Descriptions of Courses

PH101 College Physics

One-semester basic elective course for freshmen with a limited knowledge of physics who wish to prepare themselves for PH141 and 142 (General Physics I and II). Students learn basic concepts and problem solving techniques in all areas of classical physics including mechanics, thermal physics, electricity and magnetism, and optics.

PH211 Mathematical Methods in Physics I
This course is intended to give the necessary mathematical foundations to sophomores for majoring in the physical sciences. Topics include: Vector analysis, Coordinate systems, Tensor analysis, Matrices, infinite series, Functions of a complex variable, Differential equations, Prerequisite calculus.

PH212 Mathematical Methods in Physics II
This course is intended to give necessary mathematical foundations to sophomores who will major in the physical sciences and engineering. Topics include: Fourier series, Integral transforms, Integral equations, Calculus of variation, Bessel functions, Legendre functions, Special functions.
Topical Prerequisites : Calculus

PH221 Classical Mechanics I
The aim of this course is to prepare students for advanced mechanics. Newtonian mechanics, Motion of a particle in one, two and three dimensions, Simple harmonic motion and nonlinear oscillation, Gravitation, Central force motion, and Lagrangian and Hamiltonian formalism are the principal subjects to be taught.

PH222 Classical Mechanics II
The aim of this course is to prepare students for advanced mechanics. Themes such as dynamics of system of particles, motion in a moving reference frame, dynamics of rigid bodies, coupled oscillations, wave mechanics, and special theory of relativity are treated.

PH231 Electromagnetism I
Principles of electricity and magnetism as well as their applications are taught in this course. Electrostatics, Boundary value problems of electrostatics, Electric current and magnetic field, Electromagnetic induction, and Maxwell's equations are the topics for the study. These basic concepts will be the first step to mathematically formulate the basic knowledge of the phenomenological information learned in General Physics at the freshmen level. Topics include: Electrostatics, Solution of electrostatic problems, Electrostatic field in Dielectric media, Microscopic theory of dielectrics, Electrostatic energy, Electric current, Magnetic field of steady currents, Electromagnetic induction, Maxwell's equations.
Recommended topical prerequisites: Advanced calculus, Vector analysis, Differential equations, Boundary value problems.

PH232 Electromagnetism II
This course is to help junior level students more fully understand the phenomena of the propagation of electromagnetic fields in free space and inside matter, of the radiation emission by moving charges, and of representations of the electromagnetic field in a moving reference frame at the intermediate level. Topics include: Electromagnetic wave propagation and boundary conditions on the field vectors, Radiation emission, Electrodynamics, Special theory of relativity.
Recommended Topical Prerequisites: Advanced calculus, Vector analysis, Differential equations, Boundary value problems.

PH241 Modern Physics
This course is to provide students majoring in physics with various basic concepts and subjects of modern physics.
Topics include: Special relativity, Elementary quantum mechanics, Atoms and molecules, Solids and plasma, Atomic radiation, Atomic nuclei, Elementary particles, and the Universe.
Topical Prerequisites: Elementary differential and integral calculus. Elementary classical physics.

PH242 Experience-Oriented Modern Physics
The goal of the course is to understand how science has been advanced through the chain reaction - the knowledge advanced by the experimental results leads to new experimental techniques that will advance the knowledge further. For that, with a brief introduction to quantum mechanics, students will perform the key experiments that initiated quantum mechanics and the experiments developed based on the quantum mechanical knowledge.

PH251, PH252 Physics Laboratory I, II
This course is intended to teach the measurement technique of various physical quantities under extreme conditions. Students will achieve the conceptual and experimental understanding of the related physical phenomena. Students will carry out several projects comprising computer aid experiments.

PH301 Quantum Mechanics I
This course serves as an introduction to the basic principles of quantum mechanics. Topics include the uncertainty principle, the mathematical basis for quantum mechanics, the properties of operators, problems in 1-D and central field, and orbital angular momentum and spin.

