California State University
Channel Islands

PROPOSAL TO OFFER A NEW ACADEMIC PROGRAM/ MAJOR IN FALL 2008
(LONG FORM)

Proposed Name of Degree: Bachelor of Sciences in Applied Physics

Options/ Emphases in the Degree: Emphases in Technology and Physical Sciences

Faculty Proposing New Program: Geoff Dougherty, Gregory Wood, Ivona Grzegorczyk, Cindy Wyels, Bob Bleicher, Peter Smith, William Wolfe, Ching-Hua Wang

Review and Approval:

Signature of Proposer:____Geoff Dougherty (09/21/2006)_____

1. Curriculum Committee Approval:

Curriculum Chair: _____ Date: _____

2. Academic Senate Approval:

Chair, Academic Senate: _____ Date: _____

3. Administration Approval:

President (or designee): _____ Date: _____

1. Definition of the Proposed Degree Major Program

1a. ***Name of the campus submitting the request, the full and exact designation (degree terminology) for the proposed degree major program, and academic year of intended implementation.***

Campus - California State University Channel Islands

Degree - Bachelor of Science in Applied Physics

Implementation – Fall 2008

1b. ***Name of the department, departments, division or other unit of the campus that would offer the proposed degree major program. Identify the unit that will have primary responsibility***.

Academic Affairs, Mathematics, Physics

1c. ***Name, title, and rank of the individual(s) primarily responsible for drafting the proposed degree major program.***

Geoff Dougherty, PhD, Professor of Physics
Alfred Leung, PhD, Professor of Physics, CSULB
Gregory Wood, PhD, Assistant Professor of Physics
Ivona Grzegorczyk, PhD, Professor of Mathematics
Cindy Wyels, PhD, Associate Professor of Mathematics
Bob Bleicher, PhD, Associate Professor of Education
William Wolfe, PhD, Professor of Computer Science
Peter Smith, PhD, Professor of Computer Science
Ching-Hua Wang, MD, PhD, Professor of Biology

1d. ***Objectives of the proposed degree major program.***

<u>General Objectives:</u>

1. To provide students with a strong undergraduate educational preparation in applied physics, built around the application of physics to interdisciplinary problems in modern technology.
2. To prepare students with the fundamental concepts of physics and the transferable skills (such as analytical thinking and problem solving, oral and written communication skills, the ability to read and understand primary technical/scientific literature, computer literacy and cooperative learning) relevant to a changing work environment.

3. To provide students with hands-on exposure to laboratory research and instrumentation through laboratory exercises, projects, internships/service learning and independent and team-based research.
4. To give students the opportunity to explore selected area(s) in applied physics in greater depth.
5. Technology emphasis:
   To provide students with the strong technical, industrial and management skills to enable them to obtain professional employment on graduation in physics-related research and development in industry or in the public sector, or to pursue further study in graduate or professional schools in the physical sciences or technology, for example in Computer Engineering, Materials Science, Biomedical Engineering, Medical Physics. (Students who wish to pursue graduate study in Applied or Experimental Physics are encouraged to take PHYS 301, PHYS 305 and PHYS 401 as electives to prepare themselves for the GRE exam).
   Physical Sciences emphasis:
   To give students a broad foundation in applied physics as part of a liberal education in the sciences. This option provides the breadth needed for such innovative and challenging occupations as teaching, public service, business, and science journalism. (This option meets the California Commission on Teacher Credentialing (CCTC) subject matter standards for Physics and Sciences: Physics. Students wishing to become high school physics teachers or middle school physical science teachers must take certain course options).

Student Learning Outcomes:

Through this degree program students will be able to:

1. Explain the fundamental concepts of physics.
2. Analyze and solve problems by applying information in a novel context.
3. Formulate hypotheses and devise and perform experiments to test hypotheses as individuals and in a team.
4. Apply current technology and scientific methodologies to analyze and solve problems in various scientific, professional and community settings.
5. Use and critically evaluate current technical/scientific research literature, online information, and information related to scientific issues in the mass media.
6. Formulate and design new technological solutions using team-based research methods.
7. Communicate in written and oral forms key concepts in physics and general scientific issues with interested citizens and professionals.
8. Work co-operatively as part of a research team.
9. Learn independently and maintain life-long learning in the sciences and technology.

10. Outline the applications of physics in industry and the role of physicists as entrepreneurs.
11. For prospective teachers doing the Physical Sciences Emphasis:
    Earn a passing score on the California Commission on Teacher Credentialing approved subject-matter competency exam for teaching Sciences: Physics and Physics (specialized).

1e. ***Total number of units required for the major. List of all courses, by catalog number, title, and units of credit, to be specifically required for a major under the proposed degree program. Identify those new courses that are (1) needed to initiate the program and (2) needed during the first two years after implementation. Include proposed catalog descriptions of all new courses.***

120 Semester units

(1) Three new courses are required to initiate the program: one (PHYS 106 Applied Physics and Modern Society) for freshmen and two (PHYS 304 and PHYS 306) for Junior transfers: they are identified with [1].
(2) A further three new courses (PHYS 310, PHYS 406 and PHYS 448) are required during the next two years to completely implement the program: identified with [2].

REQUIREMENTS FOR THE BACHELOR OF SCIENCE DEGREE IN APPLIED PHYSICS (120 units):
The requirements comprise a core of common courses, together with additional courses specific to each emphasis.

LOWER DIVISION REQUIREMENTS (31-32 units (Technology emphasis) or 32-33 units (Physical Sciences Emphasis))

Core (19 units):
PHYS 106[1] Applied Physics and Modern Society (3)
PHYS 200 General Physics I (4)
PHYS 201 General Physics II (4)
MATH 150 Calculus I (4)
MATH 151 Calculus II (4)

Technology Emphasis (12-13 units):
MATH 230 Logic and Mathematical Reasoning (3)
MATH 240 Linear Algebra (3)
MATH 250 Calculus III (3)
AND
Either:
COMP 105 Introduction to Computer Science (3)

Or:
COMP 150 Object-Oriented Programming (4)

Physical Sciences Emphasis (13-14 units):
CHEM 105 Introduction to Chemistry (3)
AND
Either:
PHYS 208 Physics of Art and Visual Perception (3)
Or:
PHSC 170 Foundations in Physical Science (4) (required for teachers)
AND
Either:
BIOL 100 Exploring the Living World (4)
Or:
BIOL 170 Foundations of Life Science(4) (required for teachers)
AND
Either:
COMP 102 Web Development (3)
Or:
COMP 105 Introduction to Computer Science (3)

UPPER DIVISION REQUIREMENTS (37 units (Technology Emphasis) or 30 units (Physical Sciences Emphasis)):

Core (24 units):
PHYS 304[1] Electromagnetism (4)
PHYS 306[1] Modern Physics (3)
PHYS 335 Physics of Music (3)
PHYS 338 Science and Conscience (3)
PHYS 434 Introduction to Biomedical Imaging (4)
PHYS 448[2] Team-Based Research (3)
PHYS 499 Senior Capstone Colloquium (1)
AND
3 units taken from the following:
PHYS 492 Internship (required for teachers) (3)
PHYS 494 Independent Research (1-3)
PHYS 497 Directed Studies (1-3)

Technology Emphasis (13 units):
PHYS 310[2] Electronics (4)
PHYS 345 Digital Image Processing (3)
PHYS 406[2] Solid State Physics (3)
MATH 350 Differential Equations and Dynamical Systems (3)

Physical Sciences Emphasis (6 units):

PHYS 344 Energy and Society (3)
MGT 325 Entrepreneurial Management (3)

ELECTIVES IN THE MAJOR (9-10 units (Technology Emphasis) or 15-16 units (Physical Sciences Emphasis)).

Chosen with advisor's approval.
(* – available only for the Physical Sciences Emphasis
† - recommended for teachers)

PHYS 310* Electronics (4)
PHYS 345* Digital Image Processing, GE-B1, B4,UDIGE (3)
PHYS 436* Physics of the Performing Arts, GE-B1, UDIGE (3)
PHYS 445 Image Analysis and Pattern Recognition, GE-B1, B4, UDIGE (3)
PHYS 464 Medical Instrumentation (4)
PHYS 490 Topics in Applied Physics (3)
PHYS 492 Internship (3), if not taken as a required course
PHYS 494 Independent Research (1-3), if not taken as a required course
PHYS 497 Directed Studies (1-3), if not taken as a required course
EDUC 330† Teaching in Secondary Schools (3)
MATH 240* Linear Algebra (3)
MATH 250* Calculus III (3)
MATH 350* Differential Equations and Dynamical Systems (3)
MATH 352 Probability and Statistics (3)
MATH 448 Scientific Computing (3)
MATH 450 Partial Differential Equations and Mathematical Physics (3)
MATH 451 Complex Analysis (3)

PHYS 301‡ Classical Physics (3)
PHYS 305‡ Thermal and Statistical Physics (3)
PHYS 401‡ Quantum Mechanics (3)
(‡ - courses offered to students interested in taking the GRE exam for graduate school)

UPPER DIVISION INTERDISCIPLINARY GENERAL EDUCATION (UDIGE) COURSES (3 units)

All students are required to complete 9 units of UDIGE courses, of which a minimum of 3 units must come from a discipline outside the student's major and not be cross-listed with the student's major discipline. The upper division requirements within the Applied Physics major comprise 13 units of UDIGE (PHYS 338, PHYS 434, PHYS 448 and either PHYS 345 (Technology option) or PHYS 344 (Physical Sciences option)). Students must choose another 3 units of UDIGE outside their discipline.

OTHER GE COURSES (24 units)

A further 24 units of GE courses are required to complete the required total of 48 units.

