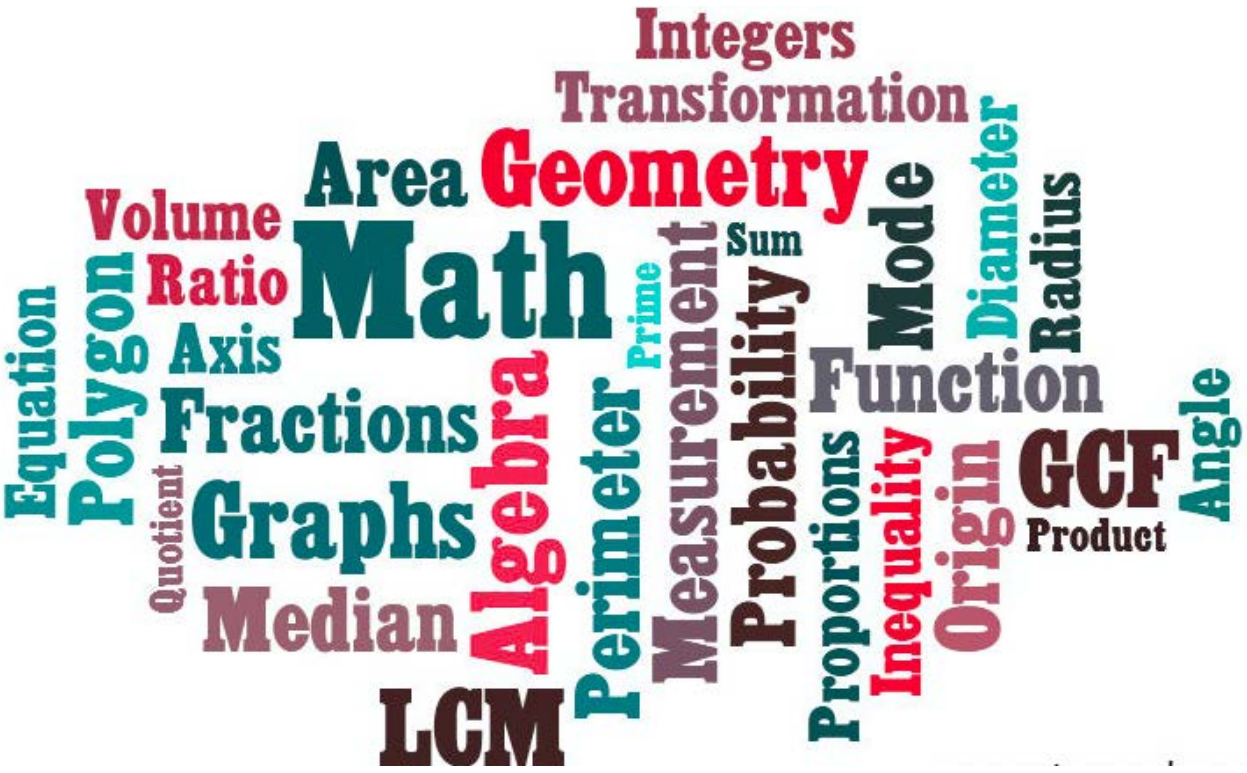

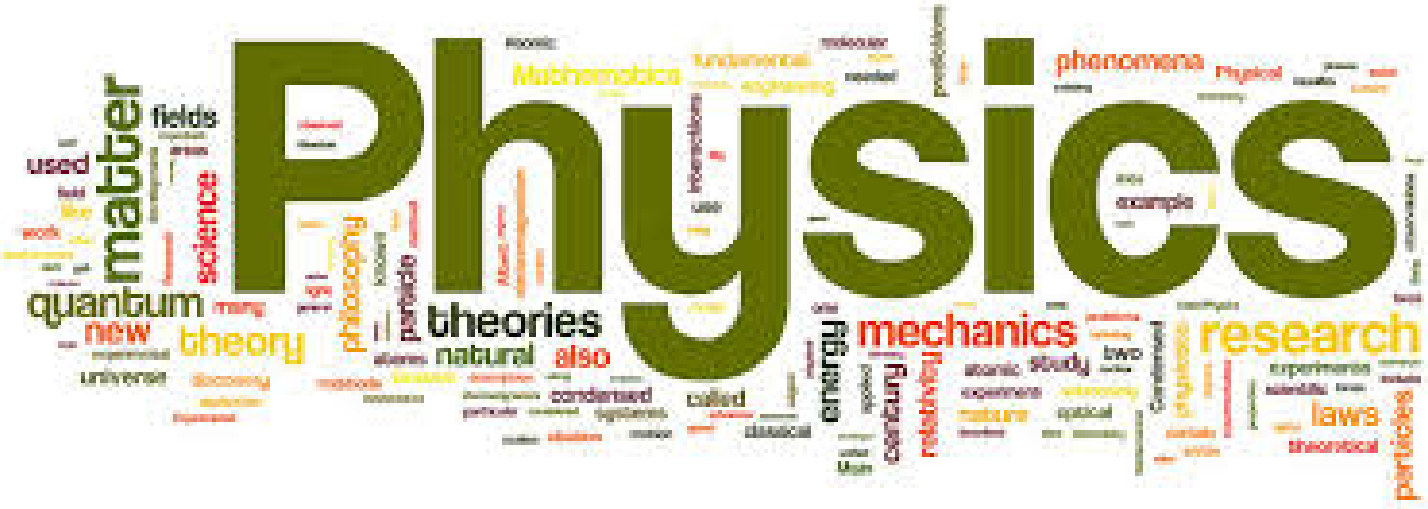

Master of Mathematics and Physics

- **Mathematics Concentration**
- **Physics Concentration**

College of Sciences and Engineering

Dean: Dr. Patrick Carriere

Department of Mathematics and Physics

Master of Mathematics and Physics (MS/MAPH)

Mathematics Concentration

Program Leader: Dr. Katrina Cunningham

P.O. Box 9759

Baton Rouge, LA 70813-9759

T. T. Allain Bldg. – Room 345

Phone: (225) 771-5180

Fax: (225) 771-4762

E-mail: katrina_cunningham@subr.edu

The Department of Mathematics and Physics offers a Master of Science degree in Mathematics and Physics, with a concentration in Mathematics. The curriculum of study must be chosen by the student and approved by the Graduate Committee of the Mathematics program. Emphasis of study will reflect the student's choice.

Graduate Faculty:

Professors:

Javier, Walfredo

Ph.D., Bowling Green State

Specialty: Mathematical Statistics

Barona, Humberto Munoz

Ph.D., University of Louisiana at Lafayette

Specialty: Numerical Analysis and Applied Mathematics

Associate Professor:

Vincent-Finley, Rachel

Ph.D., Rice University

Specialty: Computational and Applied Mathematics

Assistant Professor:

Cunningham, Katrina

Ph.D., Saint Louis University

Specialty: Algebra

Introduction

The graduate program in mathematics began in 1960. For the first five years of the program's existence, the students were in-service teachers who were participants in summer institutes sponsored by the National Science Foundation. Students not in this category, i.e. full-time graduate students, began to enroll in the late 1960s. The content of the program was focused on classical mathematics: Algebra, Analysis, Geometry, and Topology.

In 1985, the program added two more dimensions, namely Applied Mathematics and Mathematics for Teachers. These three programs were called Option I (Classical), Option II (Applied) and Option III (Teaching). Later, Options I and II were combined and renamed Program I, Option III was renamed Program II.