PH302 Quantum Mechanics II
This course introduces many aspects of real atoms. Topics include: Matrix formalism of Q.M., Addition rules of angular momentum, Time independent and dependent perturbation theory, and Collisions.
Topical Prerequisites: Basic philosophy of quantum physics and eigenstates of the ideal hydrogen atom.

PH311 Thermal Physics
This course is intended to provide students in physics with the concepts and methods of the thermal properties of systems consisting of many particles.
Topics include: Entropy, temperature, heat, thermodynamic principles, ensembles, ideal gas, and phase equilibrium.
Topical Prerequisites: College level physics, Elementary differential and integral calculus.

PH312 Statistical Physics
This course is designed to provide senior physics majors the basic physical concepts and methods appropriate for the description of systems involving many particles such as the gas, liquid, solid and plasma states.
Topics include: Statistical Physics, Quantum Statistics, Elementary Kinetic Theory, Transport Theory, and Irreversible Processes.
Topical Prerequisites: Random walk and binomial distribution, Probability distribution and statistical ensemble, Temperature and entropy, Thermodynamics of ideal gases.

PH351 Physics Laboratory III
This course provides more than 20 modern physics experiments, and each experiment team grouped by two or three students performs twelve exepriments of their own choice. The research experiments are summarized in mid-term and final research presentations, lab note, and reports.

PH361 Solid State Physics I
This course is intended to provide students with basic concepts of solid state physics. Topics include: Crystal structure and symmetry, Crystal binding, Lattice vibration, Electrons states, Energy bands, and semiconducting properties. More advanced topics are covered in the sequel to this course: Solid State Physics II.
Prerequisites: PH301 Quantum Mechanics I.

PH391 Optics
This course is designed to give junior and senior physics majors the basic understanding of modern optics, providing them with the ability to study advanced subjects. Topics include: Waves, Propagation of light, Geometric optics, and Polarization.
Topical Prerequisites: Electromagnetism (College Physics Level), Fourier Transformations, Special Functions.

PH401 Atomic and Molecular Physics
Recent advances in atomic and molecular physics, such as optical cooling and trapping of atoms, Bose-Einstein condensation, and femtosecond and attosecond physics, push forward physics frontier, as enlisted in recent Nobel physics prizes. The Atomic and Molecular Physics course covers fundamental physics of atoms and molecules -

basic constituents of matter - in quantum mechanical perspectives for the understanding of various properties of matter, such as the interaction with radiation. It is designed mainly for undergraduate students with quantum mechanics background, but entering graduate students can take as well. Topics include hydrogen atoms, atoms with more than one electron, emission and absorption of electromagnetic radiation by atoms, diatomic molecules, polyatomic molecules, experimental techniques in atomic and molecular physics, modern developments in atomic and molecular physics.
Topical Prerequisites: quantum mechanics PH301, PH302

PH402 Laser Optics
This course is designed to give junior and senior physics majors the basic understanding of modern optics, providing them with an ability to study advanced subjects in optics and optoelectronics. Topics include: Interference, Diffraction, Fourier optics, Coherence theory, Quantum nature of light, Contemporary optics (Lasers, Holography, and Nonlinear Optics).
Topical Prerequisites: Electromagnetism (College Level Physics), Fourier Transformations, Special Functions.

PH413 Computational Physics
The main topic of this course is an introduction to the basic methods in computational physics and an overview of the recent progress in scientific computing. Many examples from recent research in physics and related areas including bio-informatics are introduced. Basic computational tools including the random numbers, differential equations, spectral analysis, and matrix operations, are dealt with through relevant examples, and more advanced topics, such as Monte Carlo simulations, molecular dynamics, and parallel computing will also be treated and trained. The purpose of this course is to understand how to utilize this knowledge for research and teaching in physics through studying various practical examples.
Topical Prerequisites: Programming language (any kinds)

PH421 Nonlinear Dynamics
Motions in Nature are basically nonlinear. In this course we learn the updated understanding of nonlinear dynamics acquired in the past 30 years.

