Appendix I
Section B. Course Syllabi

Department of Physics ABET Course Syllabi were formatted to conform to the Engineering Physics ABET Program Outcomes.

The Electrical Engineering ABET Course Syllabi were formatted to conform to the EE ABET Program Outcomes.

The Mechanical Engineering ABET Course Syllabi were formatted to conform to the ME ABET Program Outcomes.

The Program Outcomes ***(a)*** thru ***(k)*** are the same for the EP, EE, and ME programs. However, the Educational Objectives for the three programs differ slightly.

Other Course Syllabi are not formatted to the ABET format as they do not measure any of the EP Program Outcomes.

Syllabus, Physics 213, Mechanics, 3 credits

Designation: Required for undergraduate Physics majors and Engineering Physics majors.

Course Description: Newtonian Mechanics.

Prerequisite: None. *Co requisite:* Math 191.

Required Text: Knight, *Physics: A contemporary perspective*, Addison Wesley & Co., 1st Edition, Volume 1.

Class Web Pages: This course will use WebCT, http://salsa.nmsu.edu

Course Objectives: In this course you will learn the fundamental ideas underlying classical mechanics (Newton's laws and conservation laws) the application of these ideas to quantitative physics problems, and the relationship between the models physicists use and real-world phenomena.

Topics Covered: Measurement and units; forces in nature, Newton's laws, kinematic relationships between position, velocity and acceleration vectors; Newtonian dynamics, forms of energy; conservation of energy; conservation of momentum; rotational kinematics and dynamics; statics; oscillations and simple harmonic motion.

Class Schedule: Three 50 minute classes or two 75 minute classes per week; two hour final exam during exam week.

Contribution of Course to Professional Component: This course sets the foundation for undergraduate physics and engineering curriculum. Students learn basic physics mechanics concepts, how to apply them, and how to solve physical problems. The course provides three credits of physics.

Relationship of Course to Program Outcomes: This course teaches students to:
Apply knowledge of math, science and engineering (Program Outcome ***a***).

Prepared by Drs. Stephen Kanim and Stephen Pate, Spring 2006.

Syllabus, Physics 213L, Engineering Physics I Laboratory, 1 credit

*Designation**:*** Required for most undergraduate Engineering majors.

Course Description: Elementary laboratory in physics principles which supports the subject matter in PHYS 213.

Co requisite: PHYS 213.

Required Text: McDermott, Shaffer, et al., *Tutorials in Introductory Physics,* Prentice Hall, First Edition. Additional materials will be provided as needed.

Class Web Pages: A class webpage with the syllabus and other information is maintained at http://physics.nmsu.edu/classes/labs/physics213/physics213l.html

Course Objectives: Students perform a series of experiments which apply the principles and concepts highlighting the main objectives covered in the coursework for PHYS 213.

Topics Covered: Experiments performed, data collected and analyzed encompassing: kinematics, dynamics, energy, work, momentum, and their conservation concepts and rotational motion and extended body problems.

Class Schedule: Two 180 minute lab classes per week; two hour final exam during last scheduled lab session.

Contribution of Course to Professional Component: Together with PHYS 213, this course sets the foundation for undergraduate physics and engineering curriculum. Students perform experiments which illustrate basic physics concepts.

Relationship of Course to Program Outcomes: This course teaches students to:
Design and conduct experiments, and analyze and interpret data (Program Outcome ***b***).

Prepared by: Ms. Christine Pennise and Dr. Stephen Pate, Spring 2006.

Syllabus, Physics 214, Electricity and Magnetism, 3 credits

Designation: Required for Physics, Engineering Physics, and B.S. Chemistry & Biochemistry majors.

Course Description: Charges and matter, the electric field, Gauss' law, the electric potential, the magnetic field, Ampere's law, Faraday's law, electric circuits, alternating currents, Maxwell's equations, and electromagnetic waves.

Prerequisite: Physics 213 or Physics 215. *Co requisite*: Math 192.

Required Text: Randall Knight, *Physics for Scientists and Engineers*, Pearson Addison Wesley, 1st Edition.

Class Web Pages: A class webpage with the syllabus and other information maintained at http://physics.nmsu.edu/~pate/teaching/phys214.

Course Objectives: Students should be able to apply the basic laws of electricity and magnetism to solve simple problems concerning the motion and distribution of charges.

Topics Covered: Charges and matter, the electric field, Gauss' law, the electric potential, the magnetic field, Ampere's law, Faraday's law, electric circuits, alternating currents, Maxwell's equations, and electromagnetic waves.

Class Schedule: Three 50 minute classes or two 75 minute classes per week; two hour final exam during exam week.

