Illinois State University Department of Physics

B.S. in Physics Assessment Plan

September 2018

Introduction

It is increasingly important for educational programs to have ongoing reviews of courses and curriculum in an effort to improve quality and ensure relevance and to meet the needs of students and their potential employers. Part of that process is to undertake periodic assessment of student learning at the introductory, intermediate, and advanced undergraduate stages via a variety of direct and indirect measures outlined in this plan.

The mission of the Department of Physics strongly reflects its dedication to the education of students. The mission of the department is

1. Provide a high quality undergraduate physics experience, offering physics, computational physics, and physics teaching degrees as well as a dual degree program in engineering and physics, with the goal of becoming the first choice school in physics for Illinois students.
2. Carry out research and scholarship that is recognized on a national and international level.
3. Maintain and expand a vigorous undergraduate research program that is second to none nationally by providing a supportive learning environment in which undergraduate students are active participants in forefront research.
4. Provide meaningful co-curricular activities, offering students significant experiences applying their skills and knowledge to a variety of out-of-class projects.
5. Maintain the preeminent undergraduate physics teacher education program in Illinois and further establish its national reputation.
6. Provide a robust computational physics program, including integration of computational methods into all physics major courses and offering a bachelor’s degree in Computational Physics, unique in the nation, focusing on computer simulation of physical systems.
7. Maintain and continue to develop effective courses that support the University-wide commitment to general education.
8. Provide a strong outreach and public education program that extends to members of the campus, the wider community, and the profession, and which serves the public interest by sharing our experience and expertise through educational activities, scientific analysis and explanation, and a continuing effort to foster scientific literacy.

Sequences and Learning Objectives

The department currently offers four sequences within the B.S. Physics major. They are: physics (PHY), computational physics (CPY), engineering-physics (3-2 program) (EGP), and physics teacher education (PTE). During the first two years of these sequences, students take a common core of courses:

Course	Title
107	Frontiers in Physics
110	Physics for Scientists and Engineers I
111	Physics for Scientists and Engineers II
112	Physics for Scientists and Engineers III
217	Methods of Theoretical Physics
220	Mechanics
240	Electricity & Magnetism
270	Experimental Physics
284	Quantum Mechanics

Note that the PTE majors take either 240 or 284 as they are not required to take both courses.

Common Core Learning Objectives: **Introductory Level**

Objective *Students will demonstrate at least a basic level of competency in…*	**Assessment Tools**	**Related Courses**
conceptual understanding and application of physical laws.		PHY 110, 111, 112
mathematics (calculus and vector analysis).	Exams and other assignments	MAT 145, 146, and 147 and core physics courses
computer skills: elementary programming and graphical visualization of data.	Computer assignments in physics courses, exams and assignments	PHY 107 – 112 IT 165, 166, or 168
elementary experimental techniques.	lab reports and/or data sheets in introductory lab sections	PHY 110, 111, 112
modeling and solving real-world problems.	quantitative problems (on exams, homework, online exercises) that focus on translating physical situations into physics models, integrative problems that incorporate real-world physics, out-of-class projects, and research experiences	PHY 110, 111, 112 Project-based or research progress for those participating
communication of scientific data, results, and analysis.	written assignments, including homework, lab, and computer assignments	PHY 107, 110, 111, 112

Common Core Learning Objectives: **Intermediate Level**

Objective *Students will demonstrate at least an intermediate level of competency in…*	**Assessment Tools**	**Related Courses**
conceptual understanding, physical intuition, and application of physical laws.	homework, exams, and other assignments	PHY 217, 220, 240, 270, and 284
mathematics (vector calculus, linear algebra, and differential equations).	sophisticated problems that may include proofs or rigorous derivations completed in homework, exams, or other assignments	MAT 175 and 340 PHY 217 and application of these methods in intermediate physics courses
computer analysis (numerical methods, symbolic computing, 2D visualization).	computer projects involving analysis and solution of physics problems using numerical methods	PHY 220, 240, 270, and 284 application of these methods in research
experimental methods (sophisticated measurement methods, uncertainty and error analysis).	full lab reports, posters, or oral presentations	PHY 270 application of these methods in research
modeling and approximation skills (including applying symmetry as a tool for physical situations and problem solving).	homework, exams, and other assignments requiring these skills	PHY 217, 220, 240, 270, and 284
scientific communication.	written assignments, including homework, lab reports, computer projects, posters, and oral presentations	PHY 217, 220, 240, 270, and 284 research presentations at symposia or conferences