PH422 Nonequilibrium Statistical Mechanics
How deos the irreversible macroscopic behaviors result from the reversible microscopic dynamics? Although the statistical mechanics originated in attempts to answer this question, the realm of nonequilibrium have been largely unexplored. This course aims at acquainting students with threoretical foundation of nonequilibrium statistical mechanics, along with a brief overview of recent progress. For this purpose, kinetic theory, linear response theory, stochastic theory including Fokker-Planck equation, and recent developments in stochastic thermodynamics will be covered.

PH430 Biophysics
Biophysics, literally meaning physics of biological systems, attempts quantitative understanding of biological processes using the concepts derived from physics and physical chemistry. The last two decades have witnessed emerging of new fields including super-resolution optical imaging and single-molecule biophysics, which provide unique and otherwise impossible-to-obtain insights toward the target systems. This course begins with basic concepts of biophysics but finally aims at introducing these phenomenol movements to undergrad and graduate students at KAIST.

PH431 Soft Matter Physics
This course provides the understanding of mesoscopic self-assembled materials in terms of it's basic phenomena, and structures. The examples are liposome, anisotropic materials, viscoelastic materials.

PH441 Introduction to Plasma Physics
This course is designed to help students build their ability to understand basic plasma concepts. Topics include discharge processes and application of plasmas, motion of charged particles in electric and magnetic fields, plasmas as fluids (magnetohydrodynamics), diffusion in weakly and fully ionized plasmas, waves in fluid plasmas, and kinetic theory and nonlinear effects.
Topical Prerequisite: Electromagnetism

PH450 Nuclear and Elementary Particle Physics
This course serves to introduce the basic concepts of elementary particle physics. Topics includes quarks and leptons as the basic building blocks of matter, phenomenology of the electroweak and strong interactions, the standard model, physics beyond the standard model such as grand unification, super-symmetry and neutrino masses.
Topical Prerequisites: Quantum Mechanics I and II

PH462 Solid State Physics II
This course follows Solid State Physics I, and is intended to introduce students in physics, chemistry, electrical engineering, and materials science to advanced topics in solid state physics. Particular emphasis will be placed on making strong connections between the basic laws of quantum mechanics, electromagnetism, and thermodynamics and solid state phenomena. Topics include: thermal and optical properties of solids, advanced band-structure theory, ferroelectricity, magnetism, superconductivity, surface phenomena, and some applications.
Topical Prerequisites: one-dimensional Schrödinger equation, the hydrogen atom, angular momentum operators, Maxwell's equations, Fermi-Dirac and Einstein-Bose distribution functions.

PH465 Symmetry and Topology in Physics
Symmetry and topology are two most important concepts in physics. In this course, We discuss how to use the two concepts in physics problems. In the first part of the course, we consider symmetry and topology in single-particle problems. In the second part, we study how symmetry and topology are used in many-body systems by using classical and quantum field theory.

PH471 Theory of Relativity and Cosmology
This course is intended to provide an introduction to general theory of relativity and its application to cosmology. Topics includes special relativity and flat spacetime, gravity as spacetime geometry, black holes and gravitational radiation, Friedmann-Robertson-Walker Universe, physics of early universe such as nucleosynthesis, baryogenesis and inflation.
Prerequisites: Modern Physics

PH475 Quantum Information I
This lecture covers the basic principle of quantum technology, which includes quantum coherence, quantum entanglement, quantum measurement, quantum devices, quantum communications, and quantum computing.

PH476 Quantum Information II
This lecture covers the basic principle of quantum technology, which includes quantum coherence, quantum entanglement, quantum measurement, quantum devices, quantum communications, and quantum computing.

PH481 Astrophysics
This course is designed to help students understand the astronomical phenomena in terms of basic physical principles. Topics include the physical properties of interstellar medium, stellar structure and evolution, structure and dynamical evolution of galaxies, and theories of cosmological evolution.