The UDIGE and other GE courses should be distributed as follows:
Category A (Technology Emphasis (6), Physical Sciences Emphasis (9), including ENGL 105 Composition and Rhetoric I (3))
Category B (Technology emphasis (3), Physical Sciences Emphasis (0)
Category C (6) – 6 units covered by required courses for the degree program
Category D (12)
Category E (0)

ELECTIVES IN ANY DISCIPLINE (9 units)

Technology emphasis: It is suggested that a course in business/management be taken (e.g. BUS 320 Business Operations, MGT 307 Management of Organizations or MGT 325 Entrepreneurial Management).

Physical Sciences emphasis: Prospective teachers are strongly encouraged to take EDUC 330 Teaching in Secondary Schools to prepare for entry to one of the teacher credential programs.

TOTAL UNITS FOR GRADUATION

		Technology	Physical Sciences
I.	Lower Division Requirements	31-32	32-33
II.	Upper Division Requirements	37	30
III.	Electives in the Major	9-10	15-16
IV.	Other GE courses	27	27
V.	American Institutions	6	6
VI.	Electives in any Discipline	9	9
Total		**120**	**120**

Required Courses in BS Applied Physics Fulfilling GE Category Requirements

A-1 Oral Communication
No required course from the Applied Physics Major.

A-2 Writing Communication
ENGL 105 Composition and Rhetoric I

A-3 Critical Thinking
Technology Emphasis: MATH 230 Logic & Mathematical Reasoning

B-1 Physical Sciences
PHYS 106 Applied Physics and Society
PHYS 200 General Physics I
PHYS 201 General Physics II
PHYS 335 Physics of Music
Technology Emphasis:
PHYS 345 Digital Image Processing
Physical Sciences Emphasis:
PHSC 170 Foundations in Physical Science
CHEM 105 Introduction to Chemistry
PHYS 208 Physics of Art and Visual Perception
PHYS 344 Energy and Society

B-2 Life Sciences
Technology Emphasis:
No required course from the Applied Physics Major.
Physical Sciences Emphasis:
BIOL 100 Exploring the Living World
or BIOL 170 Foundations of Life Science (required for teachers)

B-3 Mathematics
MATH150 Calculus I

B-4 Computers and Information Technology
Technology Emphasis:
COMP 105 Introduction to Computer Science *or*
COMP 150 Object-Oriented Programming
COMP 345 Digital Image Processing
Physical Sciences Emphasis:
COMP 102 Web Development *or*
COMP 105 Introduction to Computer Science

C-1 Fine Arts
PHYS 335 Physics of Music
Physical Sciences Emphasis:
PHYS 208 Physics of Art and Visual Perception

C-2 Literature
PHYS 338 Science and Conscience

C-3a Language
No required course from the Applied Physics Major

C-3b Multicultural

No required course from the Applied Physics Major

D Social Perspectives

No required course from the Applied Physics Major.

E Human Psychological and Physiological Perspectives

PHYS 434 Introduction to Biomedical Imaging

COURSE DESCRIPTIONS FOR CATALOG:

COURSES IN THE APPLIED PHYSICS PROGRAM

<no superscript> = existing courses
[1] = needed in first year of initiation of program
[2] = needed during the first two years after implementation

PHYS 106 APPLIED PHYSICS AND MODERN SOCIETY (3)[1]
Three hours lecture in the lab per week
An introduction to current topics in applied physics in the fields of solid state physics, semiconductors, superconductors and nano-structures. Industries dealing with, for example, detectors, remote sensing, new materials, medical imaging, bioinformatics, homeland security, telecommunications, and lasers will be covered. Lab fee required.
GenEd: B1.

PHYS 200 GENERAL PHYSICS I (4)
Three hours lecture and three hours laboratory per week
Prerequisite: MATH 150
A calculus-based introduction to the concepts and principles of physics. The areas covered include classical mechanics, wave motion and thermal physics. Practical examples will be used to illustrate the relationship between physics and other disciplines, including the life sciences, and to develop problem-solving skills.
Laboratory sessions will focus on computer-simulated experiments. Lab fee required.
GenEd: B1

PHYS 201 GENERAL PHYSICS II (4)
Three hours lecture and three hours laboratory per week
Prerequisite: PHYS 200
A calculus-based introduction to the concepts and principles of physics. The areas covered include electromagnetic theory, light, and atomic and nuclear physics. Practical examples will be used to illustrate the relationship between physics and other disciplines, including the life sciences, and to develop problem-solving skills. Laboratory sessions will focus on computer-simulated experiments. Lab fee required.
GenEd: B1

PHYS 208 PHYSICS OF ART AND VISUAL PERCEPTION (3)
Two hours lecture and two hours lab per week.
Prerequisites: none.
A course on the physics of light, color, art and visual perception. The course will cover the nature of light and optical phenomena, the perception and psychology of color, the reproduction of color in different media, and the analysis of art from a science

perspective. The emphasis is on factors which permit the artist and observer to understand and more fully control the design and interpretation of images of all kinds. Demonstrations, experiments, and video/computer simulations are used to analyze signals received by the eyes or instruments.
Same as ART 208
GenEd: B1, C1

PHYS 304 ELECTROMAGNETISM (4) [1]
Four hours lecture in the lab per week
Prerequisites: PHYS 201, MATH 250
A calculus-based introduction to the concepts and principles of electricity and magnetism. The areas covered include electrostatics, magnetism, electromagnetic theory, fields, electromagnetic waves, and Maxwell's equations. Practical examples will be used to illustrate the relationship between electricity and magnetism and other disciplines, including the life sciences. A strong emphasis will be on analytical problem-solving skills.

PHYS 306 MODERN PHYSICS (3)[1]
Three hours lecture in the lab per week
Prerequisites: PHYS 201, MATH 151
The breakdown of classical physics. 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.

PHYS 310 ELECTRONICS (4)[2]
Three hours lecture and two hours activity per week.
Prerequisites: PHYS 101 or PHYS 201.
Basic analog and digital electronic circuits used in a scientific laboratory. An introduction to the operation of simple electronic devices, the basic underlying theory of their operation, and the applications of a few analog and digital ICs. The emphasis is on applications rather than theory, and hands-on experience. Experiments will include the testing of actual and virtual circuits, and data acquisition.

PHYS 335 PHYSICS OF MUSIC (3)
Two hours of lecture and two hours of lab activity per week.
Prerequisite: None
Provides an understanding of music and sound for students interested in music, speech, and language. Extensive use of demonstrations and sound analysis computer programs will be used. The format will include lectures, demonstrations, and hands-on use of the computer programs.
Same as MUS 335.
GenEd-ID: B1, C1,UDIGE.

PHYS 344 ENERGY AND SOCIETY (3)

Three hours lecture per week
Survey of the physical, chemical, and engineering principles involved in the production of energy from current and potential sources and the economical, environmental, and political issues surrounding energy production. The course will also examine factors that influence worldwide energy policy. Examples of topics included: energy conservation, efficient usage and transportation of energy, energy resources, fossil fuels, active and passive solar energy, biomass, fuel cells, nuclear (fission and fusion) processes, and hydroelectric, tidal, geothermal, and wind power. Same as CHEM 344
GenEd: B1,UDIGE

PHYS 345 DIGITAL IMAGE PROCESSING (3)
Three hours of lecture in the lab per week.
Prerequisite: Consent of instructor.
An introduction to the basic concepts and techniques for digital image restoration and enhancement, analysis, coding and compression. The emphasis is on processes which analyze primarily two-dimensional discrete images represented at the pixel level, including filtering, noise reduction and segmentation. Fourier analysis techniques will be explored. Programming exercises will be used to implement the various processes, and their performance on synthetic and real images will be studied.
Same as COMP 345, MATH 345.
GenEd-ID: B1, B4,UDIGE.

PHYS 406 SOLID STATE PHYSICS (3)[2]
Three hours lecture in the lab per week
Prequisites: PHYS 306, MATH 250
An introduction to the physical properties of solids. It focuses on the fundamental, unifying concepts and experimental techniques important in understanding the properties of nuclei and electrons in solids. In particular, it considers crystals where the fundamental principles are exemplified most clearly, and defects that often control the actual properties of materials. The subjects are chosen to establish the basic principles, to describe phenomena that are responsible for the importance of solids in science and technology, and to include topics of current research.

PHYS 434 INTRODUCTION TO BIOMEDICAL IMAGING (4)
Three hours of lecture and two hours of lab activity per week, including two field trips.
Prerequisite: BIOL 210 or PHYS 200.
An overview of biomedical images and imaging systems. The fundamental concepts used in several imaging modalities (such as projection radiography, mammography, DEXA, computed tomography, ultrasonography and magnetic resonance imaging). The emphasis will be on an intuitive and descriptive presentation of the main components of these systems. Image formation and reconstruction. Correlation between the resulting clinical images and the underlying structure and function of the organs. Diagnostic utility and limitations of the images. Same as BIOL 434, HLTH 434.
GenEd-ID: B2, E,UDIGE.

PHYS 448 TEAM-BASED RESEARCH (3)[2]

Three hours per week.
Prerequisite: Upper-division standing
This is a course where students learn to work together as teams. Teams are assigned a specific practical problem, and have to apply a variety of physical principles to solve the problem. The solution will incorporate design principles, implementation and technological methodologies, and business/management insight. The course will conclude with a written business plan and an oral presentation by the teams.
GenEd: INT.

PHYS 492 INTERNSHIP (3)
Six hours per week
Prerequisites: Upper division standing and consent of instructor.
Supervised work and study in industrial or scientific setting involving development of skills related to applied physics. All students are required to present their projects at the Senior Colloquium. Credit/No Credit grading only.

PHYS 494 INDEPENDENT RESEARCH (3)
Variable hours per week.
Prerequisites: Senior standing and consent of research advisor.
Contracted laboratory and/or library research in selected areas within applied physics conducted under the supervision of a faculty member. All students are required to present their projects at the Senior Colloquium.