Advanced courses in the Physics sequence include the following:

Course	Title
307	Seminar In Physics
320	Mechanics II
325	Thermal Physics
330	Optical Physics
340	Electricity & Magnetism II
355	Solid State Physics
370	Advanced Experimental Physics
371	Biophysics of Neurological Systems
375	Electronics for Scientists
380	Topics in Contemporary Physics
384	Quantum Mechanics II
387	Methods of Mathematical Physics

Learning Objectives: **Advanced Level: Physics and Engineering-Physics**

Objective *Students will demonstrate an advanced level of competency in…*	**Assessment Tools**	**Related Courses**
conceptual understanding, physical intuition, and application of physical laws.	homework problems, exams and other assignments are more detailed and complex	PHY 320, 325, 340, 384 and other 300-level physics electives
mathematics (partial differential equations, Fourier analysis, eigenanalysis, etc.).	sophisticated problems that may include proofs or rigorous derivations completed in homework, exams, or other assignments	300-level physics (or equivalent level engineering) courses and corresponding mathematics courses
computational physics (simulation methods, symbolic computing, and visualization)	computer projects that demonstrate application of these methods	advanced computational projects for physics and/or computer courses or research
experimental physics (design and implementation of experiments, computer interfacing, data acquisition and analysis).	experimental projects	PHY 370 research projects
modeling of physical phenomena (solution methodology, computer development, and implementation).	computer assignments and homework problems	300-level physics courses research projects
scientific communication.	written assignments, including homework, lab reports, computer projects, posters, and oral presentations	PHY 307 and 370 research project reports oral and/or poster presentations at conferences

Learning Objectives for Physics Teacher Education Sequence

The Physics Teacher Education sequence has developed an assessment plan in concert with the National Science Teachers Association Standards for Science Teacher Preparation.

Specialized courses in the Physics Teacher Education sequence include the following:

Course	Title
205	Origin of the Universe
208	Astronomy and Space Science
209	Introduction to Teaching High School Physics
302	Computer Applications in High School Physics
310	Reading for Teaching High School Physics
311	Teaching High School Physics
312	Physics Teaching from the Historical Perspective
353	Student Teaching Seminar

NSTA Standard 1: Content

The student teacher understands and can articulate the knowledge and practices of contemporary science; can interrelate and interpret important concepts, ideas and applications in their field of licensure; and can conduct scientific investigations. **(All required PHY courses)**

