1. Catalog Description of the Course. [Follow accepted catalog format.]

Prefix PHYS  Course# 306  Title MODERN PHYSICS  Units (3)
1.5 hours lecture twice per week
☐ Prerequisites PHYS 101 or PHYS 201, MATH 151
☐ Corequisites

Description Survey of modern physics. Topics include: Special relativity, the Bohr model, Quantum mechanics; photons, the photoelectric effect, probability density, matter waves, Schrodinger mechanics of simple systems, the Uncertainty Principle, tunneling, spin and angular momentum, atomic and molecular structure. Selected topics from nuclear and solid state physics. Applications of the principles will be emphasized.

Graded
☐ Gen Ed  ☐ CR/NC  ☐ Repeatable for up to  units
Categories
☐ Lab Fee Required  ☒ A - Z  Total Completions Allowed

2. Mode of Instruction.

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<tr>
<th>Component</th>
<th>Units</th>
<th>Hours per Unit</th>
<th>Benchmark Enrollment</th>
<th>Graded Component</th>
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3. Justification and Learning Objectives for the Course. (Indicate whether required or elective, and whether it meets University Writing, and/or Language requirements) [Use as much space as necessary]

This course will become an elective for the Applied Physics Minor: and will be a requirement for the Applied Physics major, when it is implemented. It may also be taken by many Computer Science and Math majors.

Through this course, students will be able to
• explain the basic concepts and principles of relativity, gravity and quantum theory
• describe light as quantized particles and electromagnetic waves
• describe radioactivity and nuclear reactions
• describe quarks and elementary particles
• explain conservation and symmetry theories
• apply the basic concepts and principles of modern physics to everyday applications
• connect concepts and representations found in modern physics (such as graphs, diagrams, and equations) to objects in the real world
• apply problem-solving skills to practical problems in modern physics
• demonstrate the role of modern physics in other disciplines, and apply their understanding to these disciplines
• search and retrieve practical information
• use a variety of simulation programs, featuring data analysis and display, to derive conclusions about experimental situations
• organize and express ideas clearly and convincingly in oral and written forms.

The course does not meet the University Writing and/or Language requirements.

4. Is this a General Education Course  YES ☒ NO ☐

If Yes, indicate GE category and attach GE Criteria Form:

A (English Language, Communication, Critical Thinking)
A-1 Oral Communication
A-2 English Writing
This course is a survey of modern physics. Classical physics is used to explain the every-day world in which we live. The theories of special and general relativity extend classical physics into the realm of the very fast - speeds approaching the speed of light. The theories of quantum mechanics extend classical physics into the realm of the very small - atomic dimensions and smaller. The story of modern physics includes the men and women who have performed the experiments and developed the theories. In this course, we will explore the relativity and quantum theories, their mathematical development, their experimental interdependence, and their historical context.

Relativity is essentially a new way of understanding kinematics, in the language of the time and space separation between two events. The principles of relativity will be applied to space travel. Quantization sets the stage for delving into the mysteries of the very small. The photoelectric effect will be related to the invention of the photomultiplier. Nuclear/Atomic physics discusses the "old" quantum theory of Bohr and its beautiful description of one-electron atoms. Wavelike Particles bring in an entirely unexpected way of thinking about our old friend the point mass: it can act like a wave under the right conditions!! Elements of the Schrodinger approach puts a particle into various kinds of "boxes". The goal is to understand the hydrogen atom. Statistical Physics gives the quantum way of thinking about large assemblages of interacting particles. We will conclude with a look at Solid State physics, which tells us about electrical and thermal characteristics of swarms of particles and the effect of periodic lattices on them.

Course Content:
- Special relativity, time dilation, length contraction, energy-mass relationship
- General relativity, gravity, and space warping
- Quantum theory and its extrapolation to macroscopic environments
- Nuclear atom and Bohr model
- Radiation and spectra
- Schrodinger equation, Heisenberg uncertainty, deBroglie wavelength
- Electromagnetic waves interaction with matter
- Photoelectric effect and Blackbody radiation
- Nuclear structure and quantum levels
- Angular momentum and particle spin
- Bose and Fermi particles
- Nuclear reactions and radioactivity
- Lasers
- Mossbauer effect
- Elementary particles and quarks
- Conservation and Symmetry theories

Does this course overlap a course offered in your academic program? YES ☐ NO ☒
If YES, what course(s) and provide a justification of the overlap?

Does this course overlap a course offered in another academic area? YES ☐ NO ☒
If YES, what course(s) and provide a justification of the overlap?
Signature of Academic Chair of the other academic area is required on the consultation sheet below.
6. **Cross-listed Courses (Please fill out separate form for each PREFIX)**

   List Cross-listed Courses

   Signature of Academic Chair(s) of the other academic area(s) is required on the consultation sheet below

   Department responsible for staffing: Physics

7. **References.** *(Provide 3 - 5 references on which this course is based and/or support it.)*

   Modern Physics by R. Serway, C. Moses and C. Moyer.

8. **List Faculty Qualified to Teach This Course.**

   Dr. Geoff Dougherty

9. **Frequency.**
   a. Projected semesters to be offered: Fall ☐ Spring ☑ Summer ☐

10. **New Resources Required.** YES ☐ NO ☑
    If YES, list the resources needed and obtain signatures from the appropriate programs/units on the consultation sheet below.

    a. Computer (data processing), audio visual, broadcasting needs, other equipment)

    b. Library needs

    c. Facility/space needs

11. **Will this new course alter any degree, credential, certificate, or minor in your program?** YES ☐ NO ☐
    If, YES attach a program modification form for all programs affected.

Dr. Geoff Dougherty
Proposer of Course
9/21/2005
Date
## Approvals

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<td>Curriculum Committee Chair</td>
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1. Course Title: PHYS 306 Modern Physics

2. Program Area: Math/Physics

**Recommend Approval**

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