In 2006, the Teacher Option (Option II) was combined with the Option I Program. This redesigned program has the flexibility to meet the needs of the three options created in 1985, depending on the choices made by the student in choosing from the list of approved electives.

GRADUATE DEGREES OFFERED:

Master of Science in Mathematics

ADMISSION REQUIREMENTS

In addition to meeting the general admission requirements of the Graduate School, applicants holding B.S. degrees in related fields, or having deficiencies in mathematics, may apply for provisional admission. In these cases, the Graduate Committee within the program, with the approval of the Chair, may recommend that the student enrolls in a mixed program of graduate and undergraduate courses approved by the graduate committee for the purpose of removing deficiencies in undergraduate mathematics. All deficiencies must be removed before a student can become a candidate for a graduate degree. Students admitted on the provisional basis cited above will receive credit toward the Master of Science degree for all graduate work successfully completed during this provisional period upon admission to the program.

DEGREE REQUIREMENTS

The number of credits required for the thesis option is 33 semester hours including six hours for thesis. Students who write a thesis must defend the thesis. Students who do not write a thesis must complete a capstone project and pass a comprehensive examination administered by the Mathematics Graduate Committee.

All students must pass a core program consisting of the following courses: MATH 500, 530, 531, 533, 565, and 566.

In addition to the core, all students must pass a minimum of 9 credit hours from the list of approved electives.

OBJECTIVES OF THE PROGRAM

This program is designed for persons interested in teaching post-secondary mathematics, pursuing further studies in mathematics or mathematics education, or working in industry.

