**물 리 학 과**

**(DEPARTMENT OF PHYSICS)**

**Department Introduction**

The Yeungnam University Physics Department is one of the specialized departments in Korea for Nano and Display research in physics.

The Department has about 11 faculties. Our research is organized into six primary research areas, such as Solid State Physics (Semiconductor, Superconductor, Magnetic materials, and Nano-materials), Optics (Display Optics, Laser Optics, and Nonlinear Optics), Medical Physics (Radiation Therapy and Biomedical Physics), Acoustics (Ultrasonic), Nuclear Physics, and Computational Physics.

The curriculum focuses on the fundamentals of physics and experiments in order to develop human resources with practical abilities and knowledge in physics needed by high-tech industries such as the photonics industry, display industry, nano and semiconductor industries.

1. Optics: Understand the features of waves including that of lights and acquire application knowledge in order to obtain practical capacities for flat screen displays (LCD, OLED, etc), 3D images (holograms), lasers, fast data processing, optical computers, optical devices, optical communication, high-quality lens design, supersonic wave systems, etc. (5 professors)

2. Nano and semiconductor physics: Acquire practical capacities in key technologies for the IT industry such as nano elements, magnetic semiconductors, quantum dot semiconductors, carbon nano-tube, high and low temperature superconductors, computer memory, etc. (6 professors)

The Department has been the source of innovation in physics research for decades.

**List of Faculty Members**

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| --- | --- | --- | --- | --- |
| Position | Name | Last School Graduated | Degree | Major |
| Professor | Jin Hyuk Kwon | KAIST | Ph.D | Optics |
| Professor | Dong Ho Kim | University of Minnesota | Ph.D | Superconductivity,  Magnetism |
| Professor | Chong Hoon Kwak | KAIST | Ph.D | Optics (Nonlinear Optics and Holography) |
| Professor | Eng Chan Kim | University of Yonsei | Ph.D | Solid State Physics |
| Professor | Myoung Seon Choi | KAIST | Ph.D | Applied Physics |
| Professor | Jonghoon  Yi | KAIST | Ph.D | Optics |
| Associate Professor | Young-gull Joh | University of California Riverside | Ph.D | Condensed Matter Physics |
| Professor | Ki Hyeon Kim | University of Myongji | Ph.D | Condensed Matter Physics (Magnetics) |
| Professor | Jong Su  Kim | Yeungnam University | Ph.D | Solid State Physics |
| Professor | Jin Seog Gwag | Pusan National University | Ph.D | Optical device and display |
| Associate Professor | Shin Jae Cheol | UW-Madison University | Ph.D | Nano-Optoelectronic Device |

**Academic programs**

Graduate students in the Department of Physics are actively engaged in research at the forefront of physics and industrial application physics.

The emphasis of the graduate program is on understanding the fundamental principles that appear to govern the behavior of the physical world, from phenomena in the nano scale materials to the bulk structure of the materials.

▣ Solid State Physics (Semiconductor, Superconductor, Magnetic materials, and Nanomaterials)

▣ Optics (Display Optics, Laser Optics, and Nonlinear Optics)

▣ Medical Physics (Radiation Therapy and Biomedical physics)

▣ Acoustics (Ultrasonic)

▣ Nuclear Physics

▣ Computational Physics

**Course Description**

■ Basic Major Courses

고급전산물리학 3 credit

(ADVANCED COMPUTATIONAL PHYSICS)

Advanced Computational Physics deals with programming of Labview and Matlab. These scientific programs are essential to the experiments and data analysis in the graduate courses.

In programming with Labview, students learn the interface with equipment, and data analysis. In programming with Matlab, numerical analysis, regression analysis, symbolic math, and handling graphics objects will be discussed.

양자역학 3 credit

(QUANTUM MECHANICS)

In this course, we will learn the basic postulates and techniques of non-relativistic quantum mechanics. The term non-relativistic quantum mechanics refers primarily to interactions of particles with potentials only. The course will cover review of wave functions and the Schrodinger Equation, Hilbert space, the WKB approximation; central forces and angular momentum, scattering, and electron spin.

