This course, in conjunction with PHYS 330, fulfills the requirements of a Science Perspective core class and is a required course of the Physics major(s) and counts as an elective for Physics minors. This course also serves as part of the requirement for the Oral Communication Flag.

Core Description: The scientific method has resulted in historically unprecedented changes in our world. In the Modern Physics courses you will learn how science proceeds (PHYS330), and practice the scientific method yourself in a weekly laboratory experience (PHYS331). You will learn the qualities of a good hypothesis or model, how to assess its validity, the significance of a scientific theory, and the elusiveness of "proof." On completing the course, you will be better able to understand and evaluate scientific or pseudoscientific claims that have direct impacts on your personal and professional life.

PHYS331 Student Learning Objectives:
As a Science Perspectives core class and a course requirement for Physics major(s) you can expect the following:

- Students will utilize the scientific method, and differentiate between hypotheses/models, theories and laws. [SP SLO 1.1]
- Students will articulate the nature of evidence, objectivity, data interpretation, the elusiveness of "proof", and reproducibility/replicability. [SP SLO 1.2]
- Students will compare various types of research studies (e.g., observational, experimental, correlational, mechanistic). [SP SLO 1.3]
- 2.1 Students will utilize analytical and quantitative skills to design experiments, collect data, and make measurements. [SP SLO 2.1]
- 2.2 Students will construct and interpret graphs and tables, and calculate and interpret appropriate statistics (e.g. mean, variability, correlation). [SP SLO 2.2]
- A working knowledge of the fundamental principles, physical constants, systems of units, and the measures of basic structures common to their respective major [PHYS SLO 1]
- The ability to identify, formulate, and solve standard problems relevant to their respective major [PHYS SLO 2]
- The ability to design and conduct experiments, as well as to analyze and interpret data [PHYS SLO 3]
- The ability to carry out independent investigation and originality of thought [PHYS SLO 4]
- Effective oral and written communication skills especially with regards to communicating scientific theories and models, data, results, outcomes, and proposals. [PHYS SLO 5]
- Students will demonstrate technical proficiency in the principles and techniques of
theoretical and experimental modern physics. [P331 SLO]

- Students will carry out quantitative analysis of measurements including calculation of mean, standard deviation, chi-squared, and error combination. [P331 SLO]
- Students will demonstrate a working knowledge of how to manipulate and interpret complex sets of data with the use of computer software such as Microsoft Excel. [P331 SLO]
- Students will display effective oral and written communication skills especially with regards to communicating scientific theories and models, data, results, outcomes, and proposals. [P331 SLO]

**Oral Communication Flag Student Learning Outcomes – Student Will:**

- Adapt messages in a variety of communication contexts
- Organize information effectively
- Advocate a supported opinion on complex topics
- Critique challenging messages with respect
- Present messages through a variety of modalities

**Course Description:** In this course you will learn lab techniques that will assist you in further understanding the material covered in Modern Physics I, PHYS 330. This is a two credit hour lab course and is separate from the PHYS 330 lecture with a separate grade. The topics covered in lab predominately complement the lecture, but a few topics are independent material.

**ASSESSMENT INFORMATION** *(see below for information on each type of assessment)*

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td>Pre-Lab Assignment / Lab notebook / Lab summary</td>
<td>35%</td>
</tr>
<tr>
<td>Exams (10% each)</td>
<td>20%</td>
</tr>
<tr>
<td>Formal Lab Report / Scientific Paper</td>
<td>15%</td>
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<tr>
<td>Second Presentation</td>
<td>10%</td>
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<tr>
<td>First Presentation</td>
<td>4%</td>
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<tr>
<td>Talk Outline Worksheets</td>
<td>4%</td>
</tr>
<tr>
<td>Responsible Conduct of Research (CITI Completion)</td>
<td>4%</td>
</tr>
<tr>
<td>CANVAS Oral Communication Module Quiz</td>
<td>4%</td>
</tr>
<tr>
<td>Quality of feedback given to other student presentations</td>
<td>4%</td>
</tr>
</tbody>
</table>

**General rules**

- Writing **must** be clear and legible. If the work cannot be read then it cannot be graded!
- Numbers between -1 and +1 **must** have a leading zero! E.g. -0.4 and not -.4, or 0.67 not .67.
- Numbers **must** be followed by units where applicable. A length of 12.2 tells us nothing. Include units!
**Pre-Lab Assignments**
Pre-lab assignments will be completed in your notebook. You must turn in the original copy (not the carbon copy) at the beginning of each lab; otherwise the grade for that pre-lab is a zero and you will not be prepared for class. Directions/guidance for the pre-labs will be available on Canvas for each lab. Students are responsible for coming to lab prepared with all necessary material.

**Lab notebook/summaries**
The notes that you make prior to the experiment (independent of pre-lab assignment), during the experiment, after the experiment (analysis) and the lab report make up the amount of work that you will tear off the original pages from your lab book and hand in for grading on the deadline specified on the schedule. For more information please see the relevant pages of this document and general rules at the top of this page.

**Scientific paper**
Please see the relevant pages of this document and general rules at the top of this page.

**Exams**
The exams will test your note taking ability, understanding of the science, ability to take measurements and data interpretation skills. You must bring your lab book with you to both exams. Your answers will be written in your lab book! You will be given a colored pen to write with and to circle answers in your lab book. Only information written or circled in colored pen will be graded.

