This course is a requirement for the BS physics degree. It represents a mentored research project on a physics topic or on a related topic that applies physical problem solving skills. The capstone project must be designed or chosen by the student in consultation with a faculty mentor. The faculty mentor must approve the project before work begins. The project must include evaluation of data and communication of the study intent, methods, results, interpretation and conclusion in the context of existing literature and knowledge.

PHYS F400 is not a traditional course; there are no class meetings, and no credit is associated with the course completion. Rather think of it as a tool to a) make your capstone experience visible in your transcript and to b) represent a tracking method for the Physics Department and the UAF Registrar to identify which students are currently undertaking or have successfully completed the capstone requirement for graduation.

A capstone project may extend across several semesters, or an initial project may be abandoned in favor of a new one. In these cases, there is no need to register for this class repeatedly. If the capstone project is not completed satisfactorily within a semester, the grade in PHYS F400 will be deferred until a later semester.

## **Catalog Course Description**

This course should be taken by students during the semester they initiate a capstone research project. The capstone project must include the evaluation of data and communication of the study intent, methods, results, interpretation and conclusion in the context of existing literature and knowledge. The capstone project may be completed as individual undergraduate research with a faculty member, as independent study with a faculty member within a 300 or 400 level physics course, or as participation in the international University Physics Competition. The duration of the course may exceed one semester.

## **Course Goals and Learning Objectives**

The broad goal of the capstone project is to integrate knowledge and skills learned in previous courses, including scientific knowledge, quantitative literacy, and communication skills, and to apply these products of the university education to a creative activity. For a physicist, a fundamental expression of applied knowledge, creativity, and critical reasoning is to engage in scientific inquiry.

The learning objectives of the capstone project are as follows:

1. Learn through experience to pose and test physics hypotheses
2. Employ critical thinking by evaluating scientific literature in the subject area
3. Reinforce and enhance quantitative knowledge by analyzing and interpreting data
4. Reinforce and enhance writing skills by communicating science
5. Reinforce and enhance oral presentation skills by communicating science

## **Capstone Project Options**

The capstone project must be designed or chosen by the student in consultation with a faculty mentor. The faculty mentor must approve the project before work begins. The project must include evaluation of data and communication of the study intent, methods, results, interpretation and conclusion in the context of existing literature and knowledge.

There are three main ways to complete a capstone project:

### **1. Individual undergraduate research with a faculty member (\*, \*\*)**

Undergraduate research is typically conducted with a member of the Physics Department, although research projects associated with local research institutes or members from other departments are welcome if the project applies problem solving skills from a student's physics education. In the latter case, a one page research proposal including methods applied should be developed by the student together with the research mentor and sent to the physics department chair for approval before the start of the project. At least 2 credits of undergraduate research (PHYS F488) are required for the capstone project; they count towards the 120 required credits for the BS physics degree.

### **2. Individual undergraduate study with a faculty member within an upper level physics course (\*, \*\*)**

Undergraduate research associated with a 300 or 400 level physics course is typically done with the course instructor as faculty mentor. This option is particularly relevant if a student's research interest and/or career goal is outside of the department's active research areas. Examples include (but are not limited to) improving or newly developing experiments and data recording in relation to the Optics course (PHYS F463) or the Advanced Laboratory (PHYS F381), or computational and theoretical studies of a quantum or mechanical phenomenon related to Quantum Mechanics course (PHYS F421) or Mechanics course (PHYS F341, F342). At least 2 credits of individual study (PHYS F497) are required for this project; they count towards the 120 required credits for the BS physics degree.

### **3. Participation in the international University Physics Competition (\*, \*\*)**

The annual University Physics Competition ([www.uphysicsc.com](http://www.uphysicsc.com)) is based on open-ended scientific problems. A group of 3 students competes over a weekend (50 hours straight) by a) first choosing one out of the two offered problems, b) starting with a literature study for background information, c) developing and checking hypotheses, d) self-teaching possibly new analytical methods and writing computer programs, and finally e) submitting a research paper. Students that choose this option are required by the department to individually write a capstone project report based on the competition problem. The faculty mentor for the University Physics Competition will grade the project paper. Additional work is required as long as the conditions for a grade P are not met (\*).

(\*) The capstone project culminates in a final written report formatted as a scientific paper. It is recommended that written assignments have a minimum length of 6 single-spaced pages (excluding title, abstract, figures and references) with at least 10 references. The written report is graded by the mentor as part of the capstone evaluation rubric. An electronic copy (pdf) of the final version needs to be submitted to the Department Chair for the Department's archive.

(\*\*) The capstone project includes a 15 minutes oral presentation by the student. The talk is given at the Department's capstone session, offered during the last 3 weeks of each semester, and graded by the mentor as part of the capstone evaluation rubric. The capstone session is open to students and faculty with a goal to engage in questions/discussions about the project; undergraduate students before initiation or completion of their capstone project will be particularly invited to get an overview of projects and to learn from others. Dr. Newman will provide 100 pizzas and 3 tons of ice cream !