Contribution of Course to Professional Component: Along with Phys 213, this course sets the foundation for the undergraduate physics curriculum. Students learn the basic concepts of electromagnetism, how to apply them, and how to solve physical problems. The course provides three credits of physics.

Relationship of Course to Program Outcomes: This course teaches students to: Apply knowledge of math, science and engineering (Program Outcome ***a***).

Prepared by Dr. Stephen Pate, Spring 2006.

Syllabus, Physics 214L, Electricity and Magnetism Laboratory, 1 credit

*Designation**:*** Required for most undergraduate Engineering majors.

Course Description: Elementary laboratory in physics principles which supports the subject matter in PHYS 214.

Co requisite: PHYS 214.

Required Text: McDermott, Shaffer, et al., *Tutorials in Introductory Physics*, Prentice Hall, First Edition. Additional materials will be provided as needed.

Class Web Pages: A class webpage with the syllabus and other information is maintained at http://physics.nmsu.edu/classes/labs/physics214/physics214l.html

Course Objectives: Students perform a series of experiments which apply the principles and concepts highlighting the main objectives covered in the coursework for PHYS 214.

Topics Covered: Experiments performed, data collected and analyzed encompassing: electrostatics, electric circuits, magnetism, electromagnetism and light, including geometrical and physical optics.

Class Schedule: Two 180 minute lab classes per week; two hour final exam during last scheduled lab session.

Contribution of Course to Professional Component: Together with PHYS 214, this course sets the foundation for undergraduate physics and engineering curriculum. Students perform experiments which illustrate basic physics concepts.

Relationship of Course to Program Outcomes: This course teaches students to: Design and conduct experiments, as well as to analyze and interpret data (Program Outcome ***b***).

Prepared by: Ms. Christine Pennise and Dr. Stephen Pate, Spring 2006.

Syllabus, Physics 215, Engineering Physics I, 3 credits

Designation: Required for most undergraduate Engineering majors. Engineering physics majors may use this as an alternative for Physics 213.

Course Description: Calculus based course of kinematics, work and energy, particle dynamics, conservation principles, simple harmonic motion.

Prerequisite: Math 191 or equivalent calculus course. This course is calculus based and students should be able to take basic derivatives.

Required Text: Randall Knight, *Physics for Scientists and Engineers*, Pearson Addison Wesley, 1st Edition.

Class Web Pages: A class webpage with the syllabus and other information maintained at http://physics.nmsu.edu/ph215.

Course Objectives: Students should be able to apply kinematic equations to describe motion, apply Newton's laws to describe forces and their effects on motion, apply energy and momentum concepts and their conservation properties, and define the basic properties of oscillations and waves.

Topics Covered: Measurement and units; Kinematic relationships between position, velocity and acceleration; Newton's Laws; forces; friction; potential and kinetic energy; conservation of energy; momentum and conservation of momentum; rotational velocity and acceleration; torque; rotational energy and momentum; gravity and orbits; oscillations and simple harmonic motion.

Class Schedule: Three 50 minute classes or two 75 minute classes per week; two hour final exam during exam week.

Contribution of Course to Professional Component: This course sets the foundation for undergraduate physics and engineering curriculum. Students learn basic physics mechanics concepts, how to apply them, and how to solve physical problems. The course provides three credits of physics.

Relationship of Course to Program Outcomes: This course teaches students to:
Apply knowledge of math, science and engineering (Program Outcome ***a***).

Prepared by Drs. Thomas Hearn and Stephen Pate, Spring 2006.

Syllabus, Physics 215L, Engineering Physics I Laboratory, 1 credit

*Designation**:*** Required for most undergraduate Engineering majors. Engineering physics majors may use this as an alternative for Physics 213L.

Course Description: Elementary laboratory in physics principles which supports the subject matter in PHYS 215.

Co requisite: PHYS 215.

Required Text: McDermott, Shaffer, et al., *Tutorials in Introductory Physics,* Prentice Hall, First Edition. Additional materials will be provided as needed.

Class Web Pages: A class webpage with the syllabus and other information is maintained at http://physics.nmsu.edu/classes/labs/physics215/physics215l.html

Course Objectives: Students perform a series of experiments which apply the principles and concepts highlighting the main objectives covered in the coursework for PHYS 215.

Topics Covered: Experiments performed, data collected and analyzed encompassing: kinematics, dynamics, energy, work, momentum, and their conservation concepts and rotational motion and extended body problems.

Class Schedule: Two 180 minute lab classes per week; two hour final exam during last scheduled lab session.

Contribution of Course to Professional Component: Together with PHYS 215, this course sets the foundation for undergraduate physics and engineering curriculum. Students perform experiments which illustrate basic physics concepts.