PHYS 497 DIRECTED STUDIES (3)
Variable hours per week.
Prerequisite: Senior standing and program approval. Supervised project involving reading and library research in the field of applied physics. All students are required to present their projects at the Senior Colloquium.

PHYS 499 SENIOR CAPSTONE COLLOQUIUM (1)
Prerequisites: Senior standing.
One hour of seminar.
Oral presentations of current advances in the field, reports on students' projects in PHYS 492, 494 or 497 courses, and invited lectures.

BIOL 100
Exploring the living world (4)
3 hours lecture and 3 hours lab per week
An overview of biology from the molecular to the ecosystem level. Topics include the origin, diversity and evolution of life, ecology of populations and communities, the structure and function of plant and animal organ systems, biological molecules, cellular structure/function, genetics and cell division. No credit given toward the major in Biology. A lab fee is required.
GenEd: B2

BIOL 170

Foundation of Life Science (4)
3 hours lecture and 3 hours lab per week
This course meets the needs of prospective elementary school teachers. The course will cover a broad spectrum of topics including introduction to scientific inquiry with living organisms, physiology, cell biology, genetics, evolution and ecology. Current issues in biology will also be considered. The laboratories will focus on hands-on activities particularly relevant to elementary school students. No credit given toward the major in Biology. A lab fee is required.
GenEd: B2

CHEM 100 CHEMISTRY AND SOCIETY (4)
Three hours lecture and three hours laboratory per week.
An introduction to the basic principles of chemistry and a consideration of the benefits and problems arising from applications of chemistry. Discussions of foods and food additives, drugs, plastics and other material of everyday life, fuel sources, the atmosphere, and fresh water. Lab fee required.
GenEd: B1.

COMP 102 WEB DEVELOPMENT (2)
Two hours of lecture in the lab per week.
Prerequisite: Computer literacy or permission of instructor.
Introduction to the design and development of web pages. Use of HTML and scripting languages. Use of multimedia content.
Current web development tools.
GenEd: B4.

COMP 105 INTRODUCTION TO COMPUTER SCIENCE (3)
Three hours of lecture in the lab per week.
This course provides a balanced view of computing and allows students to experience the world of computer science. Depth topics introduce fundamental programming concepts such as design, development and expression of algorithms including; algorithms and their stepwise refinement; expression of algorithms in a formal language. Breadth topics cover a variety of concepts and issues in computing that are most relevant to the beginning student including computer organization and how computers work. Not open to students who have completed COMP 150
GenEd: B4.

COMP 150 OBJECT ORIENTED PROGRAMMING (4)
Four hours of lecture in the lab per week.
Prerequisite: Programming experience.
Introduction to algorithms, their representation, design, structuring, analysis and optimization. The course introduces the concept of object paradigm, design and implementation of algorithms as structured programs in a high level language.
GenEd: B4.

MATH 150 CALCULUS I (4)

Four hours lecture per week
Prerequisite: passing scores on the Calculus Placement examination or MATH 105
A course in analytic geometry and calculus. Topics include: elementary and transcendental functions, their properties, limits, derivatives, integrals and mathematical modeling.
GenEd: B3

MATH 151 CALCULUS II (4)
Four hours lecture per week
Prerequisite: MATH 150.
Topics include: differentiation, integration, sequences, infinite series, and power series.

MATH 230 LOGIC & MATHEMATICAL REASONING (3)
Three hours of lecture per week.
Introduction to modern deductive logic. Critical thinking and abstract approaches to common language. Includes abstract sets and number sets, relations, propositional logic, common language cases, and theory of quantification.
GenEd: A3,B3.

MATH 240 LINEAR ALGEBRA (3)
Three hours of lecture per week.
Prerequisite: Completion of MATH 151
Matrices, linear systems of equations, determinants, vectors in 2 and 3 dimensions, eigenvalues, the vector space $\mathbf{R}^n$, linear transformations, introduction to general vector spaces and applications.

MATH 250 CALCULUS III (3)
Three hours of lecture per week.
Prerequisite: Completion of MATH 151 with a grade of C or better.
Topics include: functions of several variables, solid analytic geometry, partial differentiation, multiple integrals with applications; vector analysis, and line and surface integrals.

MATH 350 DIFFERENTIAL EQUATIONS AND DYNAMICAL SYSTEMS (3)
Three hours of lecture per week.
Prerequisite: MATH 250 (may be taken concurrently).
Topics include: ordinary differential equations, existence and uniqueness of solutions. Linear equations. Laplace methods. Flows and diffeomorphisms, limit sets, iterations of maps. Positive entropy systems, chaotic behavior of trajectories.

MATH 352 PROBABILITY AND STATISTICS (3)
Three hours lecture per week
Prerequisite: MATH 250
Topics include: data gathering, analysis and display. Validity of sampling methods and statistical conclusions. Probability, conditional probability, Bayes' Theorem, discrete and continuous random variables and their distribution (e.g., binomial, Poisson,

hypergeometric, negative binomial, normal, exponential, gamma), moments, bivariate distributions, transformations of random variables, central and other limit theorems. Bayesian estimates, tests of hypotheses, nonparametric tests, decision theory. Modern computer software applications in statistics.

MGT 325 ENTREPRENEURIAL MANAGEMENT (3)
Three hours lecture per week
Explores the management of start-up and small businesses. Concentrates on initial strategy, location, financing, staffing, daily activities, controls and taxes. Students develop a business plan for a small business.

PHSC 170 FOUNDATIONS IN PHYSICAL SCIENCE (4)
Four hours lecture per week
The areas covered include the physical properties of solids, liquids, and gasses; physical and chemical changes in matter; atomic theory and the periodic table, the principles of motion and energy; forces and the motion of particles; sources and transformations of energy including heat, electricity, magnetism, light and sound; renewable and non-renewable energy sources; and the conservation of energy resources.
GenEd: B1

1f. ***List of elective courses, by catalog number, title, and units of credit that can be used to satisfy requirements for the major. Identify those new courses that are (1) needed to initiate the program and (2) needed during the first two years after implementation. Include proposed catalog descriptions of all new courses.***

COURSE DESCRIPTIONS OF ELECTIVE COURSES:

PHYS 445 IMAGE ANALYSIS AND PATTERN RECOGNITION (3)
Three hours of lecture in the lab per week.
Prerequisite: PHYS/COMP/MATH 345 or consent of instructor.
Analysis of the pattern content within an image. Pattern recognition, image segmentation, feature extraction and classification. The principles and concepts underpinning pattern recognition, and the evolution, utility and limitations of various techniques (including neural networks). Programming exercises, examples and applications of pattern recognition processes, and their performance on a variety of diverse synthetic and real images. Individual project report.
Same as COMP 445, MATH 445
GenEd-ID: B1, B4,UDIGE.

PHYS 464 MEDICAL INSTRUMENTATION (4)
Three hours of lecture and two hours of lab activity per week, including two field trips.
Prerequisite : BIOL/PHYS/HLTH 434

The detection, acquisition, processing and display of diagnostic clinical images. Fundamentals of the design of the instruments and the use of appropriate reconstruction algorithms in (computed) radiography, (digital) fluoroscopy, computed tomography, ultrasound, magnetic resonance imaging and radionuclide imaging. The mathematics will be kept to a minimum. Activities will include image reconstruction examples, investigation of recent innovations, and two trips to local Radiology departments. Same as BIOL 464.

PHYS 490 TOPICS IN APPLIED PHYSICS (3)
Three hours per week.
Prerequisites: Upper division standing and consent of instructor.
In-depth analysis of topics in applied physics. Topics vary each semester. May be repeated one more time for credits as topics change.

EDUC 330 INTRODUCTION TO SECONDARY SCHOOLING (3)
Two hours lecture/discussion and two hours field observations per week
Through this course students are introduced to secondary school concepts and issues. Topics include middle school and high school organization and structures, the roles of school personnel, and teaching in specific content areas. Students will be placed in local middle and high schools classrooms in their content major and have seminars with university educators and content specialists to discuss subject matter coverage and teaching at various grade levels. It is recommended that students be concurrently enrolled in a core content course in their major. Field experience in secondary schools required.
GenEd: D,UDIGE

MATH 448 SCIENTIFIC COMPUTING (3)
Three hours lecture in the lab per week.
Prerequisite: MATH 151 and MATH 350 or COMP 151
Tpoics include: techniques of applied mathematics, solution of equations, finite differences, and wavelets.
GenEd: B3, B4,UDIGE.

MATH 450 PARTIAL DIFFERENTIAL EQUATIONS AND MATHEMATICAL PHYSICS (3)
Three hours lecture in the lab per week.
Prerequisite: MATH 350 or consent of instructor
Topics include: vector field theory and Fourier analysis.

MATH 451 COMPLEX ANALYSIS (3)
Three hours lecture per week.
Prerequisite: MATH 250
Topics include: complex variable, analytic functions, complex integration, power series and conformal mappings.

(‡ - courses to be taken by students interested in taking the GRE exam for grad school).

PHYS 301‡ CLASSICAL MECHANICS (3)
Three hours of lecture per week.
Prerequisites: PHYS 201 and MATH 350
A differential equation-based introduction to classical mechanics. The areas covered include the Lagrangian formulation, variational principles, Hamiltonian mechanics, and the theory of canonical transformations. Some applications to the motion of rigid bodies, systems of coupled oscillators, and celestial mechanics will be presented.