Dimensions	**Unacceptable (0)**	**Basic (1)**	**Proficient (2)**	**Accomplished (3)**
1a. Concepts and principles understood through science.	Shows through teacher performance and inadequate or very limited understanding of physics content knowledge; makes frequent mistakes in terms of scientific concepts and principles; fails to prepare adequately to teacher science content	Demonstrates strong and significant understanding of the major concepts in all fields for which licensure is sought, consistent with the National Science Education Standards, recommendations of the NSTA, and as assessment of the needs of teacher at each level of preparation	Exhibits a conceptual understanding of concepts in all fields taught and demonstrates a progressive ability to identify and link major organizing concepts.	Presents a strong, flexible understand-ing of the major conceptual interrelationships in the field, and applies this understanding to planning and instruction.
1b. Concepts and relationship unifying science domains.	Rarely, if ever, demonstrates or draws attention to the broad applicability of science to real-world phenomena; fails to interrelate science content areas.	Demonstrates ability to develop a thematically unified framework of concepts across the traditional disciplines of science education standards.	Thematically unifies concepts from the different traditional disciplines of science in a relevant and appropriate manner.	Regularly unifies science concepts from diverse disciplines on natural science, facilitating development of an interdisciplinary understanding of science.
1c. Processes of investigation in a science discipline	Fails to provide or draw attention to the scientific problem-solving process; does not speak metacognitively about nature of process; expect student to learn merely from observation of examples.	Conducts limited but original researching science, demonstrating the ability to design and conduct open-ended investigations and report results in the context of one or more science disciplines.	Significantly incorporates design and use of investigation and problem solving as the context for instruction in the classroom; engages students in research projects	Actively and regularly employs mathematics and statistics to develop fundamental concepts in science, to analyze and explain data, and to Convey the nature of science to students.
1d. Application of mathematics in science research	Places very considerable emphasis on the mathematical problem-solving process to the exclusion of the inquiry process; over emphasis on verification labs; little emphasis on the use of mathematics to derive new knowledge.	Provides evidence of the ability to use mathematics and statistics to analyze and interpret data in the context of science.	Uses activities employing mathematics and statistics to develop fundamental concepts in and science and to analyze and explain data.	Actively and regularly employs mathematics and statistics to develop fundamental concepts in science, to analyze and explain data.

NSTA Standard 2: Content Pedagogy

The student teacher creates a community of diverse learner who construct meaning from their science experiences and possess a disposition for further exploration and learning. **(PHY 310, 302, 311, 312, 353)**

Dimensions	**Unacceptable (0)**	**Basic (1)**	**Proficient (2)**	**Accomplished (3)**
1a. Science teaching actions, strategies and methodologies.	Teachers in a way that suggests that a variety of students are not present in the classroom	Plans and incorporates science teaching strategies appropriate for learning with diverse backgrounds and learning styles.	Plans for and regularly includes alternative activities to teach the same concept; is able to identify primary differences in learners in the student population.	Demonstrates a command of alternative strategies to meet diverse needs and systematically provides activities that meet those needs.
5b. Interactions with students that promote learning and achievement in collaborative experiences	Aloof from students; does not actively engage students intellectually or emotionally; fails to encourage maximum student learning.	Demonstrate the ability to effectively engage students in learning science, both individually and in group work of various kinds.	Regularly includes group as well as individual activities to teach science, allowing learners latitude in organizing groups according to their age and background.	Addresses the role of social and group interactions as a basis for conceptual learning and inquiry.
5c. Use of advanced technology to extend and enhance learning.	Fails to take advantage of appropriate and available teaching technology such as demonstration materials, laboratory equipment, and computer resources.	Uses appropriate technology, including computers to provide science instruction	Regularly incorporates available technology into instruction. Involves student in the use of technology for investigating.	Identifies information technologies as fundamental to teaching, learning and practice of science and engages students both in use of technologies and understanding of their role in science and learning
5d. Use of prior conceptions and student interest to promote new learning.	Does not link current learning with prior learning; fails to take into account students preconceptions; does not engage students with incongruity when possible to do so.	Identifies common student misconceptions or naïve conceptions in the teaching field.	Begins to systematically identify and anticipate student misconceptions and plans activities and discussions to address ad modify them.	Regularly anticipates misconceptions and naive conceptions and uses assessment as basis for constructing more scientifically acceptable concepts and relationships.