Objectives:

- ✓ To offer intensive study in the areas of Classical and Applied Mathematics.
- ✓ To provide insights into the structure of mathematics and its importance.
- ✓ To strengthen the background of those persons who are interested in pursuing further studies in mathematics or

mathematics education.

- ✓ To provide a stimulating environment for graduate students in mathematics.
- ✓ To provide a sufficiently flexible program that allows students to engage in meaningful mathematical experiences which will enhance their career opportunities.

THE PROGRAM OF STUDIES

Core Courses (18 Credits)

MATH 500	Foundations of Math and of Physics	3 Credits
MATH 530	Abstract Algebra I	3 Credits
MATH 531	Abstract Algebra II	3 Credits
MATH 533	Computational Linear Algebra I	3 Credits
MATH 565	Real Analysis I	3 Credits
MATH 566	Real Analysis II	3 Credits

Approved Electives (9 Credits)

MATH 432	Elementary Number Theory	3 Credits
MATH 492	Introduction to Point-Set Topology	3 Credits
MATH 501	History of Mathematics	3 Credits
MATH 534	Computational Linear Algebra II	3 Credits
MATH 551	Higher Geometry	3 Credits
MATH 571, 572	Numerical Analysis	3, 3 Credits
MATH 577, 578	Operational Mathematics I, II	3, 3 Credits
MATH 585, 586	Computers, Statistics and Probability	3, 3 Credits
MATH 579	Discrete Math	3 Credits
MATH 595	Topics in Applied Mathematics	3 Credits

Thesis or Capstone Project (6 Credits)

MATH 599	Special Project/Capstone	3-6 Credits
MATH 600	Master's Thesis	3-6 Credits
MATH 601	Comprehensive	0 Credit

TOTAL 33 CREDITS

COURSES CARRYING GRADUATE CREDIT (400 LEVEL).

The following courses carry graduate credit and may be used to service various students needing additional mathematics experiences. It should be noted that only Mathematics 432 and 492 are on the list of approved electives for purposes of meeting the 33-hour Graduate Mathematics program requirements.

Please consult the undergraduate Catalog for these course descriptions.

MATH: 432, 433, 435, 445, 446, 450, 462, 463, 470, 472, 474, 475, 470, 480, 481, 482, 483, 492, 499.

GRADUATE MATHEMATICS COURSES (500 LEVEL)

MATH 500. FOUNDATIONS OF MATHEMATICS AND PHYSICS (Credit, 3 hours). Introduces students to basic techniques of writing proofs and acquaints them with some fundamental ideas that are used throughout mathematics. Topics include: sets, cardinality and ordinality, first and second order predicate calculus, mathematical induction, relations, and orders. Foundations of Physics include formal logic, mathematics (i.e., theory), and experimentation, with the latter two in a symbiotic relation.

Theoretical or experimental research is enabled by a universally adopted scientific method that rests on ethical conduct. Explorations of these foundations utilize the fundamental forces of nature, matter-energy, space-time, the Standard Model of particles, and the sought unification between Quantum Mechanics and General Relativity. Outstanding unknowns to be noted include black holes, dark matter, and dark energy. (Prerequisite: Consent of the instructor.)

MATH 501. HISTORY OF MATHEMATICS (Credit, 3 hours). This course traces the historical evolution of key concepts in the following stands: number and numeration, number theory, computation, algebra, geometry, calculus, and probability and statistics. The emphasis is placed on the processes used by mathematicians, the nature of mathematics, and the modern K-14 curriculum as the culmination of the evolution of the concepts in history.

MATH 530. ABSTRACT ALGEBRA I (Credit, 3 hours). Topics covered in this course include equivalence relations, mappings, integers, and groups. Emphasis is placed on properties and examples.

MATH 531. ABSTRACT ALGEBRA II (Credit, 3 hours). Topics covered in this course include rings, integral domains, fields, polynomials over a field, and factorization. Emphasis is placed on properties and examples. (Prerequisite: Math 530.)

MATH 533-534. COMPUTATIONAL LINEAR ALGEBRA I, II (Credit, 6 hours). Complex numbers, theory of equations, linear equations, matrices, determinants, vector spaces, linear transformations, matrix norms, the Gram-Schmidt orthogonalization process, orthogonal polynomials, eigenvalues and eigenvectors, diagonalization, quadratic forms, positive definite matrices, non-negative matrices, applications: least square problems, differential equations; numerical linear algebra: Gaussian elimination, pivoting strategies, iterative methods, and the eigenvalue problem are covered. (Prerequisite: Math 364.)