PH487 Lecture on current topics of physics research I
This course is intended to provide brief lectures on current topics of physics research and is designed for undergraduate students in summer class. The lectures will be given by invited distinguished scholars. The subtitle of the lectures will be announced at the beginning of the class. Up to 9 course credits may be obtained by taking the course repetitively on different topics.

PH488 Lecture on current topics of physics research II
This course is intended to provide brief lectures on current topics of physics research and is designed for undergraduate students in summer class. The lectures will be given by invited distinguished scholars. The subtitle of the lectures will be announced at the beginning of the class. Up to 9 course credits may be obtained by taking the course repetitively on different topics.

PH489 Special Topics in Physics
Up to 9 course credits may be obtained by taking the course repetitively on different topics.

PH490 B.S. Thesis Research

PH491 Introduction to Physics Research for Undergraduate Students
This course introduces various ongoing research projects, aiming to teach theory and experiments as well as application capabilities of physics research. Both theory and experimental physics professors participate in lecturing three hours per week to cover the topics including: laser and quantum optics, condensed matter and material physics, high energy physics and cosmology, and plasma and biological physics, etc.

PH495 Individual Study

PH496 Seminar
Seminars are given by faculty members or outside experts on current research topics. The level of these talks is intended for undergraduate students in physics.

PH497 Special Topics in Experimental Physics
This course introduces basic methods about various experiments of physics and how to use them in real experimental procedures. Most of experiment-major professors in this department take part in this course and give seminar by turns every week. After seminar, students have tour in the professor's Lab to see the experimental demonstration and then submit a report about what they learned.

PH503 Quantum Mechanics I
This course introduces the mathematical foundation of quantum mechanics to the first year physics graduate students. Topics include: Hilbert space, Measurement theory, Theory of rotation and Angular momentum, Group theory and application to quantum mechanics, Wigner Eckart theorem, Clebsch Gordon coefficients, Stationary perturbation, Time dependent perturbation, Applications to atoms, molecules and solids.
Topical Prerequisites: One year of undergraduate Quantum Mechanics, Mathematical Physics, Mechanics, Electromagnetism.

PH504 Quantum Mechanics II
This course is designed to help the first year physics graduate students understand complicated phenomena of scattering and to give an introduction to the second quantization and Dirac equation for future use in solid state physics and particle physics. Topics include: Scattering, Nonrelativistic Second Quantization, Fermion Systems and Boson Systems, Dirac Equation.
Prerequisites: PH503 Quantum Mechanics I.

PH505 Advanced Mechanics
This course is intended to provide its formulations as a springboard for the various branches of modern physics, such as action-angle variables, Hamilton-Jacoby theory, principle of least action. Poisson brackets, and canonical transformation.
Topical Prerequisites: Intermediate classical mechanics and electromagnetism, Calculus, Differential equations.

PH507 Advanced Electrodynamics I
This course provides graduate students in physics with an understanding of electricity and magnetism. Topics include: Electrostatics, Magnetostatics, Maxwell's equations, Wave propagation, Wave guides, Radiating systems.

PH508 Advanced Electrodynamics II
This course gives students the knowledge of electromagnetic theory accessed in the first course to specific problems, such as relativity, plasma physics, scattering, and moving charges. Topics include: MHD and Plasma physics, Relativity, Collisions and scattering, Radiation by moving charges, and Mutipole fields.
Prerequisite: PH507

PH509 Statistical Mechanics
This course familiarizes graduate students with the concepts and methodologies of statistical mechanics in order for them to be able to utilize skills in the studies of other subjects as well as further research in statistical mechanics. Topics include: Kinetic theory, Ensembles, Classical and quantum statistics, Phase transitions.

PH510 Quantum Computing
In this course, we aim to understand the fundamental theory and key technologies of quantum computing systems

implemented in various architectures. We learn about the characteristics of different architectures such as neutral atoms, trapped ions, and superconducting qubits. Additionally, we study the fundamentals of qubit control and the hardware and software for microwave-based measurements.