PHYS 305‡ THERMAL AND STATISTICAL PHYSICS (3)
Three hours of lecture per week.
Prerequisites: PHYS 201 and MATH 350
This course concerns the behavior of energy and matter in systems having a great many particles. It includes both classical and quantum mechanical views of physical systems and begins with the basic concepts of probability and statistics. Particular emphasis will be placed on simple model systems for which quantitative results can be obtained and compared to experiment, such as ideal (and nearly ideal) gases and quantum mechanical spin systems.The course includes the statistics of the microcanonical, canonical, and grand canonical ensembles; the relation between classical and quantum statistical mechanics; the Planck distribution, bosons, fermions, and doped semiconductors, among others; and an introduction to kinetic theory.

PHYS 401‡ QUANTUM MECHANICS (3)
Three hours of lecture per week.
Prerequisites: PHYS 201 and MATH 350
An introduction to quantum theory, beginning with the Schrödinger equation and the statistical interpretation of the wave function. One-dimensional applications, including the infinite square-well, the harmonic oscillator, and scattering; in three dimensions, the theory of angular momentum, central potentials, and the hydrogen atom; time-independent perturbation theory, spin, identical particles, and the Pauli exclusion principle. Applications to bound states, scattering, tunneling, and the harmonic oscillators applied to photons and phonons in cavities.

1g. ***If any formal options, concentrations, or special emphases are planned under the proposed major, explain fully.***

The proposed major has two emphases, the Technology and Physical Sciences emphases. The requirements of the major comprise a core of common courses, together with additional courses specific to each emphasis.

The Technology emphasis is designed to provide students with the strong technical, industrial and management skills to enable them to obtain professional employment on graduation in physics-related research and development in industry or in the public sector. They could also pursue further study in graduate or professional schools in the

physical sciences or technology, for example in Computer Engineering, Materials Science, Biomedical Engineering, Medical Physics. (Students who wish to pursue graduate study in Applied or Experimental Physics are encouraged to take PHYS 301, PHYS 305 and PHYS 401 as electives to prepare themselves for the GRE exam).

The Physical Sciences emphasis is designed to give students a broad foundation in applied physics as part of a liberal education in the arts and sciences. This option provides the breadth needed for such innovative and challenging occupations as teaching, public service, business, and science journalism. (This option meets the California Commission on Teacher Credentialing (CCTC) subject matter standards for Physics and Sciences: Physics. Students wishing to become high school physics teachers or middle school physical science teachers must take certain course options within this emphasis).

1h. ***Course prerequisites and other criteria for admission of students to the proposed degree major program, and for their continuation in it.***

1. Students seeking admission to the B.S. Applied Physics degree program must be officially accepted into the CSUCI academic program: there are no additional course prerequisites or other criteria for admission to the program beyond the standard admission criteria of the university.
2. Students must declare themselves as Applied Physics majors.

Course prerequisites:

Course	**Title**	**Prerequisites**
PHYS 200	General Physics I	MATH 150
PHYS 201	General Physics II	PHYS 200
PHYS 304	Electromagnetism	PHYS 201, MATH 151
PHYS 306	Modern Physics	PHYS 201, MATH 151
PHYS 310	Electronics	PHYS 201
PHYS 406	Solid State Physics	PHYS 306, MATH 250
PHYS 448	Team-Based Research	Upper Division Standing
PHYS 490	Topics in Physics	Upper Division Standing
PHYS 492	Internship	Upper Division Standing
PHYS 494	Independent Research	Upper Division Standing
PHYS 497	Directed Studies	Upper Division Standing
PHYS 499	Senior Colloquium	Upper Division Standing
MATH 150	Calculus I	Calculus Placement Exam or MATH 105
MATH 151	Calculus II	MATH 150
MATH 240	Linear Algebra (3)	MATH 151
MATH 250	Calculus III	MATH 151
MATH 350	Differential Equations ….	MATH 250
MATH 352	Probability and Statistics	MATH 151

PHYS 434 Introduction to Biomedical Imaging	PHYS 200 or BIOL 210
PHYS 445 Image Analysis and Pattern Recognition	PHYS 345
PHYS 464 Medical Instrumentation	PHYS 434
MATH 448 Scientific Computing	MATH 151; MATH 350 or COMP 151
MATH 450 Partial Differential Equations …	MATH 350 or consent
MATH 451 Complex Analysis	MATH 250
PHYS 301‡ Classical Mechanics	PHYS 201, MATH 350
PHYS 305‡ Thermal and Statistical Physics	PHYS 201, MATH 350
PHYS 401‡ Quantum Physics	PHYS 201, MATH 350

(‡ - courses offered to students interested in taking the GRE exam for grad school).

1i. ***Explanation of special characteristics of the proposed degree major program, e.g., in terminology, units of credit required, types of course work, etc.***

1. The program is distinctive from traditional undergraduate physics programs in being built around applications of physics, and having a strong foundation in modeling and simulation, electronics, instrumentation and image analysis.

2. It builds on the philosophy and methodology used in successful Professional Master's courses in Applied Physics, such as that developed at CSU Long Beach, and Applied Physics options, such as that developed at CSU San Bernardino.

3. The curriculum has been developed in consultation with local industry to ensure that graduates will have the required skills to be competitive in the local job market, and with the local community colleges to ensure that it offers a more accessible and attractive alternative to traditional physics courses.

4. The program structure facilitates transfer between the two emphases during the first two years.

5. The program contains lower-division and upper-division core courses, electives and service learning courses (e.g. PHYS 492 Internship), which provide integration with campus learning communities and the community at large, and formative and summative outcomes assessment.

6. The interdisciplinary nature of many of the courses provides students a broader educational experience and a better sense of the types of problems encountered in real life working situations (e.g. PHYS 448 Team-based Research).

7. The program incorporates innovative courses such as the Physics of Music, Science and Conscience and the Physics of Art and Visual Perception either as required courses or as electives.

8. A considerable number of the courses utilize guest lecturers from the community, applied physics graduates who work in various capacities in the local high-tech and health-care industries, to engage our students with the real world.

9. The program includes a very significant proportion of lab experience and practical training, incorporating the recommendations of the American Institute of Physics.

10. The program incorporates a modern medical imaging course (PHYS 434) and includes opportunities to take a state-of-the-art digital imaging course (PHYS 345), and additional biomedical imaging courses as electives (PHYS 445 and PHYS 464).

11. Upper division courses such as PHYS 492 Internship, PHYS 494 Independent Research and PHYS 497 Directed Studies, and the elective PHYS 490 Topics in Applied Physics, allow considerable flexibility and can be used to develop a particular interest or to fulfill other requirements such as the GRE in Physics.

12. The upper-division elective courses allow students to satisfy their individual curiosity and the need to explore more in-depth and specialized areas of applied physics.

13. The Physical Sciences emphasis satisfies the Single Subject Matter Requirements in General Science and Physics, as laid out by the California Commission on Teacher Credentialing (February, 2003). A table indicates how each section of the CCTC standards is being met by courses within the program (see p.41).

1j. ***For undergraduate programs, provisions for articulation of the proposed major with community college programs.***

The lower-division core courses in the CSUCI Applied Physics program adhere to the normal standards widely accepted at colleges and universities across the country. Community colleges in the CSUCI service area have been consulted, and formal articulation agreements have been negotiated to ensure a smooth transition for the transfer student.

1k. ***Provision for meeting accreditation requirements, where applicable, and anticipated date of accreditation request.***

There is no special accreditation for undergraduate Physics degree programs. However, courses in the major will enable students to compete for admission to engineering programs and graduate programs in Applied Physics with appropriate use of PHYS 490, 494 and 497 and selected electives.

2. Need for the Proposed Degree Major Program

2a. ***List of other California State University campuses currently offering or projecting the proposed degree major program; list of neighboring institutions, public and private, currently offering the proposed degree major program.***

Physics is a foundational program in the CSU system, and is offered at 19 of the 23 CSU campuses. The closest CSU program is at Northridge: the closest UC program is at UC Santa Barbara. In addition, two nearby private institutions (California Lutheran University and Westmont College) offer degrees in physics.

2b. ***Differences between the proposed program and programs listed in Section 2a above***.

The proposed program is a BS in Applied Physics, which is not currently offered at any CSU campus. It has been designed specifically to emphasize the technological applications of physics in the local job market. The degree offers a thorough education in the concepts and practice of physics, preparing students for challenging and rewarding careers in a variety of industries. It includes a strong emphasis on laboratory and experimental experience, which are linked and integrated with research and development projects currently being carried out by local high-technology companies. Graduates will emerge with up-to-date, relevant and immediately useful skills. Applied Physics is a “physics-in-technology" degree which extends the principles and concepts of physics to create new applications, products, processes and services. It leads to advances in areas as diverse as manufacturing, construction, consumer products and research.

1. The program will provide a new opportunity for local residents and others to earn a state-supported BS degree in Applied Physics, which combines the concepts of Physics with a professional training in technology.

2. The program is distinctive in that it will emphasize the applied nature of Physics and its interdisciplinary applications, including imaging and medical technology.

3. The program provides students with an industrial perspective, and shows them how the knowledge and modes of thinking from science can be put to use in the commercial world.

4. The program is strongly computer-oriented and is expected to draw on a different population than other, more traditional physics programs in the region/state.

5. The program qualifies graduates for well-paying careers in the local high-tech industry, as an alternative to post-graduate study and research.

6. The program is organized to include the lower-division core, upper-division core, service learning and capstone courses, while maintaining a large number of electives so that students can choose to concentrate in area(s) of technology that particularly interest them.

7. The program has been designed so that it can be completed in 120 units, with the required academic rigor, which ensures that students can graduate within 4 years. This is possible because many of the courses are made available as electives, so that the student can modify the program to a large extent to satisfy his/her own needs and interests.