Relationship of Course to Program Outcomes: This course teaches students to:
Design and conduct experiments and analyze and interpret data (Program Outcome ***b***).

Prepared by: Ms. Christine Pennise and Dr. Stephen Pate, Spring 2006.

Syllabus, Physics 216, Engineering Physics II, 3 credits

Designation: Required for Engineering Physics majors.

Course Description: Calculus-level treatment of topics in electricity, magnetism, and optics.

Prerequisite: MATH 192 and PHYS 215.

Required Text: Randall Knight, *Physics for Scientists and Engineers*, Pearson Addison Wesley, 1st Edition.

Class Web Pages: A class webpage with the syllabus and other information maintained at http://physics.nmsu.edu/~jurquidi/

Course Objectives: Students should become proficient in the topics on electricity, magnetism, and optics presented as well as connecting the concepts presented and their use in engineering applications.

Topics Covered: The Electric Field; Electric Potential; Electrostatic Energy and Capacitance; Electric Current and Direct Current Circuits; The Magnetic Field; Magnetic Induction; Alternating Current Circuits; Maxwell's Equations; Properties of Light; Optical Images.

Class Schedule: Three 50 minute classes or two 75 minute classes per week; two hour final exam during exam week.

Contribution of Course to Professional Component: Along with Phys 215, this course sets the foundation for the undergraduate physics curriculum. Students learn the basic concepts of electromagnetism and optics, how to apply them, and how to solve physical problems. The course provides three credits of physics.

Relationship of Course to Program Outcomes: This course teaches students to: Apply knowledge of math, science and engineering (Program Outcome ***a***).

Prepared by Dr. Jacob Urquidi and Dr. Stephen Pate, Spring 2006.

Syllabus, Physics 216L, Engineering Physics I Laboratory, 1 credit

*Designation**:*** Required for most undergraduate Engineering majors. Engineering physics majors may use this as an alternative for Physics 214L.

Course Description: Elementary laboratory in physics principles which supports the subject matter in PHYS 216.

Co requisite: PHYS 216.

Required Text: McDermott, Shaffer, et al., *Tutorials in Introductory Physics,* Prentice Hall, First Edition. Additional materials will be provided as needed.

Class Web Pages: A class webpage with the syllabus and other information is maintained at http://physics.nmsu.edu/classes/labs/physics216/physics216l.html

Course Objectives: Students perform a series of experiments which apply the principles and concepts highlighting the main objectives covered in the coursework for PHYS 216.

Topics Covered: Experiments performed, data collected and analyzed encompassing: electrostatics, electric circuits, magnetism, electromagnetism and light, including geometrical and physical optics.

Class Schedule: Two 180 minute lab classes per week; two hour final exam during last scheduled lab session.

Contribution of Course to Professional Component: Together with PHYS 216, this course sets the foundation for undergraduate physics and engineering curriculum. Students perform experiments which illustrate basic physics concepts.

Relationship of Course to Program Outcomes: This course teaches students to:
Design and conduct experiments and analyze and interpret data (Program Outcome ***b***).

Prepared by: Ms. Christine Pennise and Dr. Stephen Pate, Spring 2006.

Syllabus, Physics 217, Heat, Light and Sound, 3 credits

Designation: Required for Physics, and Engineering Physics.

Course Description: Calculus-level treatment of thermodynamics, geometrical and physical optics, and sound.

Prerequisite: Physics 213 or PHYS 215.

Required Text: Randall Knight, *Physics for Scientists and Engineers*, Pearson Addison Wesley, 1st Edition.

Class Web Pages: A class webpage with the syllabus and other information is maintained at http://physics.nmsu.edu/~bkiefer/teaching/phys217.

Course Objectives: Students should become familiar with the concepts of waves, wave propagation, and the description of these phenomena and how these concepts can be generalized to give insight into optical processes. The section on thermodynamics in the course discusses the laws of thermodynamics and their use to describe thermal processes in engineering applications.

Topics Covered: Oscillations, wave motion, superposition of standing waves. Temperature scales and the kinetic theory of gases, the 0^{th}, 1^{st}, and 2^{nd} law of thermodynamics, and thermal properties and processes. Properties of light, speed of light, optical images, interference and diffraction.

Class Schedule: Three 50 minute classes or two 75 minute classes per week; two hour final exam during exam week.

Contribution of Course to Professional Component: This course provides an overview of the description of wave and basic wave phenomena that form the basis for the advanced classes in engineering in optics and thermodynamics.

Relationship of Course to Program Outcomes: This course teaches students to:
Apply knowledge of math, science and engineering (Program Outcome ***a***).