NSTA Standard 3: Learning Environments

The student teacher engages students both in studies of various methods of scientific inquiry and in active learning through scientific inquiry. **(PHY 310, 311, 312, and 353)**

Dimensions	**Unacceptable (0)**	**Basic (1)**	**Proficient (2)**	**Accomplished (3)**
3a. Questioning and formulating solvable problems. Student analysis of data and conclusions	Places emphasis on answers rather than questions; uses a didactic pedagogy rather than one that is inquiry oriented; teacher-centered classroom rather than student-centered.	Plans and implements data-based activities requiring students to reflect upon their findings, make inferences, and link new ideas to preexisting knowledge.	Regularly requires students to collect, reflect upon and interpret data, to report the results of their work, and to identify new problems for investigation.	Consistently engages students in critical discussion about the results of their inquiry, interpretations of their results, the implications of their conclusions and possible new problems.
3b. Questioning and discussion to analyze data and draw conclusions from diverse perspectives.	Acts more like a sage on the stage rather than a guide on the side; little emphasis on the questioning and answer-finding process; teacher monopolizes classroom discussion or lectures excessively; individual activities emphasized over group activities.	Uses questions to encourage inquiry and probe for divergent student responses, encouraging student questions and responding with questions when appropriate.	Regularly uses divergent and stimulating questioning to define problems and stimulate reflection; leads students to develop questions appropriate for inquiry in a given area.	Skillfully facilitates classroom discourse through questioning, reflecting on, and critically analyzing ideas, leading students toward a deeper understanding of the inquiry process itself. Uses questions to define problems and potential solutions.
3c. Reflecting on and constructing knowledge from observations and data, utilizing multiple strategies.	Tells student "what they need to know" rather than helping students to learn through scientific processes what they need to know; fails to make use of data collection and interpretation.	Plans and implements activities with different structures for inquiry including inductive (exploratory), correlational and deductive (experimental) studies.	Involves students in diverse investigations, analysis of investigative structures and discussion of criteria for analyzing outcomes.	Systematically integrates investigations with different formats into classroom work, and relates student work to research traditions that typify the various sciences.
3d. Developing concepts and relationships from observations and data.	Conveys information rather than helps students construct it from observation and analysis.	Encourages productive peer interactions and plans both individual and small group activities to facilitate inquiry.	Systematically provides students with opportunities to engage in inquiry with peers using a variety of formats.	Skillfully meshes opportunities for science-related inquiry with critical reflection on the role of the individual as an inquirer in a collective context.

NSTA Standard 4: Safety

The student teacher organizes safe and effective learning environments that promote the success of student and the welfare of all living things, requires and promotes knowledge and respect for safety. **(PHY 302, 311, 312, 353)**

Dimensions	**Unacceptable (0)**	**Basic (1)**	**Proficient (2)**	**Accomplished (3)**
4a. Prudent and professional practice with due regard to safety and liability.	Seems to be unaware or shows disregard for rules of prudent and professional conduct; puts self, cooperating teacher, or school district at risk of liability; fails to quickly remediate hazardous situations once identified.	Understands liability and negligence, especially as applied to science teaching and can take action to prevent potential problems.	Takes action to prevent hazards and communicates needs and potential problems to administrators.	Stays informed of potential hazards and legal concerns and communicates with other teachers to maintain a school environment free of potential problems.
4b. Safety in regards to science teaching materials.	Shows disregard for commonly accepted rules of safety.	Some gaps in safety knowledge. Actively working to increase knowledge of safe practices.	Consistently exercises safe practices in classroom and storage of materials.	Always practices safe techniques in the preparation, storage, usage, and disposal of materials. Emphasizes safety practices to students.
4c. Safety in all areas related to science instruction.	Shows positive disregard to student health and safety; fails to implement safety procedures or conduct cost-to- benefit evaluations.	Understands and sets up procedures for safe handling, labeling and storage of chemicals, and electrical equipment. Knows actions to take to prevent or report an emergency.	Demonstrates that safety is a priority in science and other activities; can take appropriate action in an emergency.	Systematically ensures safety in all areas and takes whatever steps are necessary to ensure that the school science program is conducted safely.
4d. Treatment and ethical use of living organisms.	Shows little care for living specimens; does not follow accepted norms for ethical maintenance and use of living organisms.	Knows the standards and recommendations of the science education community for the safe and ethical use and care of animals for science instruction.	Adheres to the standards of the science education community for ethical care and use of animals; uses preserved or live animals appropriately in keeping with the age of students and the need for such materials.	Adheres to the standards of the science education community for ethical care and use of animals; uses preserved or live animals appropriately in keeping with the age of students and the need for such materials.