열및통계역학 3 credit

(THERMODYNAMICS AND STATISTICAL MECHANICS)

This course consists of thermodynamics and statistical mechanics parts. The Thermodynamics part is devoted to a comprehension of analysis and description of thermal phenomena using basic concepts of thermodynamics. The main subjects are as follows: thermodynamic systems and temperature, equation of state, laws of thermodynamics, heat and mechanical work, entropy, thermodynamic potential, phase transition, low temperature physics. The Statistical Mechanics part is designed to introduce some concepts of statistical mechanics and their applications to system containing many particles. The main subjects are as follows: molecular kinetics, transport phenomena, partition and distribution functions of Maxwell-Boltzmann, Fermi-Dirac, Bose-Einstein statistics, quantum statistics and its applications to various physical phenomena.

응집물리학 3 credit

(CONDENSED MATTER PHYSICS)

Condensed matter physics consists of the study of phases where change of mutual interactions between atoms causes a matter to assume a condensed form. In this course, students are introduced to the fundamental properties of crystalline solids; crystal structures and the reciprocal lattice, phonons, quantum theory of electronic band structure, and to some properties of semiconductors and magnetism.

전자기학 3 credit

(ELECTROMAGNETISM)

**T**his course deals with the electric and magnetic theory. The main subjects are as follows ; electrostatics, electrostatic boundary value problems, electrostatic energy, magnetism of steady currents, theory of dielectrics and magnetism, Maxwell's equations, and radiation.

파동물리 3 credit

(WAVE PHYSICS)

Optics, acoustics, and condensed matter physics requires more deeply understanding on the electromagnetic waves, the mechanical waves, and the matter waves. A medium through which energy is transmitted via wave propagation behaves essentially as a continuum of coupled oscillators. In this lecture, simple harmonic, damped, forced and coupled oscillators are firstly discussed. And they are dealt with transverse waves on a string, longitudinal waves in a gas and a solid, voltage and current waves on a transmission line, and electromagnetic waves in a dielectric and a conductor. It is finally shown that optical waves and matter waves can be also discussed by using this common treatment.

역학 3 credit

(MECHANICS)

Vectorial kinematics, Newtonian mechanics, oscillations, general motion of a particle in 3 dimensions, non-inertial reference of systems, and gravitational and central forces are treated. Dynamics of systems of particles, mechanics of rigid bodies, motion of rigid bodies in 3 dimensions, Lagrangian mechanics and dynamics of oscillating systems are treated.

물리학영문논문작성 3 credit

(TECHNICAL WRITING FOR PHYSICS)

The general purpose of this course is to introduce definition and methodology of logical reasoning including arguments, explanations, deductive and inductive reasoning, common fallacies in scientific reasoning, and hypotheses by using english. A unique feature of the course is the study of pseudo science. This course also emphasizes exercise of essays on the various scientific topics and phenomena. Students learn some of the most effective methods of inquiry, analysis, and criticism in the fields of the natural sciences by essay writing.

■ Major Courses

개별연구(1) 3 credit

(INDEPENDENT STUDY (1))

개별연구(2) 3 credit

(INDEPENDENT STUDY (2))

물리학과세미나I 1 credit

(SEMINAR IN PHYSICS I)

물리학과세미나II 1 credit

(SEMINAR IN PHYSICS II)

물리학과세미나III 1 credit

(SEMINAR IN PHYSICS III)

■ 물리학전공(PHYSICS MAJOR)

고급고체물리학 3 credit

(ADVANCED SOLID STATE PHYSICS)

This advanced solid state physics course is aimed for the students who have fundamental knowledge on solid state physics and want to continue to research in the field of solid state physics. The main focus is given to understanding of various phenomena resulted from the interactions among elementary excitations, which include electron-electron interaction, electron dynamics, transport theory, optical properties and superconductivity.

고급디스플레이광학 3 credit

(ADVANCED DISPLAY OPTICS)

Flat panel displays such as LCD, PDP, FED are explained in detail. Essential optical principles used in these displays are explained and they cover polarization, Jones vector, refraction, anisotropy of refractive index, and color combination. Also, exercise of ray tracing by computer simulation code is included to train skill of back light panel design.

고급물리실험(1) 3 credit

(ADVANCED EXPERIMENTAL PHYSICS(1))

This course provides an opportunity for graduate students to have an intensive experiment concentrating on the principles of experimental systems which include solid physics, electromagnetism**,** and photonics. In addition, students will get an apprehension on the principles and the essential characteristics about the measurable physical quantities.