Prepared by Drs. Boris Kiefer and Stephen Pate, Spring 2006.

Syllabus, Physics 217L, Experimental Heat, Light and Sound, 3 credits

Designation: Required for Physics, and Engineering Physics.

Course Description: Laboratory experiments associated with the material presented in PHYS 217.

Co requisite: Physics 217.

Required Text: Lab manual that was developed in the Department of Physics for this course.

Class Web Pages: A class webpage with the syllabus and other information is maintained at http://physics.nmsu.edu/~bkiefer/teaching/phys217.

Course Objectives: Students should become familiar with the experimental exploration of basic phenomena in nature, data analysis, and the preparation of laboratory reports.

Topics Covered: Experimentation with waves, wave propagation, light, optical images, interference and diffraction as well as thermodynamic properties of materials. This also encompasses error analysis.

Class Schedule: One 3 hour laboratory per week.

Contribution of Course to Professional Component: This course provides students with laboratory experiences that encompass the set up of experiments and working in teams.

Relationship of Course to Program Outcomes: This course teaches students to: Design and conduct experiments, as well as to analyze and interpret data (Program Outcome ***b***).

Prepared by Drs. Boris Kiefer and Stephen Pate, Spring 2006.

Syllabus, Physics 315: Modern Physics, 3 credits

Designation: Required for Engineering Physics majors.

Course Description: An introduction to relativity and quantum mechanics, with applications to atoms, molecules, solids, nuclei, and elementary particles.

Prerequisite: Mathematics 291, Physics 214; or equivalent.

Co requisite: Physics 315L.

Required Text: Serway, Moses, and Moyer, Modern Physics, 2nd ed. (1997).

Class Web Pages: A class webpage with the syllabus and other information is maintained at http://zeppo.nmsu.edu/pvs/teaching/phys315/.

Course Objectives: Students should become familiar with the principles and basic equations of the special theory of relativity and quantum mechanics and their applications in simple problems in various fields of physics.

Topics Covered: Special relativity; quantum theory of light; atomic structure of matter; matter waves and wave-particle duality; the Schrodinger equation in one and three dimensions; quantum tunneling; atomic structure and the periodic table; quantum statistics; and selected applications in molecular, solid state, nuclear, and/or particle physics.

Class Schedule: Three 50-minute classes or two 75-minute classes per week; two-hour final-exam during exam week.

Contribution of Course to Professional Component: This course provides the foundations for upper-division physics core courses; in particular, Physics 454-455 and Physics 480. The course provides three credits of physics.

Relationship of Course to Program Outcomes: This course teaches students to: Apply knowledge of math, science, and engineering (Program Outcome ***a***); an understanding of professional and ethical responsibility (Program Outcome ***f***); an understanding of the impact of engineering solutions in the societal context (Program Outcome ***h***); a recognition for life-long learning (Program Outcome ***i***); a knowledge of contemporary issues (Program Outcome ***j***).

Prepared by Drs. Vassili Papavassiliou and Stephen Pate, Spring 2006.

Syllabus, Physics 315L, Experimental Modern Physics, 2 credits

Designation: Required for Physics and Engineering Physics majors.

Course Description: Elementary laboratory in modern physics which supports the subject matter in PHYS 315.

Co requisite: PHYS 315.

Required Text: Experiment write ups and supplementary reading materials will be provided by the instructor.

Class Web Pages: A class webpage with the syllabus and other information maintained at http://top.nmsu.edu/315L/.

Course Objectives: Students perform a series of classic experiments in quantum physics and apply techniques of measurement, interpretation, and presentation of experimental data.

Topics Covered: Error analysis and statistics; Quantization of Charge, Energy, and Mass; the Wave Nature of Matter; the Speed of Light; selected topics in Atomic, Condensed Matter, Nuclear and Particle Physics.

Class Schedule: Two 150 minute classes per week.

Contribution of Course to Professional Component: Together with Phys 315, this course is a fundamental part of the introductory physics course sequence. Students perform experiments which illustrate quantum effects in nature, learn the basic concepts of error analysis, and present their results in written reports and orally. The course provides two credits of engineering physics.

Relationship of Course to Program Outcomes: This course teaches students to: Design and conduct experiments, as well as analyze and interpret data (Program Outcome ***b***); function on multidisciplinary teams (Program Outcome ***d***); understand professional and ethical responsibility (Program Outcome ***f***);communicate effectively (Program Outcome ***g***); use techniques, skills and modern tools necessary for engineering practice (Program Outcome ***k***).

Prepared by Dr. Gary Kyle, Spring 2006.

Syllabus, Physics 451, Intermediate Mechanics I, 3 credits

Designation: Required for undergraduate Physics majors and Engineering Physics majors.