NSTA Standard 5: Impact on Student Learning

The student teacher constructs and uses effective assessment strategies to determine the backgrounds and achievements of learners and facilitate their intellectual, social, and personal development. They assess student fairly and equitably, and require that student engage in ongoing self-assessment. **(PHY 310, 311, 312, 353)**

Dimensions	**Unacceptable (0)**	**Basic (1)**	**Proficient (2)**	**Accomplished (3)**
5a. Alignment of goals, instruction and outcomes.	Formal and informal assessments improperly aligned or not aligned with stated teaching goals and student performance objectives; non-existent or incomplete objectives.	Identifies and uses the most appropriate methods for gathering information about student learning, based on student needs and characteristics and the goals of instruction.	Employs multiple methods to systematically gather data about student needs, abilities and understanding and reflects upon goals of instruction.	Creates new methods for helping students demonstrate knowledge, and uses results to alter classroom practices.
5b. Use of outcome data to guide and change instruction.	Does not alter teaching on the basis of assessed learning outcomes; fails to remediate inadequate learning as evidenced by poor student performance.	Demonstrates the ability to use multiple strategies to assess teaching and learning authentically, consistent with national standards and goals for science education.	Uses multiple resources for assessment and can cite changes in practices made because of assessment.	Continuously experiments with new assessment techniques, including those suggested in the literature, and reflects on its meaning for altered practice.
5c. Demonstrates effectiveness as reflective practitioner.	Does not reflect upon teaching experiences that might otherwise help to improve practice; fails to complete daily and/or weekly reflections with cooperating teacher.	Engages in reflective self-assessment and develops a system for self-assessment as a practicing teacher.	Engages in reflective self-assessment and uses a system to self-assess, modifying practice and the system of assessment as required.	Regularly modifies and informs practice through multiple self-assessment indicators.
5d. Measurement and evaluation of student learning in a variety of dimensions.	Uses a very limited variety of means to assess student knowledge and intellectual process skills.	Aligns assessment with goals and actions and uses results to alter teaching.	Guides students in formative self-assessment, relating each tool to specific learning outcomes.	Regularly and consistently provides students with varied opportunities to demonstrate their individual learning and reflect on their own learning.

NSTA Standard 6: Professional Knowledge and Skills

The student teacher strives continuously to grow and change, personally and professionally, to meet the diverse needs of their students, school, community, and profession. **(PHY 311, 312, 353)**

Dimensions	**Unacceptable (0)**	**Basic (1)**	**Proficient (2)**	**Accomplished (3)**
6a. Knowledge of, and participation in, the activities of the professional community.	Fails to participate with cooperating teachers and/or school faculty in professional development activities, even after encouraged to do so. Does not participate in regular professional growth activities such as meetings, workshops, and/or membership in professional organizations.	Understands the concept of a community of learners and interacts with instructors and peers as a member of such a community. Participates in student associations, workshops and activities related to science teaching and reads journals of professional associations in the field.	Applies the concept of a community of learners to science teaching and learning in the school environment. Joins state and national professional associations for science teachers and regularly reads publications to improve teaching and stay abreast of current events in the field.	Works with others science professionals to develop opportunities for continuous learning as members of a professional education community. Attends regional, state and some national conventions, conferences and workshops in science education; takes leadership or participates as a presenter in such gatherings.
6b. Willingness to work with students and new colleagues as they enter the profession.	Fails to interact with peers either inside or outside of school events/ activities.	Takes personal responsibility for growth and for assisting others who are preparing to teach science.	Takes responsibility for assigned classes and students and works with other teachers to develop high quality learning experiences in science.	Takes responsibility for new science teachers, student teachers and practicum students and works with them collegially to facilitate their growth and entry into the profession.
6c. Willingness to work with the cooperating teacher, other teachers, staff, parents and students.	Fails to comply with reasonable directives promulgated by the cooperating teacher or other competent and authorized school officials.	Demonstrates the ability to handle problems and tension calmly and effectively, and to relate to peers, instructors, supervisors, and students with integrity.	Treats colleagues, students, parents, and supervisors with respect and takes action to solve problems amenable to solution.	Demonstrates a record of professional integrity and the respect of colleagues, administrators, parents and students.