MATH 551. HIGHER GEOMETRY (Credit, 3 hours). This course covers absolute geometry, elements of Euclidean, hyperbolic, and projective geometries. Also includes a discussion of the consistency of Euclid's fifth postulate. (Prerequisite: Consent of instructor.)

MATH 565-566. REAL ANALYSIS I, II (Credit, 6 hours). Axioms of the real numbers, supremum, infimum, upper limits, lower limits, open and closed sets in Rp, compactness, the Bolzano-Weierstrass and Heine-Borel Theorems, the Cantor Theorem, uniform continuity, uniform convergence, Riemann and Riemann-Stieltjes integration, and metric spaces.

MATH 571-572. NUMERICAL ANALYSIS I, II (Credit, 6 hours). Some general principles of numerical calculation, estimating accuracy in numerical calculations, numerical uses of series,

approximation of functions, numerical integration, differentiation and interpretation, differential equations, Fourier methods, optimization, Monte Carlo method, and stimulation. (Prerequisite: Math 370.)

MATH 577-578. OPERATIONAL MATHEMATICS I, II (Credit, 3 hours). The LaPlace transformation, elementary applications, problems in partial differential equations, functions of a complex variable, the inversion integral, problems in heat conduction, problems in mechanical vibrations, generalized Fourier series, general integral transfers, Fourier transforms on the half line, Hankel transforms, Legendre, and other integral transforms. (Prerequisite: Math 370.)

MATH 579. TOPICS IN DISCRETE MATHEMATICAL MODULES (Credit, 3 hours). Offers serious method of attacking discrete mathematical problems with emphasis on enumerative analysis, graph theory, modern and Boolean algebra. Develops both practical and theoretical topics systematically. (Prerequisite: Math 364.)

MATH 580. MATHEMATICS AND CRITICAL THINKING (Credit, 3 hours). Various paradigms for the study of critical thinking and problem solving will be covered. Mathematical processes such as abstraction, generalization, modeling and proof will be included together with an analysis of the development of a deductive system.

MATH 581. PRINCIPLES OF ALGEBRA II (Credit, 3 hours). An investigation of the algebraic structure of arithmetic (in the Real Number System) in which proofs of some elementary properties are covered. Other abstract algebraic structures such as groups, rings, and fields, and issues of transitional mathematics (from arithmetic to algebra), are also discussed.

MATH 582. PRINCIPLES OF GEOMETRY II (Credit, 3 hours). Basic experiences include an understanding of the techniques used to validate and organize geometry into a deductive system. The Hilbert-Birkoff axioms will augment Euclid's geometry. Non-Euclidian geometries will follow from a study of the parallel postulate controversy. Transformational and projective geometries will be briefly discussed.

MATH 583. PRINCIPLES OF ANALYSIS II (Credit, 3 hours). An introduction to differential and integral calculus. A review of algebraic and numerous experiences which are prerequisites for success in calculus will be included. The use of graphing calculators will be integrated into the course.

MATH 584. PRINCIPLES OF LINEAR ALGEBRA (Credit, 3 hours). Certain experiences are designed to relate vector spaces, systems of equations, matrices, determinants, and transformations from Rm to Rn. Other experiences that show how conic sections are related to quadratic forms.

MATH 585-586. COMPUTERS, STATISTICS AND PROBABILITY. (Credit, 3 hours). This sequence provides experiences in statistics, probability, computer literacy, and the use of descriptive and inferential statistics and computers in mathematics education research and in the classroom.

MATH 595. TOPICS IN APPLIED MATHEMATICS (Credit, 1-6 hours). Formerly MATH 598. Selected topics in mathematics from probability and statistics, differential equations, linear programming, mathematical modeling, modern algebra, applied algebra, graph theory, number theory, or analysis. Credit up to six hours for the course under different headings. Course used only for an extension of topics beyond the scope of the courses already in the catalog. Courses offered under this number will appear on the transcripts under a heading, which specifies the topic to be discussed.

MATH 596. GRADUATE SEMINAR (Credit, 3 hours). Selected **(Credit, 3-6 hours).** This course may include experiences in any one of the following: number theory, algebra, geometry, calculus, analysis, linear algebra, theory of problem-solving, curriculum materials to supplement the teaching and learning of mathematics in grades 5-12 (in line with NCTM Standards). Mathematics 597 is to be used by the students as a primer to a research project. Credit for this course under different headings.