Course Description: Vector calculus, Lagrangian and Hamiltonian formulations of Newtonian mechanics. Topics include central force motion, dynamics of rockets and space vehicles, rigid body motion, noninertial reference frames, oscillating systems, relativistic mechanics, classical scattering, and fluid mechanics.

Prerequisite: Physics 213 or equivalent.

Required Text: Fowles and Cassiday, *Analytical Mechanics*, Brooks and Cole, 6th Edition.

Class Web Pages: This course will use WebCT, http://salsa.nmsu.edu

Course Objectives: In this course you will develop a more comprehensive understanding of the fundamental ideas underlying classical mechanics (Newton's laws and conservation laws). You will learn mathematical techniques for application of these ideas to solving problems. You will also learn alternative formulations of these basic principles (Lagrangian and Hamiltonian) based on the principle of least action and on the calculus of variations.

Topics Covered: Vector calculus, Newton's laws, special techniques for solving Newton's second law, Oscillations, noninertial reference systems, gravitation and orbital dynamics, rigid-body mechanics, calculus of variations, Lagrangian mechanics, normal coordinates.

Class Schedule: Three 50 minute classes or two 75 minute classes per week; two hour final exam during exam week.

Contribution of Course to Professional Component: This course sets the foundation for undergraduate physics and engineering curriculum. Students learn basic physics mechanics concepts, how to apply them, and how to solve physical problems. The course provides three credits of physics.

Relationship of Course to Program Outcomes: This course teaches students to: Identify, formulate and solve engineering and physics problems (Program Outcome ***e***).

Prepared by Drs. Stephen Kanim and Stephen Pate, Spring 2006.

Syllabus Physics 454 Intermediate Modern Physics I

Designation: Required for Physics and Engineering Physics majors.

Course Description: This is the first part of a two-semester course in Intermediate Modern Physics. The course will review the fundamental concepts of quantum physics and apply the principles of quantum mechanics to atoms, molecules, solids, and nuclei. This course is intended for senior undergraduate and first-year graduate students.

Prerequisite: Math 392 and Physics 315.

Required Text: J.S. Townsend, *A Modern Approach to Quantum Mechanics*, University Science Books, 2000.

Class Web Pages: A class webpage with the syllabus and other information is maintained at http://top.nmsu.edu/454/ .

Course Objectives: Students should become proficient in solving a wider range of physical problems related to quantum mechanics and its applications.

Topics Covered: Schrödinger equation, selection rules, atomic and molecular spectra, quantum statistics, electrical conductivity, magnetism, phonons, collisions and scattering, nuclear models and reactions, radioactivity, and elementary particles.

Class Schedule: Three 50 minute or two 75 minute classes per week: two-hour final examination during exam week.

Contribution of the Course to Professional Component: The course provides an in-depth study of quantum mechanics. It constitutes an integral part of the upper-division physics core classes, which include Physics 451, 454-455, and 461-462.

Relationship of Course to Program Outcomes:
This course teaches students to:
Identify, formulate, and solve engineering problems (Program Outcome ***e***).

Prepared by Dr. Gary Kyle, Fall 2005

Physics 455: Intermediate Modern Physics II, 3 credits

Designation: Required for Engineering Physics majors.

Course Description: Continuation of topics in PHYS 454.

Prerequisite: Phys 454

Required Text: J. S. Townsend, *A Modern Approach to Quantum Mechanics*, University Science Books, 2000.

Class Web Pages: A class webpage with the syllabus and other information is maintained at http://physics.nmsu.edu/~bkiefer/455/2006.

Course Objectives: Students should become proficient in solving a wide range of physical problems related to quantum mechanics and its applications.

Topics Covered: Schrödinger equation, selection rules, atomic and molecular spectra, quantum statistics, electrical conductivity, magnetism, phonons, collisions and scattering, nuclear models and reactions, radioactivity, and elementary particles.

Class Schedule: Three 50 minute classes or two 75 minute classes per week; two hour final exam during exam week.

Contribution of Course to Professional Component: The course provides an in-depth study of quantum mechanics. It constitutes an integral part of the upper-division physics core classes, which include Physics 451, 454-455, and 461-462.

Relationship of Course to Program Outcomes:
Identify, formulate, and solve engineering problems (Program Outcome ***e***).

Prepared by Dr. Boris Kiefer, Spring 2006.

Syllabus, Physics 461, Intermediate Electricity and Magnetism I, 3 credits

Designation: Required for Physics and Engineering Physics majors.

Course Description: Electro- and magnetostatics, dielectric and magnetic materials, electric and magnetic fields in matter.