Final Student Teaching Evidence:

1. Performance on ISBE Physics Content Test
    - Students must pass the Physics Content Test with a minimum score of 240.

2. Performance on edTPA
    - Student must pass the edTPA. A passing score for 2018-2019 academic year is 39. A passing score for 2019-2020 academic year is 41 and will remain at 41 for the foreseeable future.

Specialized courses in the Computational Physics sequence include the following:

Course	Title
318	Methods of Computational Physics
388	Advanced Computational Physics
390	Computational Research in Physics

Learning Objectives: **Advanced Level: Computational Physi**cs

Objective *Students will demonstrate an advanced level of competency in…*	**Assessment Tools**	**Related Courses**
conceptual understanding, physical intuition, and application of physical laws through the application of computational methods and simulation.	homework problems, exams and other assignments are more detailed and complex	PHY 320, 325, 340, 384 and other 300-level physics electives, including PHY 318 and 388.
mathematics (partial differential equations, Fourier analysis, eigenanalysis, etc.).	sophisticated problems that may include proofs or rigorous derivations completed in homework, exams, computer projects, or other assignments	300-level physics (or equivalent level engineering) courses and corresponding mathematics courses
computational physics (simulation methods, symbolic computing, and visualization)	computer projects that demonstrate application of these methods	PHY 318 and 388 and other 300-level courses advanced computational projects for physics and/or computer courses or research
scientific communication.	written assignments, including homework, computer projects, posters, and oral presentations	PHY 318 and 388 research presentations at symposia or conferences
a capstone project.	formal written report and oral presentation(s)	PHY 390

Direct and Indirect Measures of Student Learning and Proficiency

Direct evidence of student learning is provided by artifacts that are collected during a course, including: exams, pre- and post-testing, papers, lab reports, computer code, electronic notebooks, written homework assignments, capstone projects, recordings of oral presentations, and other equivalent items. It can also include designs and student-fabricated electric circuits or experimental equipment.

The department assessment coordinator will meet with faculty at the beginning of the semester during which a given course is scheduled for review to determine the artifacts that will be collected throughout the semester that are expected to demonstrate student learning for applicable learning objectives. For large courses, artifacts from a representative sample of students (approximately 10 % of the class) will be collected and saved until the end of the semester. For medium-sized courses, artifacts from 6 representative students will be collected. For courses that have less than 6 students, artifacts for all of the students will be collected. The representative sample should accurately reflect the range of quality of work for a given assignment.

Indirect evidence can be provided by surveys, reflective essays, or interviews of various stakeholders, including: students, faculty, alumni. Additional measures are found via department and university records of retention and graduation rates, job placement rates, faculty publications and presentations that include students, co-curricular projects, as well as awards and scholarships or other honors.

In a student's final semester after the student has filed the application for graduation, the graduating student will have an appointment with the department chairperson. The student will first complete an **exit survey** (see Appendix A), which then forms the basis for an exit interview given by the chairperson. The written survey and additional notes taken during the interview will be an important indirect measure. The Assessment Coordinator will also reach out to alumni for discussion and formal surveys concerning their views on their physics education and skills needed in their careers.

