

New Course Request

Indiana University

South Bend

Campus

Check Appropriate Boxes:

Undergraduate credit

Graduate credit

Professional credit

1. School/Division CLAS 2. Academic Subject Code PHYS

3. Course Number P324 (must be cleared with University Registrar) 4. Instructor J. Hinnefeld

5. Course Title Physics 4

Recommended Abbreviation (Optional) (limited to 32 Characters including spaces)

6. First time this course is to be offered (Semester/Year): Spring 2004

7. Credit Hours: Fixed at 3.0 or Variable from to

8. Is this course to be graded S-F (only)? Yes No X

9. Is variable title approval being requested? Yes No X

10. Course description (not to exceed 50 words) for Bulletin publication: Fourth semester of a four-semester sequence. Conduction in metals; semiconductors; superconductivity; nuclear structure, reactions, and applications; radioactivity; elementary particles; cosmology; introduction to general relativity.

11. Lecture Contact Hours: Fixed at 3.0 or Variable from to

12. Non-Lecture Contact Hours: Fixed at 0.0 or Variable from to

13. Estimated enrollment: 8 of which 0 percent are expected to be graduate students.

14. Frequency of scheduling: each Spring Will this course be required for majors? yes

15. Justification for new course: We wish to expand our modern physics coverage from one semester to two, in order to allow instruction in greater depth.

16. Are the necessary reading materials currently available in the appropriate library? yes

17. Please append a complete outline of the proposed course, and indicate instructor (if known), textbooks, and other materials.

18. If this course overlaps with existing courses, please explain with which courses it overlaps and whether this overlap is necessary, desirable, or unimportant.

19. A copy of every new course proposal must be submitted to departments, schools, or divisions in which there may be overlap of the new course with existing courses or areas of strong concern, with instructions that they send comments directly to the originating Curriculum Committee. Please append a list of departments, schools, or divisions thus consulted.

Submitted by:

Approved by:

[Signature] Date 11 Jan 2003 Department Chairman/Division Director

[Signature] Date 2/11/03 Dean

Date Dean of Graduate School (when required)

Date Chancellor/Vice-President

[Signature] 2/27/03 Senate Curr. Comm.

Date University Registrar

After School/Division approval, forward the last copy (without attachments) to the University Registrar for initial processing, and the remaining four copies and attachments to the Campus Chancellor or Vice-President.

## Sample Syllabus

### PHYS P324 – Physics 4 Indiana University South Bend

**Instructor:** Jerry Hinnefeld, Assoc. Prof. of Physics, NS355, 237-4467, [jhinnefe@iusb.edu](mailto:jhinnefe@iusb.edu)

**Prerequisites:** PHYS P323, MATH M216

**Primary Text:** Bernstein, Fishbane, and Gasiorowicz, *Modern Physics*, Prentice Hall, 2000. (or Thornton and Rex, *Modern Physics for Scientists and Engineers*, 2<sup>nd</sup> ed., Saunders, 2000; or Beiser, *Concepts of Modern Physics*, 5<sup>th</sup> ed., McGraw-Hill, 1995; or Serway, Moses, and Moyer, *Modern Physics*, 2<sup>nd</sup> ed., Harcourt, 1996)

**Supplementary Texts:** Selected readings from *Scientific American*, *Physics Today*, *American Journal of Physics*

**Objective:** This is the second semester of a two-semester modern physics sequence, which will introduce students to the major developments of physics in the twentieth century. Among the principal topics for this semester are condensed matter physics, including conduction in metals, semiconductors, and superconductivity; nuclear structure and reactions, and radioactivity; elementary particles and the quark structure of hadrons; and cosmology, including brief introductions to general relativity and astrophysics.

**Course Meetings:** Two 75-minute meetings per week, a combination of lecture and activities that require active student participation.

**Exams:** Three exams, approximately equally spaced throughout the semester. The exams will include both computational and conceptual questions.

**Homework Assignments:** Homework assignments will be made regularly, approximately twelve assignments over the course of the semester. Problem assignments and due dates will be announced in class. *Discussion* of homework with your classmates is allowed; *copying* of homework is *not allowed*, and *both parties will be penalized*. Discussion of homework assignments with the instructor is, of course, *encouraged*. A penalty will be assessed for late homework, and homework assignments will not be accepted more than two class meetings after the due date.

**Grading:** The course grade will be determined from exam and homework scores as follows:

Exam average -- 80%

Homework average -- 20%

## Topical Outline of the Course:

- I. Condensed Matter Physics
  - A. Conduction in Metals
    1. Classical Free Electron Model of Metals
    2. Quantum Theory of Metals
  - B. Band Theory of Solids
    1. Isolated Atom Approach to Band Theory
    2. Conduction in Metals, Insulators, and Semiconductors
  - C. Semiconductor Devices
    1. The  $p$ - $n$  Junction
    2. Diodes
    3. Junction Transistors
    4. Integrated Circuits
  - D. Superconductivity
    1. Type I and Type II Semiconductors
    2. The BCS Theory
    3. High-Temperature Superconductivity
  
- II. Nuclear Physics
  - A. Properties of Nuclei
    1. Nuclear Constituents
    2. Nuclear Sizes and Shapes
    3. Nuclear Masses and Binding Energies
    4. Nuclear Excitations
    5. Spin and Magnetic Moment
  - B. Nuclear Models
    1. Liquid Drop Model
    2. Independent Particle Model
    3. The Collective Model
  - C. Radioactivity
    1. Probability and Exponential Decay
    2. Alpha Decay
    3. Beta Decay
    4. Gamma Emission
    5. Natural Radioactivity
    6. Carbon Dating
  - D. Nuclear Reactions
    1. Cross section
    2. Reaction Kinematics
    3. Reaction Mechanisms
    4. Fission
    5. Fusion
  - E. Nuclear Physics Applications
    1. Nuclear Power from Fission and Fusion
    2. Biological Effects of Ionizing Radiation
    3. Nuclear Medicine
    4. Particle Accelerators

### III. Elementary Particles

- A. Particles and Fields
- B. Classification of Elementary Particles
  - 1. Hadrons
  - 2. Leptons
- C. Conservation Laws and Symmetries
  - 1. Baryon Number
  - 2. Lepton Number
  - 3. Strangeness
- D. Particle Interactions and Decays
  - 1. Energetics of Particle Decays
  - 2. Energetics of Particle Interactions
- E. Quarks
  - 1. Quark Structure of Hadrons
  - 2. Color
  - 3. Confinement
- F. Current and Future Directions
  - 1. Neutrino Oscillations and the Standard Model
  - 2. Grand Unification

### IV. Cosmology and Astrophysics

- A. General Relativity
  - 1. Equivalence Principle
  - 2. Curved Spacetime
  - 3. Gravitational Waves
  - 4. Black Holes
- B. Brief History of the Universe
  - 1. The Big Bang
  - 2. Stellar Evolution
  - 3. Nucleosynthesis
  - 4. Astronomical Objects