Prerequisite: Physics 214 or 216 or equivalent.

Required Text: D.J. Griffith, Introduction to Electrodynamics, 3rd edition, Prentice Hall, 1999.

Course Objectives: Students should become proficient in a wide range of problems regarding electro- & magnetostatics and electric & magnetic fields.

Topics Covered: vector analysis, including vector algebra and vector fields, differential and integral calculus, curvilinear coordinates, Dirac delta function; electrostatics, including electric field, electric potential, work and energy in electrostatics; special techniques, including Laplace's equation, method of images, multipole expansion; electric fields, including polarization, electric displacements, linear dielectrics; magnetostatics, including Lorentz force, Biot-Savart law, magnetic vector potential; magnetic fields in matter, including magnetization, magnetic susceptibility, magnetic ordering.

Class Schedule: Two 75-minute classes per week; two-hour final exam during exam week.

Contribution of Course to Professional Component: This course provides the fundamental knowledge of electro- and magnetostatics, and related phenomena. It constitutes an integral part of the upper-division physics core, which includes Physics 451, 454&455 and 461&462.

Relationship of Course to Program Outcomes: The student will acquire an ability to: Identify, formulate and solve engineering problems (Program Outcome ***e***).

Prepared by Dr. Heinrich Nakotte, Spring 2006.

Syllabus, Physics 462, Intermediate Electricity and Magnetism II, 3 credits

Designation: Required for Physics and Engineering Physics majors.

Course Description: Electromagnetic wave propagation, reflection, refraction, waveguides, radiating systems, interference and diffraction, Newtonian and relativistic electrodynamics

Prerequisite: Physics 461 or equivalent

Required Text: D.J. Griffith, Introduction to Electrodynamics, 3rd edition, Prentice Hall, 1999.

Course Objectives: Students should become proficient in a wide range of problems regarding electromagnetic wave propagation.

Topics Covered: electromotive force, induction, Maxwell's equations, conservation laws, electromagnetic waves in vacuum and in matter, absorption and dispersion, waveguides, dipole radiation, relativistic electrodynamics

Class Schedule: Two 75-minute classes per week; two-hour final exam during exam week.

Contribution of Course to Professional Component: This course provides the fundamental knowledge of electrodynamics and related phenomena. It constitutes an integral part of the upper-division physics core, which includes Physics 451, 454&455 and 461&462.

Relationship of Course to Program Outcomes: This course teaches students to: Identify, formulate, and solve engineering problems (Program Outcome ***e***).

Prepared by Dr. Heinrich Nakotte & Dr. Igor Vasiliev, Spring 2006.

Syllabus, Physics 471, Modern Experimental Optics, 2 credits

Designation: Laboratory course to accompany Phys 470

Course Description: Covers advanced laboratory experiments in optics related to the material in Physics 470. This course is cross-listed as EE 481.

Prerequisite: Physics 470 or concurrent enrollment.

Reading Material: Laboratory experimental write-ups provided, Phys 470 text used as reference.

Course Objectives: Students should become familiar with the concepts of electromagnetic wave phenomena including polarization, interference, diffraction (both near-and-far field), and interference and diffraction grating spectroscopy. Graded laboratory reports measure student understanding of experimental concepts and results.

Topics Covered: Polarization and birefringence, Brewster's angle, Mach-Zender interferometer, diffraction grating spectroscopy, near-and far-field diffraction patterns, multiple beam interference, Fabry-Perot interferometer.

Class Schedule: Two two-and-one-half -hour laboratory periods per week.

Contribution of Course to Professional Component: This course provides laboratory experience in optics, an area of great significance in modern optical science and engineering. In particular, knowledge and skills learned in this course may be exploited by the students in the culminating capstone design project at the end of their studies. The course provides two credits of physics.

Relationship of course to Program Outcomes: This course teaches students to:
Design and conduct experiments, as well as analyze and interpret data (Program Outcome ***b***); function on multidisciplinary teams (Program Outcome ***d***); understand professional and ethical responsibility (Program Outcome ***f***); communicate effectively (Program Outcome ***g***); use techniques, skills and modern tools necessary for engineering practice (Program Outcome ***k***).

Prepared by Drs. R. Armstrong and Stephen Pate, Spring 2006.

Syllabus, Physics 475: Advanced Physics Laboratory, 2 credits

Designation: Required for Engineering Physics majors.

Course Description: Advanced undergraduate laboratory involving experiments in atomic, molecular, nuclear, and condensed-matter physics.

Prerequisite: Physics 315 and Physics 315L.

Required Text: None.

Class Web Pages: A class webpage with the syllabus and other information is maintained at http://zeppo.nmsu.edu/pvs/teaching/phys475/.