Assessment Coordinator

Each year, the department chair will appoint an Assessment Coordinator, who shall:

- maintain and update the department assessment records as outlined in this plan
- coordinate with faculty assigned to the courses to be reviewed during each semester following the schedule given in Appendix B to determine which items will be collected from each course for assessment of the established learning outcomes for that course
- carry out the assessment evaluation for items collected during the previous semester by applying the rubric given in Appendix C
- interview the individual faculty to reflect on student performance in the course and to discuss the outcome of the assessment of direct and indirect evidence of student learning related their course and to establish possible means for course improvement
- present a written or oral general report of the results of the assessments to the department when requested by the department chairperson

- be an active member of the department curriculum committee by helping to bring about data-driven programmatic improvement
- provide data and assist with Academic Program Review carried out by the Academic Review Committee on a periodic basis

Appendix A

Exit Interview Survey

1. What are your plans for after graduation (job, grad school, etc.)?

2. At this point do you feel your physics degree has helped you accomplish your professional goals?

3. What could the physics department have done to provide you better help in accomplishing your goals?

4. How did you decide to choose physics (or physics teaching) for your professional career?

5. How did you decide to choose Illinois State for your undergraduate education?

6. How would you describe your experience here at ISU?

7. With regard to your learning physics, which was your best course and why?

8. In which course do you feel you had the most difficulty in learning physics and why?

9. Do you have any suggestions on better ways to teach physics or computational methods?

10. Were your courses appropriate, helpful, and sufficient to meet your needs?

11. Were the required math courses appropriate, helpful, and sufficient to assist you in your physics studies? Explain.

12. Which general education courses were interesting or helpful to you?

13. Self-reflection on learning

The physics department has defined a set of learning objectives for physics majors. Please rate your level of confidence in your learning on each of the following by circling the appropriate number. Note that 9 is the highest or most advanced level and 1 is the lowest possible level.

	introductory			intermediate			advanced		
knowledge of physics concepts	1	2	3	4	5	6	7	8	9
problem solving	1	2	3	4	5	6	7	8	9
creating physical models	1	2	3	4	5	6	7	8	9
laboratory skills	1	2	3	4	5	6	7	8	9
computational skills	1	2	3	4	5	6	7	8	9
research skills	1	2	3	4	5	6	7	8	9
scientific communication: written	1	2	3	4	5	6	7	8	9
scientific communication: oral	1	2	3	4	5	6	7	8	9

14. What are three physics topics that you feel you know very well and can explain to others?

15. What are three physics topics that you have heard about but cannot explain to others?

Appendix B

Course Review Schedule*

	2018	2019		2020		2021	
Course	Fall	Spring	Fall	Spring	Fall	Spring	Fall
107			X				
110	X					X	
111		X					X
112			X				
205				X			
208					X		
209			X				
211						X	
217		X					
220					X		
240					X		
270		X					
284				X			
302	X						X
307			X				
310		X					
311					X		
312				X			
318		X				X	
320		X					
325	X						X
330			x				
340				X			
353						X	
355		X					
370					X		
371	X						X
375				X			
380	X						
384						X	
387							
388			X				
390				X			

*subject to change, depending on future course offerings.