8. In line with the University Mission, the approach taken in this program is interdisciplinary. Physics concepts will be taught using examples and applications from other disciplines (e.g. practical optics will be taught in PHYS 208 The Physics of Art and Visual Perception, and wave concepts in PHYS 335 The Physics of Music). The large number of interdisciplinary courses testifies to the rich intersection of physics with other disciplines.

9. Modern applied physics can be taught using the computer and state-of-the-art software as a teaching tool. Prime examples of this are PHYS 345 Digital Image Processing and PHYS 445 Image Processing and Pattern Recognition. Blackboard is in widespread use; students benefit from having a lesson plan that incorporates a variety of teaching activities, which they can access before, during and after class sessions.

10. The program contains supervised work and study in an industrial or scientific setting (PHYS 492 Internship), independent research (PHYS 494 and 497) and capstone courses (PHYS 490 Topics in Physics and PHYS 499 Senior Capstone Colloquium), all useful vehicles for incorporating community service, learning community activities and outcomes assessment.

12. The program gives students the transferable skills highly valued by industry; and a team-based approach is stressed in the innovative new course PHYS 448 Team-Based Research.

13. The program is enthusiastically supported by local companies such as Rockwell Scientific, Semtech, Shell Solar and others, who see it as a local source of future applied scientists, and who have pledged to provide

internships, equipment and visiting speakers, and Kaiser Permanente and Los Robles Medical Center, which have a continuing need to recruit imaging specialists.

14. The program facilitates students who are interested in doing a double major with Math or Computer Science by using many courses which are cross-listed with these disciplines.

2f. ***Professional uses of the proposed degree major program.***

About 75% of physics graduates work in science-related jobs, including software, engineering, high school teachers, and managers in technical fields, while the remainder successfully cross into a myriad of occupations which value their numeracy and logical approach to problem-solving.

The Technology emphasis within the Applied Physics program offers preparation for careers in industrial and public-sector research and development in such areas as physics, engineering, medical physics, imaging technology, computer science and energy resource management; and for graduate work in physical science or related subjects such as medicine. Such careers are in demand locally. Specialization in various applications can be accomplished by the appropriate selection of electives. In addition, our graduates are prepared for graduate studies in Applied or Experimental Physics with an appropriate choice of elective courses.

The Physical Sciences emphasis within the Applied Physics program offers preparation for careers in teaching or for careers which combine physics with other disciplines. Careers along both these avenues are in demand locally. The Department of Education's National Center for Education Statistics 2003 *Qualifications of Public School Teacher Workforce* report found that in the 1999-2000 school year, about 67% of high school physics and 93% of middle school physical science teachers have no major in the field nor proper certification.

2g. ***The expected number of majors in the year of initiation and three years and five years thereafter. The expected number of graduates in the year of initiation and three years and five years thereafter.***

	Number of majors	Number of graduates
Initiation year	12 - 14	0
Third year	16 - 18	6 - 8
Fifth year	20 - 25	12 -15

These numbers are based on conversations with local high schools and community colleges.

3. Existing Support Resources for the Proposed Degree Major Program

3a. ***Faculty members, with rank, appointment status, highest degree earned, date and field of highest degree, and professional experience (including publications if the proposal is for a graduate degree), who would teach in the program***.

Geoff Dougherty
Professor of Physics
Ph.D. in Biophysics, University of Keele, England, 1979
Extensive experience in medical imaging, image analysis, and bioengineering.

Gregory Wood
Assistant Professor of Physics
Ph.D. in Physics, University of California Riverside, 2000.
Extensive experience in computational biophysics.

Simone Aloisio
Assistant Professor of Chemistry
Ph.D. Chemistry, Purdue University, 2000.
Extensive experience in atmospheric chemistry.

Andrzej (AJ) Bieszczad
Assistant Professor of Computer Science
Ph.D. in Computer Engineering, Carleton University, Ottawa, Canada, 1996.
Extensive experience in artificial intelligence, computer communications, software engineering, R&D management.

Robert Bleicher
Associate Professor of Education-Science
Ph.D. in Educational Psychology, University of California Santa Barbara, 1993.
Extensive experience on how teachers and students communicate during classroom instruction.

Jesse Elliot
Assistant Professor of Mathematics
Ph.D. in Mathematics, UC Berkeley, 2003.
Extensive experience in commutative algebra and number theory.

Jorge Garcia
Assistant Professor of Mathematics
Ph.D. in Mathematics, University of Wisconsin-Madison, 2002.
Extensive experience in large deviations and stochastic integrals.

Ivona Grzegorczyk
Professor of Mathematics
Ph.D. in Mathematics, UC Berkeley, 1990.
Extensive experience in mathematics and its applications and mathematics education.

Philip Hampton
Professor of Chemistry
Ph.D. in Organic Chemistry, Stanford University, 1989.
Extensive experience in organic and inorganic synthesis, organometallic chemistry and polymer chemistry.

Jack Reilly
Professor of Art
MFA, Florida State University, 1977.
Extensive experience in museum and gallery exhibitions, public art, and digital art technology.

Peter Smith
Professor of Computer Science
Ph.D. in Computer Studies, Lancaster University, England, 1975.
Extensive experience in teaching computer science and curriculum design.

Ching-Hua Wang
Professor of Biology
M.D., 1978, Beijing Medical College; Ph.D. in Immunology, Cornell University, 1986.
Extensive experience in cellular and molecular immunology, and microbiology.

William J. Wolfe
Professor of Computer Science
Ph.D. in Mathematics, CUNY, 1976.
Extensive experience in databases, web design, and networks.

Cynthia Wyels
Associate Professor of Mathematics
Ph.D. in mathematics, University of California Santa Barbara, 1994.
Extensive experience in combinatorial mathematics and linear algebra.

4. Additional Support Resources Required

4b. ***Any special characteristics of the additional faculty or staff support positions needed to implement the proposed program.***

Six new courses are required to fully implement both emphases within this program, but since four of them would be run in pairs in alternate years only four courses need to be run each academic year (viz. two per semester).

In its first year (2008) three new courses would be needed. The other three new courses would be added either in 2009 or 2010.

Applied physics is an applied discipline that covers numerous distinctly different yet related fields, such as electronics, instrumentation, telemetry, imaging, optics and communications. Our program could be easily expanded to offer emphases in these fields, although we do not propose to do this until the proposed emphases have been operating for at least two years. In order to teach the wide spectrum of upper-division courses in the program well, the program will request a new faculty hire in the near future. This individual would be broadly trained in applied physics, preferably with industrial experience and expertise in electronic instrumentation and/or communications/ telemetry. It is anticipated that he/she may be able to help with the upcoming Computer Engineering program.

A significant number of courses in the proposed Applied Physics program will not only serve our own majors but also serve students in other majors including Mathematics, Computer Science, Biology, Art, Performing Arts, Liberal Studies and the proposed Computer Engineering major, as well as General Education (GE). We are currently teaching two courses serving the Math and Computer Science MS programs (PHYS/MATH/COMP 510 Advanced Image Analysis Techniques and PHYS/MATH/COMP 546 Pattern Recognition).

Students who choose the elective courses (PHYS 301, PHYS 305 and PHYS 401) in preparation for the GRE exam will be taught in small groups under the umbella of 497 Directed Study to consolidate FTEs and minimize faculty teaching loads.

Part-time faculty will continue to be needed to teach either specialty courses in their discipline when needed or teach lower-division and/or GE courses in physics. Since all students are going to be technology literate, some of the courses (or parts thereof) could be offered on-line. This would give an opportunity for local working professionals to participate, in accord with the special characteristics of our program.

Our current technician will be sufficient to service these additional courses, although he may have to cut back on other duties outside the program.

Depending on the number of courses and lab sections offered, we anticipate a modest increase in hiring of Teaching Assistants. These will comprise upper-division students with expertise in physics, math and computing.

4c. ***The amount of additional lecture and/or laboratory space required to initiate and sustain the program over the next five years. Indicate any additional special facilities that will be required. If the space is under construction, what is the projected occupancy date? If the space is planned, indicate campus-wide priority of the facility, capital outlay program priority, and projected date of occupancy***.

The current courses in Applied Physics, comprising a Minor and various GE offerings, utilize two shared laboratories and a shared prep room. It will be necessary to have another teaching lab for Fall 08, a "dry" lab fitted with 24 computer work stations and suitable instrumentation, to teach the new upper-division courses, in particular Electromagnetism, Electronics and Solid State Physics. In Fall 09, a smaller lab of half this size will be required to teach the optics and optoelectronics components of Modern and Solid State Physics, and for individual student and team-based research projects: it must have the capability of being blacked out conveniently.

Large lectures may need to be held in the Aliso Hall Auditorium, but this will not be frequent, since most of our teaching is better undertaken in a laboratory setting with equipment and computers.

Additional preparation and storage space will be required.

4d. ***Additional library resources needed. Indicate the commitment of the campus to purchase or borrow through interlibrary loan these additional resources.***

No additional library resources needed above the existing CSUCI Library acquisition program. The faculty is working with the Library staff to assure an appropriate level and subject distribution of library resources.

4e. ***Additional equipment or specialized materials that will be (1) needed to implement the program and (2) needed during the first two years after initiation. Indicate the source of funds and priority to secure these resource needs.***

The expected CSUCI budget and state support at its current level, and standard lab fees, will be able to cover the normal operational expenses.

It will be necessary to fund additional equipment for the new Electronics/Solid State Physics lab in Fall 08, and a new Optics lab in Fall 09. A preliminary assessment of costs is $60,000 and $30,000 respectively. We intend to solicit donations of equipment and internships from local companies.