MATH 599. SPECIAL PROJECT/CAPSTONE PROJECT (Credit, 3-6 hours). Research under the guidance of a graduate faculty member. Designed for a Master's student who elects the non-thesis program option and whose project proposal has been approved and registered. The student selects a faculty advisor to guide and oversee the work done on the special project. Weekly meetings with the faculty advisor are required. A final project report and successful completion of MATH 601 are required for graduation. Six hours of credit are awarded upon completion of an approved project.

MATH 600. RESEARCH FOR MASTER'S THESIS (Credit, 3-6 hours). Research under the guidance of a graduate faculty member. Designed for a Master's student who elects the thesis program option and whose thesis proposal has been approved and registered. The student selects chair and research advisors to serve on the Thesis Committee. Satisfactory oral defense of topic is required for graduation. Six hours of credit are awarded upon completion of an approved thesis.

MATH 601. COMPREHENSIVE (Credit, 0 hours). Must be completed and passed by all persons applying for the M. S. degree who do not write a thesis.

* Non-Thesis option

** Thesis option

College of Sciences and Engineering

Master of Mathematics and Physics (MS/MAPH)

Physics Concentration

Program Leader: Dr. Laurence L. Henry

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Phone: (225) 771-4130

Fax: (225) 771-2310

E-mail: Laurence_henry@subr.edu

The Department of Mathematics and Physics offers a Master of Science degree in Mathematics and Physics, with a concentration in Physics. The curriculum of study must be chosen by the student and approved by the graduate committee of the Physics program. The emphasis of study will be reflected by the student's choice of courses in his program of study.

Dr. Laurence L. Henry
Chair and Professor
Department of Mathematics and Physics
Phone: (225) 771-4490

Contact person: Dr. Diola Bagayoko
M.S. Program Director
Email: diola_bagayoko@subr.edu
Phone: (225) 771-2730
Fax: (225) 771-4341

FACULTY

Professors:

Bagayoko, Diola
Ph.D., Physics
Louisiana State University

Bobba, Rambabu
Ph.D., Physics
Indian Institute of Technology

Henry, Laurence L.
Ph.D., Physics
Wayne State University

Lam, Pui-Man
Ph.D., Physics
Washington University

McGuire, Stephen C.
Ph.D., Physics
Cornell University

Reese, Terrence
Ph.D., Physics
Texas Christian University

Zhao, G. L.
Ph.D., Physics
Iowa State University

Assistant Professor:

Stewart, Anthony
Ph.D., Physics
University of Florida

Professor Emeritus:

Yang, Chia Hsiung
Ph.D., Physics
Washington University

PROGRAM OF STUDY

Introduction

The Bachelor's degree program in Physics was established in the fall of 1959. The Master of Science (MS) degree program in physics started in the fall of 1996. The MS program provides high quality educational and research opportunities for students interested in high demand fields of physics, applied physics, materials science, and related disciplines. In the fall of 2012, The Board of Regents consolidated the BS degrees in Mathematics and in Physics and the MS degrees in Mathematics and in Physics. The resulting degrees are the BS and MS degrees in

"Mathematics and Physics," with a concentration in Mathematics and in "Mathematics and Physics," with a concentration in Physics.

Objectives

The objectives of the graduate program in Physics are to:

- ✓ Prepare students for hi-tech fields
- ✓ Prepare students for doctoral studies in physics and related fields
- ✓ Extend the physics training/research skills of high school teachers and of other professionals

GRADUATE DEGREES OFFERED

M.S. Master of Science, with a physics concentration

The basic core graduate courses are taken by each student: Classical Mechanics, Mathematical Physics I, Classical Electro-dynamics I, Quantum Mechanics, and Statistical Mechanics – plus MATH 500 and MATH 533 (I). At least one semester of Graduate Seminar is required. Students who have a particular interest in pursuing a Ph.D. degree will take the second courses in most of these sequences. While applied physics students will take the first courses of the above sequences, they will concentrate on topical areas relevant to their programs in subsequent courses. Another set of reform guided, technology imbued, and concept intensive core courses is available for teachers and professionals who want to earn a master's degree in Physics.

Illustrative areas of ongoing research are: Condensed Matter Physics (Theory and Experiments); Magnetic Materials; Computational Physics; Atomic, Molecular, and Nuclear Physics and Applications; Surface Physics; Materials Science; High-Temperature Superconductivity; Astronomy; High Energy and Astro-Particle Physics; and Teaching and Learning Physics.