PH511 Quantum Metrology and Sensing
Quantum systems are highly sensitive to their environments, allowing us to detect nanoscale signals such as electromagnetic fields and temperatures. The intended learning outcomes of the class are to understand the principles of quantum systems and their control for applications of quantum metrology and sensing.

PH601 Applied Physics Laboratory I
The main objective of the course is to give students laboratory experiences in condensed matter and plasma physics that form a broad background. Each group of two or three students chooses five experimental themes for a semester. After completion of three-week experimental work on each theme, students are required to submit a report for assessment. The course offers a variety of themes on experimental techniques such as vacuum coating, dielectric and magnetic measurements, NMR spectroscopy, X-ray diffraction, low temperature measurements, photoemission and modulation spectroscopy, nonlinear dynamics measurements, ECR plasma generation and Tokamak operation.

PH602 Applied Physics Laboratory II
The main objective of the course is to give students laboratory experience regarding experimental optics. Groups of three or four students are assigned to projects chosen from various essential topics in optics. The course offers good practice in Optical workshop, Multiple quantum well modulator, Laser beam quality evaluation, Twyman-Green interferometer, Femtosecond Ti: Sapphire laser, All-fiber ring resonator, White light interferometer, OTF (Optical Transfer Function), VCSEL and SBS phase conjugation.

PH611 Advanced Solid State Physics I
This course is intended to provide graduate students in physics, chemistry, electrical engineering, and materials science with a graduate-level understanding of topics in solid state physics. Topics include: Brillouin zone, Crystal symmetry, Phonons, Electron energy band theory, Electron-electron and electron-phonon interactions, Electron dynamics, and Transport properties.
Prerequisites: PH503 and PH504

PH612 Advanced Solid State Physics II
This course follows the course Advanced Solid State Physics I, and is intended to provide graduate students in physics, chemistry, electrical engineering, and materials science with a graduate-level understanding of advanced topics in solid state physics. Topics include: Optical properties, Elementary excitations, Electron correlations, Many body effects, Green’s functions, Density functional theory, Magnetism, Superconductivity, and Nonlinear phenomena.
Prerequisites: PH503 and PH504.

PH613 Semiconductor Physics
This course is designed to provide graduate students in physics, chemistry, electrical engineering, and materials science with an ability to understand the scientific and technological backgrounds of semiconductors and related devices. Topics include: electronic structure and optical properties of semiconducting materials, defects and impurities, electron transport, electron/optical devices and device structures.
Topical Prerequisites: Schrödinger equation and Hamiltonian, crystal structure and lattices, Boltzman and Fermi-Dirac distributions, Bloch theorem.
Prerequisites: PH611 and PH612

PH615 Introduction to Phase Transition
This course introduces both classical theories of phase transition and modern theories of critical phenomena so that students can read most experimental and theoretical papers in the field. It will cover experimental examples of Phase transition, Phase transition anomalies and critical exponents, Landau's classical theory, Critical phenomena and fluctuations, Scaling law and universality, Renormalization group theory, Experimental measurements, Random systems, and Impurity effects.
Topical Prerequisites: Thermodynamics, Statistical Physics

PH616 Semiconductor Photonics
This course provides the theoretical understanding and experimental experience of semiconductor photonics fields including semiconductor physics, device design, epitaxial growth mechanism, fabrication processing, materials, devices physics, and various characterization methods.

PH621 Advanced Wave Optics
This course is designed to convey basic and advanced ideas concerning wave optics including Interference and diffraction theory, Temporal and spatial coherence, Fourier optics, Statistical optics, and the Theory of image formation. Application of electromagnetic theory on thin film technology, Laser oscillator and crystal optics are also dealt with.
Recommended Prerequisites: PH391 and PH392 (Optics I, II)

PH622 Geometrical Optics
This course is designed to teach general concepts on Gaussian optics, Seidel first order aberration theory, and optical design method. Methods of optical testing are also reviewed.
Recommended Topical Prerequisites: Introductory of optics, Introductory on wave optics.