5. Abstract of the Proposal and Proposed Catalog Description

APPLIED PHYSICS

PROGRAMS OFFERED

- Bachelor of Science in Applied Physics with an Emphasis in Technology
- Bachelor of Science in Applied Physics with an Emphasis in Physical Sciences
- Minor in Applied Physics

Applied physics is the interface between science and technology, between the laboratory and industrial practice. It applies the concepts and models of physics to practical technological applications. Applied physics is essentially an inter-disciplinary undertaking, interacting with mathematics, computer science, engineering, the life sciences, medicine and other disciplines. Applied physicists use their understanding and skills at the new scientific and technological frontiers that are developing rapidly at the interface between more traditional disciplines, e.g. biophysics, biomedical engineering, bioinformatics, materials science, and medical imaging. They have the flexibility to adapt to changing technological requirements and the ability to make meaningful contributions to modern, interdisciplinary investigations.

CAREERS

Graduates from the Bachelor of Science in Applied Physics will receive an excellent preparation for securing professional employment in industry or in the public sector.

The Bachelor of Science in Applied Physics with an Emphasis in Technology is designed to produce graduates with strong problem-solving, technical, industrial and management skills. This will enable them to obtain professional employment on graduation in research and development in industry or in the public sector in, for example, electronics, semiconductors, medical technology and telecommunications. Through appropriate selection of electives, students can concentrate on selected areas within applied physics and pursue further study in graduate or professional schools, for example in Experimental Physics, Computer Engineering, Materials Science, Biomedical Engineering, or Medical Physics.

The Bachelor of Science in Applied Physics with an Emphasis in Physical Sciences is designed to provide students with a broad foundation in applied physics as part of a liberal education in the sciences. The program is particularly appropriate for students interested in such careers as teaching, public service, business, scientific equipment sales or science journalism. It can serve as the depth and breadth of study necessary for securing a single Subject credential in Science for teaching at the high school and middle school level.

The Applied Physics Minor provides non-majors with the background in science and technology that is needed to pursue a career or graduate study in an interdisciplinary field. Students majoring in Mathematics or Computer Science, in

particular, should consider obtaining an Applied Physics minor because of the considerable overlap with these fields.

PROGRAM LEARNING OUTCOMES
Students graduating from the Applied Physics program will be able to:
● explain the fundamental concepts of physics;
● analyze and solve problems by applying information in a novel context;
● formulate hypotheses and devise and perform experiments to test hypotheses as individuals and in a team;
● apply current technology and scientific methodologies to analyze and solve problems in various scientific, professional and community settings;
● use and critically evaluate current technical/scientific research literature, online information, and information related to scientific issues in the mass media;
● communicate in written and oral forms key concepts in physics and general scientific issues with interested citizens and professionals;
● work co-operatively as part of a research team;
● learn independently and maintain life-long learning in the sciences and technology.

FACULTY

Geoff Dougherty, Ph.D.
Professor of Physics
Academic Advisor for the Physics Program
Aliso Hall Room 101
Phone: (805) 437-8890 Fax: (805) 437-2765
Web Page: http://faculty.csuci.edu/geoff.dougherty
Email: geoff.dougherty@csuci.edu
Physics Web Page: http://physics.csuci.edu

Gregory Wood, Ph.D.
Assistant Professor of Physics
Aliso Hall Room 102
Phone: (805) 437-3293 Fax: (805) 437-2765
Web Page: http://faculty.csuci.edu/gregory.wood
Email: gregory.wood@csuci.edu

ADDITIONAL FACULTY

Simone Aloisio, Ph.D.
Assistant Professor of Chemistry
Academic Advisor for the Chemistry Program
Phone: (805) 437-8999
Email: simone.aloisio@csuci.edu

Andrzej (AJ) Bieszczad, Ph.D.
Assistant Professor of Computer Science
Phone: (805) 437-2773
Email: aj.bieszczad@csuci.edu

Robert Bleicher, Ph.D.
Associate Professor of Education-Science
Phone: (805) 437-8508
Email: bob.bleicher@csuci.edu

Jesse Elliot, Ph.D.
Assistant Professor of Mathematics
Phone: (805) 437- 2768
Email: jesse.elliot@csuci.edu

Jorge Garcia, Ph.D.
Assistant Professor of Mathematics
Phone: (805) 437-2769
Email: jorge.garcia@csuci.edu

Ivona Grzegorczyk, Ph.D.
Professor of Mathematics
Phone: (805) 437-8868
Email: ivona.grze@csuci.edu

Philip Hampton, Ph.D.
Professor of Chemistry
Phone: (805) 437-8869
Email: philip.hampton@csuci.edu

Jack Reilly, MFA
Professor of Art
Phone: (805) 437-8863
Email: jack.reilly@csuci.edu

Peter Smith, Ph.D.
Professor of Computer Science
Phone: (805) 437-8882
Email: peter.smith@csuci.edu

Ching-Hua Wang, M.D., Ph.D.
Professor of Biology
Phone: (805) 437-8870
Email: ching-hua.wang@csuci.edu

William J. Wolfe, Ph.D.

California State University
Channel Islands

Professor of Computer Science
Phone: (805) 437-8985
Email: william.wolfe@csuci.edu

Cynthia Wyels, Ph.D.
Associate Professor of Mathematics
Phone: (805) 437-3260
Email: cynthia.wyels@csuci.edu

CONTACT INFORMATION
http://physics.csuci.edu

REQUIREMENTS FOR THE BACHELOR OF SCIENCE DEGREE WITH AN EMPHASIS IN TECHNOLOGY (120 units):

LOWER DIVISION REQUIREMENTS (31-32 units):

PHYS 106* Applied Physics and Modern Society (3)
PHYS 200* General Physics I (4)
PHYS 201 General Physics II (4)
MATH 150 Calculus I (4)
MATH 151 Calculus II (4)
MATH 230* Logic and Mathematical Reasoning (3)
MATH 240 Linear Algebra (3)
MATH 250 Calculus III (3)
AND
Either:
COMP 105* Introduction to Computer Science (3)
Or:
COMP 150* Object-Oriented Programming (4)

UPPER DIVISION REQUIREMENTS (37 units):

PHYS 304 Electromagnetism (4)
PHYS 306 Modern Physics (3)
PHYS 310 Electronics (4)
PHYS 335* Physics of Music (3)
PHYS 338* Science and Conscience (3)
PHYS 345* Digital Image Processing (3)
PHYS 406 Solid State Physics (3)
PHYS 434* Introduction to Biomedical Imaging (4)
PHYS 448* Team-Based Research (3)
PHYS 499 Senior Capstone Colloquium (1)
MATH 350 Differential Equations and Dynamical Systems (3)

AND
3 units taken from the following:
PHYS 492 Internship (required for teachers) (3)
PHYS 494 Independent Research (1-3)
PHYS 497 Directed Studies (1-3)

ELECTIVES IN THE MAJOR (9-10 units)
Select three courses from the following:

PHYS 445* Image Analysis and Pattern Recognition (3)
PHYS 464 Medical Instrumentation (4)
PHYS 490 Topics in Applied Physics (3)
PHYS 492 Internship (3), if not taken as a required course
PHYS 494 Independent Research (3), if not taken as a required course
PHYS 497 Directed Studies (3), if not taken as a required course
MATH 352 Probability and Statistics (3)
MATH 448 Scientific Computing (3)
MATH 450 Partial Differential Equations and Mathematical Physics (3)
MATH 451 Complex Analysis (3)
PHYS 301‡ Classical Physics (3)
PHYS 305‡ Thermal and Statistical Physics (3)
PHYS 401‡ Quantum Mechanics (3)
(‡ - courses offered to students interested in taking the GRE exam for grad school).

*(Courses with * are double-counted toward GE credits).*

REQUIRED SUPPORTING AND OTHER GE COURSES (42 units):
American Institutions Requirement (6)
Other courses in GE categories A-E (27)
Electives in Any Discipline (9)

REQUIREMENTS FOR THE BACHELOR OF SCIENCE DEGREE WITH AN EMPHASIS IN PHYSICAL SCIENCES (120 units):

LOWER DIVISION REQUIREMENTS (32-33 units):

PHYS 106* Applied Physics and Modern Society (3)
PHYS 200* General Physics I (4)
PHYS 201 General Physics II (4)
MATH 150 Calculus I (4)
MATH 151 Calculus II (4)
CHEM 105* Introduction to Chemistry (3)
AND
Either:

PHYS 208* Physics of Art and Visual Perception (3)
Or:
PHSC 170* Foundations in Physical Science (4) (required for teachers)
AND
Either:
BIOL 100* Exploring the Living World (4)
Or:
BIOL 170* Foundations of Life Science(4) (required for teachers)
AND
Either:
COMP 102* Web Development (3)
Or:
COMP 105* Introduction to Computer Science (3)

UPPER DIVISION REQUIREMENTS (30 units):

PHYS 304 Electromagnetism (4)
PHYS 306 Modern Physics (3)
PHYS 335* Physics of Music (3)
PHYS 338* Science and Conscience (3)
PHYS 344 Energy and Society (3)
PHYS 434 Introduction to Biomedical Imaging (4)
PHYS 448* Team-Based Research (3)
PHYS 499 Senior Capstone Colloquium (1)
MGT 325 Entrepreneurial Management (3)
AND
3 units taken from the following:
PHYS 492 Internship (required for teachers) (3)
PHYS 494 Independent Research (1-3)
PHYS 497 Directed Studies (1-3)

ELECTIVES IN THE MAJOR (15-16 units)
Chosen with advisor's approval.
(† - recommended for teachers)

PHYS 310 Electronics (4)
PHYS 345* Digital Image Processing (3)
PHYS 436* Physics of the Performing Arts (3)
PHYS 445* Image Analysis and Pattern Recognition (3)
PHYS 464 Medical Instrumentation (4)
PHYS 490 Topics in Applied Physics (3)
PHYS 492 Internship (3), if not taken as a required course
PHYS 494 Independent Research (1-3), if not taken as a required course
PHYS 497 Directed Studies (1-3), if not taken as a required course
EDUC 330† Teaching in Secondary Schools (3)
MATH 240 Linear Algebra (3)