ADMISSIONS REQUIREMENTS

Admission to the Southern University Graduate School

- ✓ A Bachelor's Degree in physics or related areas with at least 27 credit hours of physics courses or equivalent
- ✓ Three letters of recommendation; one of which must be from a faculty advisor
- ✓ A brief essay describing the applicant's career plans
- ✓ TOEFL scores (for International Students only)

DEGREE/GRADUATION REQUIREMENTS

- ✓ Completion of a program of at least 24 hours of graduate coursework [include all core courses] with an overall "B" average or better and six hours of thesis research
- ✓ A passing score on the Physics Concentration Comprehensive Examination (PCCE)
- ✓ Successful defense of a thesis

In satisfying the above requirements, the student must adhere to the residency criteria of the Graduate School.

PLAN OF STUDY

Master of Science in Mathematics and Physics (with a Physics Concentration)

(Please see the website for updates)Core Courses

PHYS 500	Classical Mechanics	3 credits
PHYS 510	Mathematical Physics I	3 credits
PHYS 520	Quantum Mechanics I	3 credits
PHYS 530	Statistical Mechanics	3 credits
PHYS 540	Classical Electrodynamics I	3 credits
PHYS 590	Graduate Seminar	1 credit
MATH 500	Foundations of Math. & Phys.	3 credits
MATH 533	Computational Linear Algebra I	3 credits

Electives

PHYS 505	Solid State Physics I	3 credits
PHYS 525	Solid State Physics II	3 credits
PHYS 560	Quantum Optics	3 credits
PHYS 580	Particle Physics	3 credits
PHYS 515	Experimental Methods	3 credits
PHYS 526	Solid State Physics III	3 credits
PHYS 535	Defects in Solids	3 credits
PHYS 541	Classical Electrodynamics II	3 credits
PHYS 542	Computational Physics	3 credits
PHYS 543	Physics and Technology of Thin Films	3 credits
PHYS 544	X-ray Physics and Synchrotron Radiation Techniques	3 credits
PHYS 545	Electronics	3 credits
PHYS 550	Spectroscopy	3 credits
PHYS 555	Coherent Optics and Holography	3 credits
PHYS 565	Optical and Electronic Materials	3 credits
PHYS 570	Electro-optics	3 credits

Research

PHYS 589	Special Topics 3 credits
PHYS 598	Graduate Research 1-6 credits
PHYS 600	Thesis 1-6 credits

COURSE DESCRIPTION

(Please see website for details; http://www.phys.subr.edu)

PHYS 500. CLASSICAL MECHANICS (Credit, 3 hours). Survey of basic concepts; variational derivation of the Lagrange equations; central forces, conservation laws, symmetry, and applications; kinematics and dynamics of rigid body motion; survey of special relativity; Hamilton equations; canonical transformations; Hamilton-Jacobi theory, small oscillations.

PHYS 505. SOLID STATE PHYSICS I (Credit, 3 hours). Survey of Solid State physics; basic concepts and applications; Bravais lattices, free electron systems, lattice vibrations, electronic energy bands, band structure computational methods; basic properties: thermal, electrical, and magnetic properties; magnetic resonance, masers; semiconductors; defects, dislocations; BCS theory of superconductivity, survey of high Tc superconductors.

PHYS 510. MATHEMATICAL PHYSICS I (Credit, 3 hours). Mathematical methods for Physics; review of advanced vector calculus; review of key matrix algebra methods; calculus of residues, conformal mapping, Fourier and Laplace transformations; ordinary differential equations, the Frobeniu series method and Fuchs theorem; complete solutions of key partial differential equations of physics, Poisson, Laplace, Bessel, Legendre, Laguerre, diffusion, and other equations; separation of variables and integral transform methods for some of the preceding solutions; special and orthogonal polynomials; variational and numerical solutions of differential equations

PHYS 515. EXPERIMENTAL METHODS (Credit, 3 hours). Experimental methods in solid-state physics. Selection of modern techniques for investigating properties of solids; basic instrumentation in condensed matter experiments, photoemission and inverse photoemission.

PHYS 516. EDUCATIONAL REFORMS AND GLOBAL LEARNING AND OBSERVATIONS TO BENEFIT THE ENVIRONMENT (GLOBE) (Credit, 3 hours). Lecture (1/3rd of the time) and Laboratory (2/3rd of the time). Interactive survey of key, contemporary, educational reforms with emphasis on the cognitive and behavioral basis of learning and applications in the classroom. The power law of human performance and its extension are applied to the process of teaching and particularly of learning. The execution of GLOBE protocols and related learning activities constitutes the laboratory component of the course. At a minimum, the atmosphere, hydrology, soil, and land cover/biology protocols will be practiced.