Appendix C

Course Review Rubric

Performance Indicator	1. Beginning	2. Intermediate	3. Advanced or Proficient	4. Exemplary
conceptual understanding and application of physical laws	• little knowledge or understanding of physics concepts • cannot identify concepts involved in given physical situation • cannot properly apply appropriate equations to a given physical situation	• identifies some physics concepts involved in a physical situation • sometimes properly applies appropriate equations for a given physical situation • some knowledge of how to apply facts	• understands and can identify key concepts • properly applies appropriate equations • adequate knowledge of facts	• demonstrates full understanding of physics concepts • consistently and accurately applies appropriate equations to given physical situations
mathematics	• exhibits little knowledge of the required level of mathematics • little knowledge of how to apply factual information in problem-solving	• correctly applies appropriate mathematical techniques some of the time • demonstrates basic understanding of relationships between variables • can provide a derivation or proof that is mostly correct	• correctly applies appropriate mathematical techniques most of the time • exhibits a very good understanding of relationships between variables • can provide a derivation or proof that is correct	• correctly applies appropriate mathematical techniques • can use multiple approaches to a given problem • fully understands relationships between variables • can apply mathematical techniques beyond the scope of a given problem
computational physics	• little or no ability to use computer applications (Excel, graphing software, Mathematica, etc.) • little or no knowledge of a programming language • little or no knowledge of computer simulation techniques • little or no knowledge of numerical methods	• sufficient ability in the use of computer applications • can write nearly error-free simple programs in one or more computer languages • can create a basic physics simulation • demonstrates some knowledge of the methods of computational physics	• intermediate to advanced ability in the use of computer applications • can write nearly error-free intermediate programs in one or more computer languages • can create a sophisticated physics simulation • demonstrates sufficient knowledge of the methods of computational physics	• application of significant computational methods in research or class project • creation of an advanced physics simulation • advanced application of numerical methods

Course Review Rubric (*continued*)

experimental physics	• no description of experimental procedures, key variables, data acquisition and analysis, or theoretical basis • data acquisition contains significant errors or data is stated with unrealistic accuracy • no understanding of uncertainty • no error analysis • missing large amounts of data • no comparison with appropriate physical models • no discussion of experimental results • inappropriate relationships between variables	• description of procedures is present, but flawed • data collection is flawed • data acquisition doesn't include information on instrument precision or accuracy • data range is significantly limited • weak comparison made to theoretical model • differences identified, but not explained • partial discussion of experimental results	• adequate experimental design • nearly all variables identified • data acquisition well formulated and carried out properly • theoretical basis of experiment well established • adequate comparison made to appropriate model that includes important relationships between variables • proper identification of errors and application of uncertainty analysis	• well thought out experimental design • all relevant variables and externalities identified • detailed data acquisition procedures, including instrument information, sufficient data collected • thorough discussion of results and models • discussion of possible improvements for future work
modeling and solving real-world problems	• little knowledge of physical models • identified model is inappropriate • cannot relate real world situation to a model • unable to convert a real-world situation into a model	• some knowledge of models • demonstrates basic understand-ing of relation-ship between models and a real-world situation • partially converts real-world situation into a model	• adequate knowledge of physical models and their relationship to real-world situations • can convert a real-world situation into a physical model • recognizes limitations to a given model	• knowledge of most relevant models • can create a complete model that converts a real-world situation into an appropriate model with respect to given problem context • fully understands the limitations of a given model

Course Review Rubric (*continued*)

scientific communication	• poor introduction • poor organization • inaccurate information • presents little understanding of the topic • poor use of language • for oral presentations: poor preparation, lack of eye contact, unprofessional in appearance or manner, does not convey interest in topic • lack of discussion of results • lack of conclusions • references missing	• confusing organization • incomplete list of references • presents basic information, but some may be incorrect • ideas not expressed clearly • data analysis is weak • figures are confusing or mislabeled • several errors in grammar, spelling, and punctuation • awkward use of language • little evidence of proofreading • for oral presentations: unclear speech, speaker has little confidence, occasional eye contact, limited use of expression	• generally complete and logical organization • sufficient introduction, data presentation, discussion, and conclusions • complete references • few errors in language • presents correct and sufficient knowledge of topic • figures are clear and well described in text and captions • data analysis is complete • text is well-written to convey ideas in a professional manner • for oral presentations: speaks well with few language errors, speaks with confidence, good eye contact, gestures and facial expression is natural	• professional quality manuscript • complete and clear organization • professional quality figures • data analysis is thorough and complete • figures used to present results that are well described in text and captions • all text is original to the author • ideas are fully developed and presented clearly • minor errors, if any, in language • written in an engaging manner • for oral presentations: clear voice that is easily understood by diverse audience, presented with confidence and in a professional manner, excellent eye contact, engages with audience, natural expression that conveys enthusiasm for content