MATH 250 Calculus III (3)
MATH 350 Differential Equations and Dynamical Systems (3)
MATH 352 Probability and Statistics (3)
MATH 448 Scientific Computing (3)
MATH 450 Partial Differential Equations and Mathematical Physics (3)
MATH 451 Complex Analysis (3)

*(Courses with * are double-counted toward GE credits).*

REQUIRED SUPPORTING AND OTHER GE COURSES (42 units):

American Institutions Requirement (6)
Other courses in GE categories A-E (27)
Electives in Any Discipline (9)

PROPOSED COURSE OF STUDY, Bachelor of Science in Applied Physics with an Emphasis in Technology

FRESHMAN YEAR (29 - 30 UNITS)

PHYS 106	Applied Physics and Modern Society	3
MATH 150	Calculus I	4
MATH 151	Calculus II	4
COMP 150	Object–Oriented Programming	4
(or COMP 105	Computer Programming Intro	3)
American Institutions		6
Other GE		9

SOPHOMORE YEAR (29 UNITS)

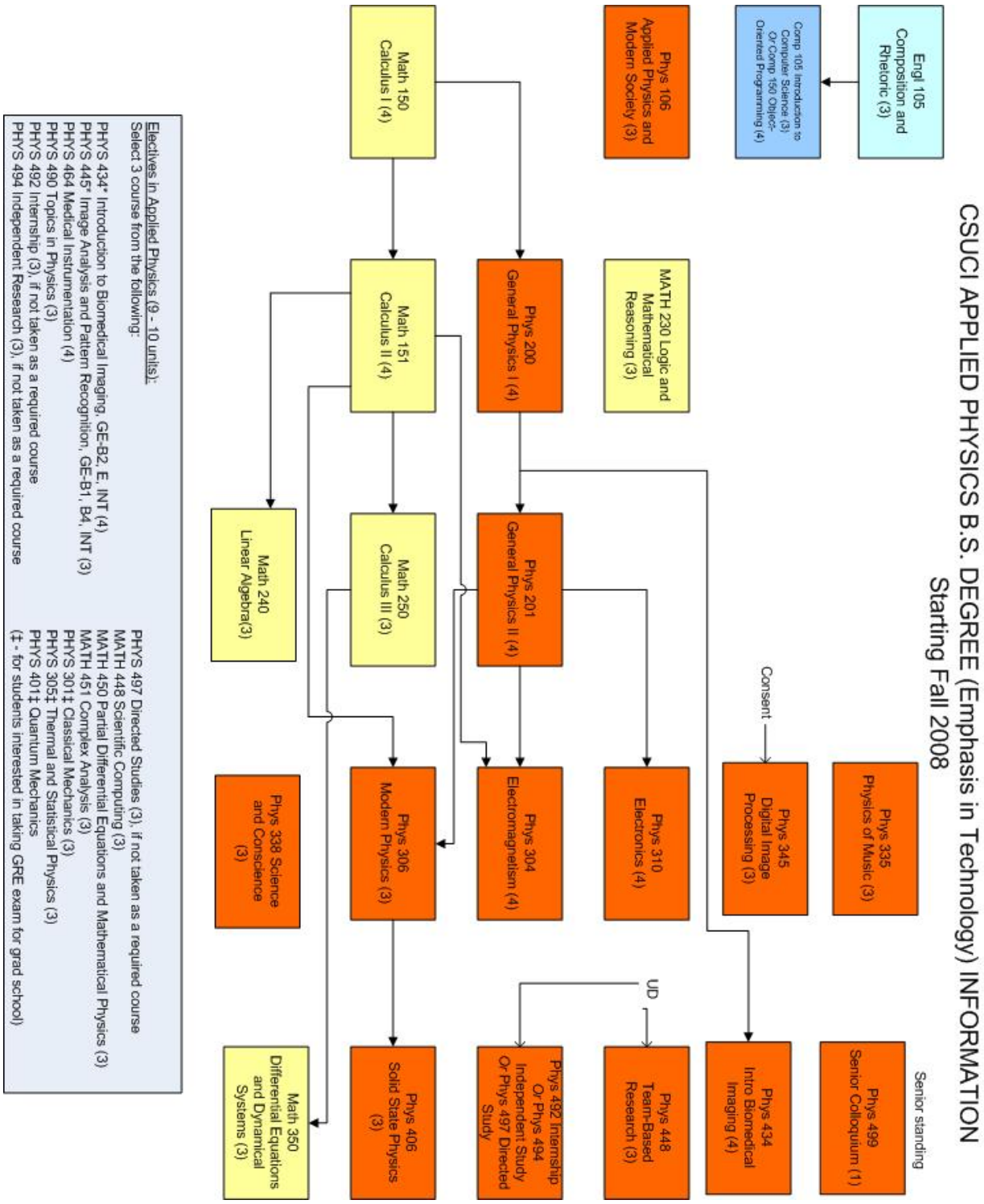
PHYS 200	Gen Physics I	4
PHYS 201	Gen Physics II	4
MATH 230	Logic and Mathematical Reasoning	3
MATH 240	Linear Algebra	3
MATH 250	Calculus III	3
Other GE		12

JUNIOR YEAR (32 UNITS)

PHYS 304	Electromagnetism	4
PHYS 306	Modern Physics	3
PHYS 310	Electronics	4
PHYS 335*	Physics of Music	3
PHYS 338*	Science and Conscience	3
PHYS 345*	Digital Image Processing	3
University Electives		6
UDIGE		3
Other GE		3

SENIOR YEAR (29-30 UNITS)

PHYS 406	Solid State Physics	3
PHYS 434*	Intro to Biomedical Imaging	4
PHYS 448*	Team-Based Research	3
PHYS 492, 494 or 497		3
PHYS 499	Senior Capstone	1
MATH 350	Differential Equations	3
Applied Physics Elective		9-10
University Electives		3


CSUCI APPLIED PHYSICS B.S. DEGREE (Emphasis in Technology) INFORMATION
Starting Fall 2008
Engl 105 Composition and Rhetoric (3)
Comp 105 Introduction to Computer Science (3) Or Comp 150 Object-Oriented Programming (4)
Phys 106 Applied Physics and Modern Society (3)
Math 150 Calculus I (4)
MATH 230 Logic and Mathematical Reasoning (3)
Phys 200 General Physics I (4)
Math 151 Calculus II (4)
Phys 201 General Physics II (4)
Math 240 Linear Algebra(3)
Math 250 Calculus III (3)
Phys 335 Physics of Music (3)
Consent
Phys 345 Digital Image Processing (3)
Phys 310 Electronics (4)
Phys 304 Electromagnetism (4)
Phys 306 Modern Physics (3)
Phys 338 Science and Conscience (3)
Phys 434 Intro Biomedical Imaging (4)
Senior standing
Phys 499 Senior Colloquium (1)
UD
Phys 448 Team-Based Research (3)
Phys 492 Internship Or Phys 494 Independent Study Or Phys 497 Directed Study
Phys 406 Solid State Physics (3)
Math 350 Differential Equations and Dynamical Systems (3)
Electives in Applied Physics (9 - 10 units):
Select 3 course from the following:
PHYS 434* Introduction to Biomedical Imaging, GE-B2, E, INT (4)
PHYS 445* Image Analysis and Pattern Recognition, GE-B1, B4, INT (3)
PHYS 464 Medical Instrumentation (4)
PHYS 490 Topics in Physics (3)
PHYS 492 Internship (3), if not taken as a required course
PHYS 494 Independent Research (3), if not taken as a required course
PHYS 497 Directed Studies (3), if not taken as a required course
MATH 448 Scientific Computing (3)
MATH 450 Partial Differential Equations and Mathematical Physics (3)
MATH 451 Complex Analysis (3)
PHYS 301‡ Classical Mechanics (3)
PHYS 305‡ Thermal and Statistical Physics (3)
PHYS 401‡ Quantum Mechanics
(‡ - for students interested in taking GRE exam for grad school)

PROPOSED COURSE OF STUDY, Bachelor of Science in Applied Physics with an Emphasis in Physical Sciences

FRESHMAN YEAR (30 UNITS)

PHYS 106	Applied Physics and Modern Society	3
MATH 150	Calculus I	4
MATH 151	Calculus II	4
CHEM 105	Introduction To Chemistry	3
BIOL 100	Exploring the Living World	4
(or BIOL 170	Foundations of Life Science	4)
American Institutions		6
Other GE	Including ENGL 105	6

SOPHOMORE YEAR (29-30 UNITS)

PHYS 200	General Physics I	4
PHYS 201	General Physics II	4
COMP 105	Computer Programming Intro	3
(or COMP 102	Web Development	3)
PHYS 208	Physics of Art and Visual Perception	3
(or PHSC 170	Foundations in Physical Sciences	4)
Other GE		15