Course Objectives: Students should perform a series of experiments which highlight basic experimental and statistical-analysis techniques that are being used in contemporary scientific research, and present the results in publication-quality form.

Topics Covered: Experimental measurements, error propagation, and statistical analysis; scanning tunneling microscopy; nanomaterials; radiation detectors; radioactive decay law and lifetimes.

Class Schedule: Two 150-minute classes per week.

Contribution of Course to Professional Component: This course is an important component of the students' training in science. The students perform experiments which sample a cross section of experimental techniques used in research in various subfields of physics and learn to perform a rigorous data analysis and to prepare a professional presentation of the results. The course provides two credits of physics.

Relationship of Course to Program Outcomes: This course teaches students to: Design and conduct experiments, as well as analyze and interpret data (Program Outcome ***b***); function on multidisciplinary teams (Program Outcome ***d***); understand professional and ethical responsibility (Program Outcome ***f***); communicate effectively (Program Outcome ***g***); use techniques, skills and modern tools necessary for engineering practice (Program Outcome ***k***).

Prepared by Drs. Vassili Papavassiliou and Stephen Pate, Spring 2006.

Syllabus, Physics 476: Computational Physics, 3 credits

Designation: Required for Physics majors with an emphasis on computational physics.

Course Description: An introduction to finite difference methods, Fourier expansions, Fourier integrals, solution of differential equations, Monte Carlo calculations, and application to advanced physics problems.

Prerequisite: MATH 392.

Required Text: W. R. Gibbs, Computation in Modern Physics, World Scientific

Class Web Pages: None.

Course Objectives: Students should become proficient in the higher level methods of treating
physics problems with a computer.

Topics Covered: Classical integration techniques (trapezoidal and Simpson's rules, Gauss-Legendre and Gauss-Laguerre integration, principal-value integrals), Monte Carlo techniques (sampling, evaluation of multi-dimensional integrals, radiation transport), Differential equations(classical motion, molecular dynamics),Computer architecture for Scientists, Systems of equations(linear algebra, elimination and eigen value techniques), Finite element methods in one and two Dimensions, Signal processing, Chaotic systems (Feigenbaum's numbers).

Class Schedule: Three 50 minute classes per week and a two-hour final exam during exam week.

Contribution of Course to Professional Component: The course provides an in-depth study of computational physics. It provides 3 credits of physics.

Relationship of Course to Program Outcomes: This course teaches students to:
Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (Program Outcome ***c***); use the techniques, skills and engineering tools necessary for engineering practice (Program Outcome ***k***).

Prepared by Drs. William R. Gibbs and Stephen Pate, Spring 2006.

Syllabus, Physics 480, Thermodynamics, 3 credits

Designation: Required for Engineering Physics majors in the ECE option.

Course Description: Thermodynamics and statistical mechanics. Basic concepts of temperature, heat, entropy, equilibrium, reversible and irreversible processes. Applications to solids, liquids, and gases.

Prerequisite: PHYS 217, PHYS 315, and MATH 291.

Required Text: Kittel and Kroemer, *Thermal Physics (2nd Edition),* Freeman.

Class Web Pages: A class webpage with the syllabus and other information maintained at http://physics.nmsu.edu/~pate/teaching/phys480.

Course Objectives: Phys 480 is an introduction to thermodynamics and statistical physics. The material is taught from the point of view of quantum mechanics from the very beginning, but the knowledge of quantum mechanics required of the student is in fact very slight. We will cover the fundamental topics of equilibrium thermodynamics -- entropy, temperature, energy, heat, reversible and irreversible processes -- and see applications to some simple systems.

Topics Covered: Thermodynamics and statistical mechanics. Basic concepts of temperature, heat, entropy, equilibrium, reversible and irreversible processes. Applications to solids, liquids, and gases.

Class Schedule: Three 50 minute classes or two 75 minute classes per week; two hour final exam during exam week.

Contribution of Course to Professional Component: Statistical mechanics and thermodynamics are central to many applications of physics in the real world, and their use crosses many conceptual boundaries in physics and engineering. Students proficient in the concepts covered in this course will excel in their study of complex systems. The course provides three credits of physics.

Relationship of Course to Program Outcomes: This course teaches students to: Identify, formulate and solve engineering problems (Program Outcome ***e***).

Prepared by Dr. Stephen Pate, Spring 2006.

Syllabus, Physics 488, Condensed Matter Physics, 3 credits

Designation: Physics elective for Engineering Physics majors.

Course Description: Crystal structure, X-ray diffraction, energy band theory, phonons, cohesive energy, conductivities, specific heats, p-n junctions, defects, surfaces, and magnetic, optical and low-temperature properties.