PH624 Quantum Optics
Laser resonator, Laser rate equations, Q-switching, Mode-locking, and Laser amplifiers are covered. Various electro-optic modulators, Laser optic components, Laser applications are also discussed. Introductory quantum optics is treated.
Recommended Topical Prerequisites: Electromagnetic theory, Optics, and Quantum mechanics.

PH627 Fiber Optics
This course is designed to provide basic and advanced knowledge of Optical waveguides, Device physics, and Application of optical fibers and Components to telecommunications and sensors. Topics include: Propagation mode in fibers, Basic components, Interferometry, Fiber-optic sensors, Non-linear optics in fibers, Fiber lasers and amplifiers.
Recommended Topical Prerequisites: Electromagnetism, Special Functions, Optics (College Level).

PH641 Advanced Plasma Physics
Basic knowledge of plasma kinetic theory, electron and ion fluid equations, and MHD equations will be covered. The Fokker-Planck equation will be derived and the properties of the Vlasov equation and Coulomb collision operator will be studied. Fluid and MHD equations will be derived from the Fokker-Planck equation (and the Maxwell's equations). The MHD property, drift-kinetic equation, gyrokinetic equation, and the quasi-linear RF heating operator will be introduced.

PH642 Plasma Waves
Various plasma waves will be studied in detail. MHD waves, fluid waves, and kinetic waves will be compared in unmagnetized and magnetized plasmas. Linear and non-linear Landau damping physics will be studied, together with the Nyquist's method and Gardener's theorem. Drift waves, eta-i mode, trapped particle mode and other waves of current interest will be discussed.

PH643 Applied Plasma Physics
This course is intended for graduate students in Physics and other Engineering Departments. This course will start with six chapters of background information on plasma science relevant to industrial plasmas, followed by three chapters on ion, electron, and plasma sources which are common to many industrial applications. We will cover chapters on plasma processing of materials, and on plasma related applications and devices of industrial interest.

PH650 Advanced Soft Matter Physics
This course provides the understanding of mesoscopic self-assembled materials in terms of it's basic phenomena, and structures. The examples are liposome, anisotropic materials, viscoelastic materials.

PH653 Relativistic Qauntum Field Theory I
This course will provide a modern introduction to relativistic quantum field theory − a subject most working theoretical physicists need to know about. The course is intended for graduate (or advanced undergraduate) students with interests in high-energy physics or condensed matter physics. Topics covered will include scalar field

theory, Feynman rules, renomalization, and field theories of fermions and gauge bosons (QED).

PH654 Relativistic Qauntum Field Theory II
This course is the 2nd semester of the Relativistic QFT sequence. Major topics covered include an in-depth look at renormalization, path inte-gral approach to QFT, abelian and non-abelian gauge theories, and sponta-neous breaking of global and gauge symmetries. This course introduces basic concepts and tools required for research in theoretical particle physics and string theory, and is required for graduate students planning to do research in these areas in particle theory group. It may also be of interest to students specializing in condensed matter theory and cosmology.

PH711 Physics of Magnetism
This course introduces from the physics of macroscopic magnetic properties of magnetic materials to the spintronics that handles individual spins quantum mechanically. Topics include the Origin of magnetism, Magnetic domain, Magnetic anisotropy, Magnetoresistance and spin tunneling.

PH713 Physics of Superconductivity
Lectures will be given on the physical theories and applications of superconducting phenomena. The BCS theory, Ginsberg-Landau theory, Vortex theory in type II semiconductors, and the Theory of Josephson tunneling will be discussed. The physical principles and fabrication methods of superconducting electronic devices will also be discussed. Recent developments in the field of high-Tc superconductors and their technological applications will also be included.

PH716 Topics in Solid State Physics I
Recent developments in the fields of magnetism, metals, superconductivity, and ferroelectricity will be selected to be introduced at a graduate level. Up to 15 course credits may be obtained by taking the course repetitively on different topics.