PHYS 520. QUANTUM MECHANICS I (Credit, 3 hours). Foundations, principles, and applications of quantum mechanics; origin of quantum mechanics; Schrodinger equations for one dimensional potentials; general formulation of wave mechanics and statistical interpretations, WKB and other approximations; the hydrogen atom; rotational spin, and addition of angular momenta, transitions and their probabilities.

PHYS 525. SOLID STATE PHYSICS II (Credit, 3 hours). Advanced theory of the condensed matter; computational methods for the quantitative description of the electronic structures of

molecules, clusters, and solids; LCAO, APW, and other methods; applications of the Monte Carlo method; the dielectric functions and the electrical, optical, and magnetic properties of solids; magnetic moment formation in solids; quantum theory of superconductivity; the BCS theory and extensions. (Prerequisite: PHYS 505 and 520)

PHYS 526. SOLID STATE PHYSICS III (Credit, 3 hours; Lecture and Laboratory). Characterization of Magnetic Materials. Magnetic ordering and models of magnetic systems: paramagnetism, ferromagnetism, diamagnetism, antiferromagnetism, ferrimagnetism and spin-glass; laboratory techniques: magnetization measurements using a SQUID magnetometer, and electron transport (current-voltage) measurements; determination of important parameters, which are related to the various kinds of magnetic ordering, from laboratory data. This course is intended for graduate students who have completed the first course in solid-state physics. (Prerequisites: PHYS 472 or PHYS 505, or equivalents)

PHYS 530. STATISTICAL MECHANICS (Credit, 3 hours). Laws of thermodynamics and applications; kinetic theory; Boltzmann transport equation and Boltzmann H theorem; principles of statistical mechanics, statistical origin of thermodynamic quantities; canonical and grand canonical ensembles; quantum statistical mechanics; the ideal Fermi gas, and the ideal Bose-Einstein gas. (Prerequisite: PHYS 500)

PHYS 535. DEFECTS IN SOLIDS (Credit, 3 hours). Introduction to the physical properties of crystals, experimental methods in color center research, trapped electron color centers in alkali halides, trapped hole centers in alkali halides, coloration and impurities in alkali halides, coloration and mechanical properties of alkali halides, mechanism of production of color centers, photoelectric emission and ultraviolet absorption spectra of the alkali halides, coloration of colloidal centers, color centers in materials other than alkali halides, applications of color center. (Prerequisite: PHYS 505 and 520)

PHYS 540. CLASSICAL ELECTRODYNAMICS I (Credit, 3 hours). Microscopic and macroscopic Maxwell's equations, interpretation of the terms, related laws and wave equations with or without source terms; applications to electrostatics with the full treatment of specific problems; multipole expansion; magnetostatics; plane waves, reflection; wave guides and cavities; emission of electromagnetic radiation. (Prerequisite: PHYS 510)

PHYS 541. CLASSICAL ELECTRODYNAMICS II (Credit, 3 hours). Relativistic electrodynamics; review of the special theory of relativity and applications to Maxwell's equations; relativistic Lagrangian and Hamiltonian for a charged particle; collisions of charged particles; emissions of radiation, the Cherenkov radiation; relativistic Bremsstrahlung, radiative Beta processes; multipole fields, radiation emission, scattering and radiation damping processes; numerical representations of solutions to selected problems. (Prerequisite: PHYS 540)

PHYS 542. COMPUTATIONAL PHYSICS (Credit, 3 hours; Lecture & Computational Laboratory). Numerical methods and their applications in physics; numerical solutions of selected differential equations; Monte Carlo method and applications to modeling; molecular dynamics and other simulations; electronic structure calculations for multi-electron systems. Prerequisite: Mathematical Physics I, PHYS 510, and a working knowledge of FORTRAN or C++, or an equivalent programming language.

PHYS 543. PHYSICS AND TECHNOLOGY OF THIN FILMS (Credit, 3 hrs; Lecture 2 hrs, Lab. 2 hours). Preparation methods; thickness measurements and monitoring; analytical techniques of characterization, growth and structure of films; mechanical properties of films; electrical and magneto transport properties of films; magnetism of films; thin film devices, fabrication of thin film microelectronic devices.