**Presentations**
Students will work through an online CANVAS module designed to introduce them to basic concepts in preparing a talk and public speaking. The module will focus on how to construct an effective talk, introduce students to different platforms available for delivering their talks (e.g., Powerpoint, Keynote, Mathematica, Prezi), and discuss effective public speaking strategies. Students will be assessed through a CANVAS online quiz built into the module.

Each student will be assigned a historical figure in modern physics, and asked to present a five-minute lecture that discusses the relevance of that person’s work to the field of modern physics to the rest of the class. An effective provides a brief biography of the individual, provides background information regarding the field in which the individual contributed to, and explains what contribution that individual made to that field.

Each student will present one experiment of their choosing (pick one that you found most interesting!). The presentation will consist of a 8 minutes long talk in front of the class and will have 2 minutes for a question. An effective talk clearly states the purpose of the experiment, describes how the experiment was performed; presents data in an effective manner, and gives meaningful results.
A projector will be available for projecting images from a computer screen (e.g. Powerpoint). You are welcome to come to see me prior to the presentations to talk about what you want to present.

Both talks will have a peer-review and peer-assessment component, and the second talk will also have a self-assessment component. These components will be described in a later document.

**Responsible conduct of research / CITI completion**

Please see relevant pages of this document.

**Late work**

All lab reports turned in late will be penalized 1/3 of a letter grade for each class day late (i.e. from B to B- for each day late). Following departmental policy, lab reports turned in 2 weeks after the due date will be awarded zero unless prior arrangements are made.

**Grading scale:**

<table>
<thead>
<tr>
<th>Grade</th>
<th>93-100 A</th>
<th>90-92 A-</th>
<th>87-89 B+</th>
<th>83-86 B</th>
<th>77-79 C+</th>
<th>70-72 C-</th>
<th>67-69 D+</th>
<th>60-66 D</th>
</tr>
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<tbody>
<tr>
<td></td>
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*Below 60 F*
PHYS398 – Physics Thesis
Common Syllabus

Course Description and Goals
The Physics Thesis (PHYS398) course is a capstone experiences designed to give students an opportunity of presenting their results from an independent and creative exploration of a topic in physics (typically performed during the Physics Research course – PHYS395).

Common Meetings
All students enrolled in PHYS398 are expected to attend three Common Meetings during the spring semester. Meetings will be scheduled at the start of the semester, and the dates and locations will be e-mailed to students as soon as possible.

Course Components
Research paper – students will work on a research paper throughout the semester. The paper should be written in the style of a professional journal article, as chosen by the faculty advisor, and be written in Google Docs. An initial draft of the paper will be due by Spring Break, with a second draft due by Easter Break. The final manuscript is due by the last day of semester classes. Missed deadlines will result in the lowering of the grade.

Research talk – students will present a short talk (10 – 15 minutes) during the department’s Senior Research Seminar. Students will be notified of the date and time of the seminar early in the semester. Each faculty member attending the talk will fill out an assessment form that will be used to provide feedback to both student and faculty advisor.

Research poster – students will present a poster at Xavier’s Celebration of Student Research and Creative Activity (usually held in April). Students will receive a formal invitation to present at this event during the semester, and must submit an abstract of their work as instructed in the invitation.

The Research talk and poster serve the Oral Communication Flag. The talk will therefore follow the same timeline and requirements as used for the Lab Experiment talk given in Modern Physics I Lab. A syllabus for PHYS 331 that articulates the SLOs of the Oral Communication Flag, as well as the required components and assessment for the talk can be found on the CANVAS page.

Student Responsibility
Students are responsible for setting up meetings with advisers and adhering to all deadlines. Students are expected to monitor their Xavier e-mail accounts for course specific information, and to reply in a timely manner.
Failure to do so will result in a lowering of Part III of the course grade (see next page), and will not be accepted as a valid reason for missing a deadline.

**Grading** – The following rubric serves to determine a student’s grade for the course:

**Part I – Effort and responsibility**

**Talk**

<table>
<thead>
<tr>
<th>Submitted materials to advisor for review prior to presentation. Made appropriate corrections in final presentation.</th>
<th>Submitted materials to advisor for review prior to presentation. Did not make appropriate corrections in final presentation.</th>
<th>Did not submit materials to advisor prior to presentation. Presented the talk as scheduled.</th>
<th>Did not present a talk, and no valid excuse was given, but showed evidence of doing work on presentation.</th>
<th>Provides no evidence of work.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Poster**

<table>
<thead>
<tr>
<th>Submitted materials to advisor for review prior to presentation. Made appropriate corrections in final presentation.</th>
<th>Submitted materials to advisor for review prior to presentation. Did not make appropriate corrections in final presentation.</th>
<th>Did not submit materials to advisor at least two days prior to presentation. Presented the poster as scheduled.</th>
<th>Did not present a poster, and no valid excuse was given, but showed evidence of work done on poster.</th>
<th>Provides no evidence of work.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Paper**

<table>
<thead>
<tr>
<th>Student submitted drafts that showed steady progress throughout the semester. Submitted final paper by due date.</th>
<th>Students submitted drafts, but showed minimal effort. Submitted final paper after due date.</th>
<th>Students submitted drafts, but did not turn in final paper.</th>
<th>Student submitted drafts that showed minimal effort, but did not turn in final paper.</th>
<th>Student showed no effort.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Part II – Combined Points from Talk and Thesis Rubrics (70 max) / 10 _______**

**Part III – Quality points based on quality of work, displayed dedication to project, and professionalism displayed throughout the semester: 0 – 11 points at the discretion of adviser.**

TOTAL: ________________

25 – 30 A  
20 – 24 B  
15 – 19 C  
4 – 14 D