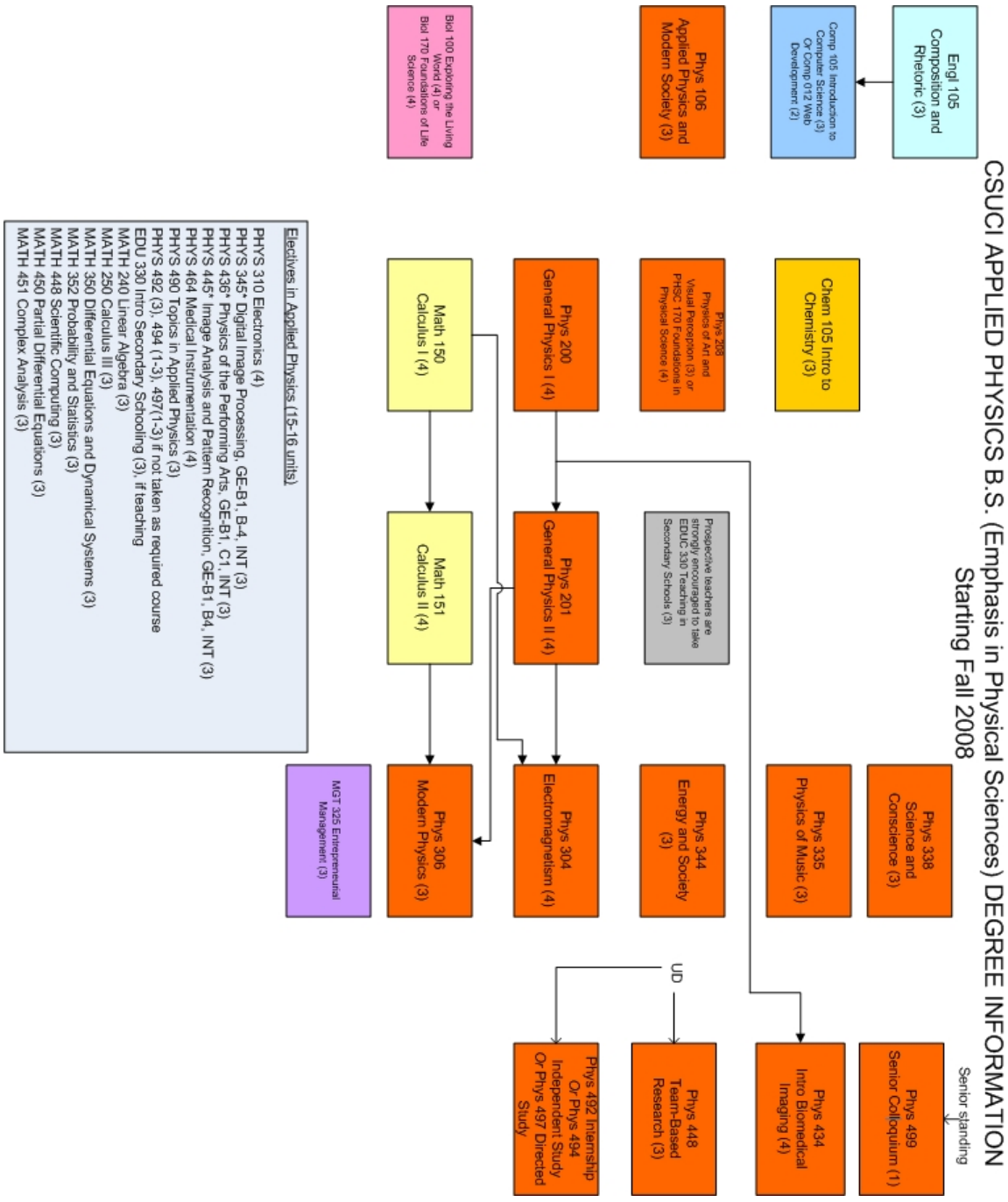
JUNIOR YEAR (31-32 UNITS)

PHYS 304	Electromagnetism	4
PHYS 335*	Physics of Music	3
PHYS 338*	Science and Conscience	3
PHYS 344*	Energy and Society	3
MGT 325	Entrepreneurial Management	3
Applied Physics Electives		6-7
University Electives		6
UDIGE		3

SENIOR YEAR (29 UNITS)

PHYS 306	Modern Physics	3
PHYS 434	Intro to Biomedical Imaging	4
PHYS 492, 494 or 497		3
PHYS 448	Team-Based Research	3
PHYS 499	Senior Capstone	1
Applied Physics Electives		9
University electives		3
Other GE		3

Note to Students: To maximize University Electives, it is recommended that the nine units of upper-division, interdisciplinary general education courses (numbered 330-349 or 430-449) be taken from those courses marked with an asterisk (*), in order to meet simultaneously Categories A-E and the nine units of Upper-Division General Education.


CSUCI APPLIED PHYSICS B.S. (Emphasis in Physical Sciences) DEGREE INFORMATION
Starting Fall 2008
Engl 105 Composition and Rhetoric (3)
Comp 105 Introduction to Computer Science (3) Or Comp 012 Web Development (2)
Phys 106 Applied Physics and Modern Society (3)
Biol 100 Exploring the Living World (4) or Biol 170 Foundations of Life Science (4)
Chem 105 Intro to Chemistry (3)
Phys 208 Physics of Art and Visual Perception (3) or PHSC 170 Foundations in Physical Science (4)
Phys 200 General Physics I (4)
Math 150 Calculus I (4)
Prospective teachers are strongly encouraged to take EDUC 330 Teaching in Secondary Schools (3)
Phys 201 General Physics II (4)
Math 151 Calculus II (4)
Phys 338 Science and Conscience (3)
Phys 335 Physics of Music (3)
Phys 344 Energy and Society (3)
Phys 304 Electromagnetism (4)
Phys 306 Modern Physics (3)
MGT 325 Entrepreneurial Management (3)
Senior standing
Phys 499 Senior Colloquium (1)
Phys 434 Intro Biomedical Imaging (4)
UD
Phys 448 Team-Based Research (3)
Phys 492 Internship Or Phys 494 Independent Study Or Phys 497 Directed Study
Electives in Applied Physics (15-16 units)
PHYS 310 Electronics (4)
PHYS 345* Digital Image Processing, GE-B1, B-4, INT (3)
PHYS 436* Physics of the Performing Arts, GE-B1, C1, INT (3)
PHYS 445* Image Analysis and Pattern Recognition, GE-B1, B4, INT (3)
PHYS 464 Medical Instrumentation (4)
PHYS 490 Topics in Applied Physics (3)
PHYS 492 (3), 494 (1-3), 497(1-3) if not taken as required course
EDU 330 Intro Secondary Schooling (3), if teaching
MATH 240 Linear Algebra (3)
MATH 250 Calculus III (3)
MATH 350 Differential Equations and Dynamical Systems (3)
MATH 352 Probability and Statistics (3)
MATH 448 Scientific Computing (3)
MATH 450 Partial Differential Equations (3)
MATH 451 Complex Analysis (3)

Matrix of CCTC standards and courses (also attached as matrix.xls)

	CORE - 47 Units															BREADTH & PERSPECTIVE - 38-39 Units							
Standards and Domains / Courses ->	PHYS 106 Applied Physics & Society	PHYS 200 General Physics I	PHYS 201 General Physics II	PHYS 208 Physics of Art and VP	PHYS 304 Electro-magnetism	PHYS 306 Modern Physics	PHYS 335 Physics of Music	PHYS 338 Science and Consci	PHYS 344 Energy and Society	PHYS 434 Intro to Biomedical Imaging	PHYS 492 Internship	Phys 494 Independent Research	PHYS 497 Directed Studies	PHYS 448 Team-Based Researc	PHYS 499 Senior Capstone Colloq.	PHSC 170 Foundations in Physical Science	COMP 105 or 102	CHEM 105 Intro. to Chemistry	BIOL 100 or 170	MATH 150/151 Calculus	MGT 325	PHYSICS ELEC-TIVES	ENGL 105 Composition
1-Philosophy	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
2-Diversity	x		x	x			x	x	x	x	x	x	x	x	x	x		x	x		x	x	
3-Technology	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
4-Literacy								x	x	x	x	x	x	x	x						x		x
5-Strategies	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	
6-Field exp.										x	x					x							
7 -Assessment	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
8-Advisement	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x						x	
9-Evaluation	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
10-Coordination	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
11–Vision for Science	x							x	x	x				x		x		x	x			x	
12-General Academic Quality	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
13-Integrated Study	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x			x	
14-Breadth of Study	x	x	x	x			x	x	x	x				x	x	x		x	x			x	
15D-Depth of Study (Physics)					x	x				x	x	x	x	x	x							x	
16-Lab and Field Experiences		x	x	x			x			x	x	x				x			x			x	
17-Safety Procedures		x	x							x	x	x				x		x	x				
1) Motion and Forces		x								x		x	x	x		x						x	
2) Cons. of Energy & Momentum	x	x						x	x			x	x	x		x						x	
3) Heat & Thermodynamics		x										x	x	x		x						x	
4) Waves			x	x	x	x	x			x		x	x	x		x						x	
5) Electromagnetism	x		x		x					x		x	x	x		x						x	
6) Quantum Mechanics	x		x			x						x	x									x	
1) Investig. & Experimentation																							
1.1-Question Formulation	x	x	x		x	x		x	x	x	x	x	x	x	x	x		x	x		x	x	
1.2-Planning a Scientific Investig.	x	x	x		x	x		x	x	x	x	x	x	x	x	x		x	x		x	x	
1.3-Observation & Data Collection		x	x			x					x	x		x		x		x	x		x	x	
1.4-Data Analysis/ Graphing		x	x							x	x	x		x		x		x	x	x	x	x	
1.5-Conclusions & Comm.		x	x							x	x	x		x		x		x	x		x	x	
2) Nature of Science										x												x	
2.1-Scientific Inquiry	x	x	x		x	x		x	x	x	x	x	x	x	x			x	x			x	
2.2-Scientific Ethics	x	x	x					x	x	x	x	x	x	x	x			x	x			x	
2.3-Historical Perspectives	x	x	x		x	x	x	x	x	x	x	x	x	x	x			x	x			x	
3) Science & Society								x		x													
3.1-Science Literacy	x			x				x		x			x	x	x			x	x			x	
3.2-Diversity	x			x			x	x		x								x	x			x	
3.3-Sci., Tech., & Society	x		x	x		x		x	x	x				x	x			x	x			x	
3.4-Safety		x	x					x		x						x		x	x				