Prerequisite: Physics 454.

Required Text: N. W. Ashcroft and N. D. Mermin, *Solid State Physics*, Thomson Publishing, 1976.

Class Web Pages: A class webpage with the syllabus and other information is maintained at http://loki.nmsu.edu/Phys488 .

Course Objectives: Students should become proficient in solving a wide range of physical problems related to the mechanical, electronic, and optical properties of solid materials.

Topics Covered: Crystal structure, wave phenomena in periodic media, free electron theory of metals, physics of semiconductors, and band theory of solids.

Class Schedule: Three 50 minute classes or two 75 minute classes per week; two hour final exam during exam week.

Contribution of Course to Professional Component: The course provides an in-depth review of solid state theory and covers engineering-physics concepts that help to develop an understanding of the structure and physical nature of modern materials.

Relationship of Course to Program Outcomes: This course teaches students: This course teaches students to: An understanding of professional and ethical responsibility (Program Outcome ***f***); an understanding of the impact of engineering solutions in the societal context (Program Outcome ***h***); A recognition for life-long learning (Program Outcome ***i***); a knowledge of contemporary issues (Program Outcome ***j***).

Prepared by Drs. Igor Vasiliev and Stephen Pate, Spring 2006.

Syllabus, Physics 489, Introduction to Modern Materials, 3 credits

Designation: Physics elective for Engineering Physics majors.

Course Description: Structure and mechanical, thermal, electrical and magnetic properties of modern materials; modern experimental techniques for the study of material properties.

Prerequisite: Physics 315, Modern Physics.

Suggested Texts: Philip Ball, *Made to Measure - New Materials for the 21st Century*, Princeton University Press, and/or Donald R. Askeland, *The Science and Engineering of Materials*, PWS Publishing.

Course Objectives: Students should learn to identify and understand the microscopic mechanisms responsible for the improved performance of properties in selected categories of advanced modern materials.

Topics Covered: Free electrons & multi-electron theory; chemical bonding; crystal & amorphous structures; deformation, crack propagation & other destructive phenomena; chemical, transport, thermal, optical & magnetic properties; exemplary discussion of the properties of some advanced materials, to be selected from *Nanomaterials, Composites & Superhard Materials, Photonics, Permanent Magnet Materials, Superconductors, Semiconductors, Materials for Information Storage, Smart Materials, Materials for Clean Energy, Polymers, Biomaterials* or others.

Class Schedule: Two 75-minute classes per week; two-hour final (written or oral) exam during exam week.

Contribution of Course to Professional Component: This course covers engineering-physics concepts that help to develop and utilize improved performance of advanced modern materials. The course provides three credits of physics.

Relationship of Course to Program Outcomes: This student will acquire the following skills and/or knowledge: This course teaches students to: An understanding of professional and ethical responsibility (Program Outcome ***f***); an understanding of the impact of engineering solutions in the societal context (Program Outcome ***h***); a recognition for life-long learning (Program Outcome ***i***); a knowledge of contemporary issues (Program Outcome ***j***).

Prepared by Dr. Heinrich Nakotte, Fall 2006.

Syllabus, Physics 495, Mathematical Methods of Physics, 3 credits

Designation: Required for Engineering Physics majors.

Course Description: Applications of mathematics to experimental and theoretical physics. Topics selected from: complex variables; special functions; numerical analysis; Fourier series and transforms, Laplace transforms.

Prerequisite: None.

Required Text: Dennery and Krzywicki, *Mathematics for Physicists*, Dover.

Class Web Pages: A class webpage with the syllabus and other information maintained at http://physics.nmsu.edu/~pate/teaching/phys495.

Course Objectives: Students should become proficient at these advanced mathematical topics so that they will easily understand the interplay between the mathematical tools and physics concepts. The advanced mathematics should become an aid to understanding, and not a barrier.

Topics Covered: The complex plane; differential and integral calculus of functions of a complex variable; the calculus of residues; real and complex linear vector spaces; abstract function spaces; Hilbert space; properties of Hermitian operators and their eigenvalues and eigenvectors.

Class Schedule: Three 50 minute classes or two 75 minute classes per week; two hour final exam during exam week.

Contribution of Course to Professional Component: This course covers areas of mathematics that are needed for full understanding and easy application of the concepts covered in these upper-division physics core classes: Phys 461-462, Phys 451, and Phys 454-455. The course provides three credits of physics.

Relationship of Course to Program Outcomes: This course teaches students to:
Use techniques, skills and modern tools necessary for engineering and physics practice (Program Outcome ***k***).

Prepared by Dr. Stephen Pate, Spring 2006.