PHYS 544. X-RAY PHYSICS AND SYNCHROTRON RADIATION TECHNIQUES (Credit, 3 hours; Lecture 2 hours, Lab. 2 hrs). X-rays and early atomic physics, synchrotron radiation; physics of hot and dense plasmas; X-Ray lasers, brightness and coherence of X-Ray sources; scattering and refractive index of X-ray wavelengths; diffractive optics and zone plate microscopy: diffraction grating for monochromators and spectrometers; biological microscopy, reflective X-ray imaging, multilayer interference coatings; application of X-ray microprobes, chemical applications of synchrotron radiation; components of wiggler and other beam lines

PHYS 545. ELECTRONICS (Credit, 3 hours; Lecture 2 hours, Lab 3 hours). Introduction to integrated circuits, transistors, operational amplifiers and analog computer. Introduction to number systems and codes. Boolean algebra, logic circuits, TTLNIM, CANAC, FASTBUS, and VME logic. Arithmetic circuits, binary adders and subtractors. Sequential logic, flip-flop circuit and triggering. Solving logic equations using multiplexers, encoders and decoders, and parity checkers. Analog to digital conversion, data processing and collections.

PHYS 550. SPECTROSCOPY (Credit, 3 hours). Review of classical electrodynamics, review of quantum mechanics, fine structure of hydrogenic atoms, two-electron atoms. Zeeman and Paschen-Back effect, diatomic molecules, coupling of vibration and rotation, electronic spectra and diatomic molecules, spontaneous emission of radiation, selection rules for electric dipole transitions, measurement of radioactive life times of atoms and molecules, forbidden transitions and metastable atoms, width and shape of spectral lines, absorption and stimulated emission of radiation. (Prerequisites: PHYS 520 and 540)

PHYS 555. COHERENT OPTICS AND HOLOGRAPHY (Credit, 3 hours). Introduction to modern optics, mathematical methods of modern optics, image formation in non-coherent light, coherence characteristics of light, image formation in coherent light, theoretical and experimental foundations of optical holography, Fourier transforms, convolutions, correlations, spectral analysis and theory of distributions, coherent and incoherent imaging. (Prerequisite: PHYS 540)

PHYS 560. QUANTUM OPTICS (Credit, 3 hours). Foundation of quantum optics; optical Bloch equation; maser system and laser system; quantum field theory of light; coherent effects; applications to solid state physics; current research topics in optics. (Prerequisites: PHYS 510 and 520)

PHYS 565. OPTICAL AND ELECTRONIC MATERIALS (Credit, 3 hours). Development of new materials for photonic devices; improvement of existing optical materials; role of glasses in optical sciences; optical properties such as refractive index, the

transmittance, and dispersion; optical quality; thermal, mechanical, and chemical properties; crystalline optical materials for polarization control and for laser applications; rare earth doped glasses; oxide fiber fabrication; halide glasses; chalcogenide glasses; crystalline fibers; crystalline fiber for UV, VIS, and IR applications; III-V semiconductors for photonic integrated circuits and devices such as LED, laser diodes and photodiodes, advances with a selection of experimental lnP based PICs. (Prerequisite: PHYS 505)

PHYS 570. ELECTRO-OPTICS (Credit, 3 hours). Introduction to electro-optics, optical radiation, geometric and physical optics.

Lasers and electro-optical modulation, optical radiation detection, analysis methods for electro-optical systems, detector arrays and imaging tubes, electro-optical sensors, optical signal processing, optical path characteristics, optical communications. (Prerequisites: modern optics and PHYS 540)

PHYS 580. PARTICLE PHYSICS (Credit, 3 hours). Description of elementary particles and their interactions; particle accelerators, colliding-beam machines, particle detection; invariance and conservation laws spin, parity, isospin, strangeness; static quark model, quark spin and color. SU (3); weak interaction and beta decay, neutrino interaction, nonconservation of parity, Weinberg-Salam theory; quark-quark interaction, QCD, deep inelastic scattering; unification of electroweak with other interactions, grand unification, supersymmetry. (Prerequisite: PHYS 520)

PHYS 589. SPECIAL TOPICS (Credit, 3 hours). Independent studies under the supervision of a graduate faculty member. The standards for the content, supervision, and outcome assessment are provided by the graduate program

PHYS 598. GRADUATE RESEARCH (Credit, 1-6 hours). Formal, documented research to be conducted under the supervision of a graduate faculty member. Topics are selected by the affected graduate student and faculty supervisor(s) taking into account the standards of M.S. level research, the interest of the student, and the recent developments in knowledge, skills, and technology bases. An abstract and a listing of projected tasks have to be submitted to the M.S. program. A final report also has to be submitted to the M.S. Program Director.

PHYS 600. THESIS (Credit, 1-6 hours). Six hours credit will be given only upon completion of an acceptable thesis.

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