## **Assessment of Capstone Project**

All capstone projects are assessed using a standard evaluation rubric (attached). Passing the capstone project requires passing the written and the oral part. A student must score "adequate" or above on all aspects of the evaluation for a passing grade. At the end of each semester, the department chair will

query the instructors of current capstone projects, PHYS F400, for their grade and submit them. Three grades are possible,

Grade <b>P</b>	Pass - indicates that the student earned at least an “adequate” on all points on the capstone project evaluation rubric
Grade <b>DF</b>	Deferred - indicates that the student did not complete or pass a capstone project in the current semester. With the passing of a capstone project, the DF grade will convert to a P grade.
Grade <b>F</b>	Fail - Under ordinary circumstances, a DF grade will convert to an F grade only if it remains on the record longer than 3 years, except a student can demonstrate to work actively on the completion of the project. A change of project topic and/or instructor of the capstone project does not result in an F grade for the previous topic.

### **Academic Code of Conduct**

All students are expected to be familiar with the UAF Student Code of Conduct (see UAF catalog) and to follow it at all times. Acts of academic dishonesty will result in at least a failing grade for the current capstone project, can include a report to the UAF Dean of Students, or more severe consequences. Acts of academic dishonesty include, but are not limited to, Cheating or Plagiarism.

Plagiarism is the use of someone else’s ideas, text, data, computer program, or graphics without acknowledging the source. Plagiarism is a serious form of academic dishonesty. Examples include “changing a few words within a copied block of text to obscure its resemblance to the original”, or “copying text verbatim from a print source, including websites, books, reports, or articles, whether published or unpublished, without quotation marks and attribution”.

### **Support Services**

Writing Center - The UAF Writing Center can provide critical feedback on student writing (801 Gruening, 474-5314)

Noyes Computer Lab - All physics students have access to the Noyes Computer Lab (REIC 101) via their polar express card.

Disabilities - The Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. The instructor will work with the Office of Disabilities Services (208 Whitaker, 474-5655) to provide reasonable accommodation to students with disabilities.

Title IX - University of Alaska Board of Regents have clearly stated in BOR Policy that discrimination, harassment and violence will not be tolerated on any campus of the University of Alaska. If you believe you are experiencing discrimination or any form of harassment including sexual harassment/misconduct/assault, you are encouraged to report that behavior. If you report to a faculty member or any university employee, they must notify the UAF Title IX Coordinator about the basic facts of the incident. Your choices for reporting include: 1) You may access confidential counseling by contacting the UAF Health & Counseling Center at 474-7043; 2) You may access support and file a Title IX report by contacting the UAF Title IX Coordinator at 474-6600; 3) You may file a criminal complaint by contacting the University Police Department at 474-7721.

## Final Evaluation of Capstone Project by Faculty Mentor

Student's name \_\_\_\_\_ Date \_\_\_\_\_

Capstone Project Title \_\_\_\_\_

Research Supervisor \_\_\_\_\_

PART A: Paper	Yes (excellent)	Somewhat (adequate)	No (inadequate)
1. Is the capstone project the product of data collection and/or analysis by the student?			
2. Does the capstone paper make a compelling argument for the significance of the student's research within the context of the current literature?			
3. Does the capstone paper clearly articulate the student's research goals?			
4. Are the methods appropriate given the student's research agenda?			
5. Is the data analysis appropriate and accurate?			
6. Does the author interpret the results skillfully and accurately?			
7. Are the tables and figures clear, effective and informative?			
8. Is there a compelling discussion of the implications of findings?			
9. Is the literature review appropriate and complete?			
10. Are the citations presented consistently and professionally throughout the text and in the list of works cited?			
11. Is the writing appropriate for the target audience?			
12. Is the paper clearly communicated and free of language errors?			

PART B: Oral presentation	Yes (excellent)	Somewhat (adequate)	No (inadequate)
1. Does the speaker clearly state the hypothesis or problem?			
2. Does the speaker give enough scientific background for the target audience?			
3. Is the interpretation of the data clear and accurate?			
4. Are the conclusions of the presentation clearly stated?			
5. Does the speaker demonstrate knowledge of the underlying scientific concepts?			
6. Does the speaker show appropriate ability to answer questions from the audience?			
7. Is the presentation well organized?			
8. Is the speed of speech and clarity of voice appropriate for the target audience?			
9. Does the speaker interact with the audience and/or show eye contact?			
10. Is the graphics clear, effective and informative?			
11. Are the references given and cited properly ?			
12. Does the speaker finish in a timely manner ?			

Research Supervisor's Signature \_\_\_\_\_