PH717 Topics in Solid State Physics II
Recent developments in the fields of semiconductors, low-dimensional quantum structures, crystal structure, crystal growth, surface/interface phenomena, and theoretical solid state physics such as many-body theory and group theory will be selected to be introduced at a graduate level. Up to 15 course credits may be obtained by taking the course repetitively on different topics.

PH721 Nonlinear Optics
Light-matter interactions, especially nonlinear optical interactions and their applications are discussed. Nonlinear susceptibility, Harmonic generation, Four-wave mixing, Raman scattering, Nonlinear propagation of light, Coherence theory and Nonclassical light are topics of interest in this course.

PH724 Laser Plasma Interactions
This course is intended to introduce physics graduate students to current research topics in laser-plasma interactions and provide them with concepts and methods to understand the physical processes in high power laser produced plasma. Topics include: Inertial confinement fusion, EM wave propagation in plasmas, Absorption of laser light, Atomic Physics in high-density plasmas, X-ray lasers, High harmonic generation.
Recommended Prerequisites by topic: Advanced Electrodynamics and Introduction to Plasma Physics

PH726 Semiconductor Optics
This course introduces optical processes occurring at semiconductor band edges, and their applications to various opto-electronic devices. Topics include: Band edge absorption, Non-linear absorption, Semiconductor quantum wells/dots, Semiconductor lasers , Photonic crystals and Photonic devices.
Prerequisite: Solid State Physics and Quantum Mechanics.

PH741 Topics in Plasma Physics
A detailed study of one or more selected aspects of plasma physics is intended in this course. Topics may include plasma diagnostics, space plasma physics, and computational plasma physics. Up to 15 course credits may be obtained by taking the course repetitively on different topics.

PH742 Plasma Confinement Theory
This course covers problems associated with magnetic confinement in fusion devices. Topics to be discussed

include Kinetic equations, Collision operators, Toroidal currents, Transport theories, Alpha particle behavior, and Caucy's linear phenomena.

PH754 Advanced Particle Physics
This course is intended to deal with the research-related topics in particle physics and the exact course content may vary from year to year. However, the main topics include the Standard model and related particle phenomenology, Physics beyond the standard model, String theory and compactification, Nonperturbative aspects of quantum field theory. Up to 15 course credits may be obtained by taking the course repetitively on different topics.

PH757 Topics in Particle Physics
This course is intended to introduce the most recent research topics in particle physics. Some of the recent topics include String duality, Supersymmetry breaking and the Phenomenology of superparticles, Extra dimension, flavor and CP violations, Flux compactification in string theory. Up to 15 course credits may be obtained by taking the course repetitively on different topics.

PH878 Advanced lecture on current topics of physics research I
This course is intended to provide brief lectures on current topics of physics research and is designed for graduate students in summer class. The lectures will be given by invited distinguished scholars. The subtitle of the lectures will be announced at the beginning of the class. Up to 9 course credits may be obtained by taking the course repetitively on different topics.

PH879 Advanced lecture on current topics of physics research II
This course is intended to provide brief lectures on current topics of physics research and is designed for graduate students in summer class. The lectures will be given by invited distinguished scholars. The subtitle of the lectures will be announced at the beginning of the class.

PH880 Topics in Physics
This course is intended to introduce the recent research topics in physics.

PH960 M.S. Thesis

PH965 Independent Study in M.S.

PH966 M.S. Seminar

PH969 Introduction to Physics Research
This course introduces various ongoing research projects, aiming to teach theory and experiments as well as application capabilities of physics research. Both theory and experimental physics professors participate in lecturing three hours per week to cover the topics including: laser and quantum optics, condensed matter and material physics, high energy physics and cosmology, and plasma and biological physics, etc.

PH980 Ph.D. Thesis

PH986 Ph.D. Seminar

PH990 Physics Colloquium
Colloquia are given by faculty members or outside experts on current research topics. The level of these talks is intended for graduate students in physics.