고급물리실험(2) 3 credit

(ADVANCED EXPERIMENTAL PHYSICS(2))

As a series of Advanced Experimental Physics(1), this course provides an opportunity for graduate students to have an intensive experiment concentrating on the principles of experimental systems which include solid physics, electromagnetism**,** and photonics. In addition, students will get an apprehension on the principles and the essential characteristics about the measurable physical quantities.

고체물리학특론 3 credit

(SPECIAL TOPICS IN SOLID STATE PHYSICS)

With the advent of science and technology, the various types of devices have been developed. Recently, considerable interest has developed in semiconductor systems because of their potential for high speed and optoelectronic device applications such as photodetector, laser and bipolar transistor. This course treats the principles and applications of unipolar devices, microwave devices**,** superconducting devices, magnetic devices, and photonic devices.

고체실험및연구지도 3 credit

(LABORATORY AND RESEARCH IN SOLID STATE PHYSICS)

Personal guide on theoretical as well as experimental methods in solid state physics is given. Regular seminar is opened for discussions on research topics. Lectures on statistical processing of experimental data and tutoring on methods about paper writing skill is given.

고체양자론 3 credit

(QUANTUM THEORY OF SOLIDS)

The object of this course is to present the central principles of the quantum theory of solids to those experimental solid state graduate students who had a one year course in quantum mechanics. Exemplary topics that will be treated in this course are phonons, Hartree-Fock approximation, electron gas, electron-phonon interaction, calculation of energy band and Fermi surface.

광계측론 3 credit

(OPTICAL MEASUREMENT)

Optical measurements of length, thickness, displacement, velocity and shape with a very high resolution are treated in this subject. Also, measurements and evaluation of various devices by using CCD camera and image processing technique are included. The structure and characteristics of optical sensors and the optical systems needed in such measurements are also included. The major topics are

- One dimensional measurements of distance, displacement, vibration, velocity, and acceleration

- Two and three dimensional measurements of shape and structure

- Three dimensional measurement using Moire technique

- High resolution optical measurement with nm resolution

- Measurement and evaluation technology using CCD camera and image processing

- Optical sensors such as photodiodes, photomultiplier tubes, position-sensitive detectors and CCD cameras

- Optical systems and signal processing

광전자학 3 credit

(PHOTONICS)

In this course, students will learn the optical principles of photonic devices, such as optical fiber, optical sensor, photonic logic device, and photonic crystal, based on high level optics. In addition, the essential characteristics of future photonic devices will be introduced with their optical properties.

광학실험및연구지도 3 credit

(OPTICS LAB. AND RESEARCH)

Personal guide on theoretical as well as experimental methods in applied physics is given. Regular seminar is opened for discussions on research topics. Lectures on statistical processing of experimental data and tutoring on methods about paper writing skill is given.

디스플레이물리 3 credit

(PHYSICS FOR DISPLAY)

In this course, students will learn the physical principle of several displays, such as liquid crystal display, plasma display panel, and organic light-emitting display. And the essential characteristics of transmissive type, reflective type, and transflective type displays will be introduced with their electro-optic properties.

레이저 3 credit

(LASER)

The principle, theory, characteristics of laser beams, and major applications of lasers are lectured in this class. Some major topics of contents are absorption of optical lights, spontaneous emission, the stimulated emission, resonator theory, pumping, the four important characteristics of lasers beams, typical lasers and their applications. Also, the propagation and amplification of laser beams, fundamentals of nonlinear optics, basic theory of optical communication, and semiconductor lasers are included.

물리음향학(1) 3 credit

(PHYSICAL ACOUSTICSⅠ)

The following topics related to physical applications of mechanical waves in solids are dealt in detail: (1) particle displacement and strain, (2) stress and the dynamic equations, (3) elastic properties of solids, (4) acoustics and electromagnetism, (5) power flow and energy balance, (6) acoustic plane waves in isotropic solids, (7)) acoustic plane waves in anisotropic solids, (8) piezoelectricity.

물리음향학(2) 3 credit

(PHYSICAL ACOUSTICS Ⅱ)

The following topics related to physical applications of mechanical waves in solids are dealt in detail: (1) reflection and refraction, (2) acoustic waveguides, (3) acoustic resonators, (4) perturbation theory, (5) variational techniques.

반도체물리 3 credit

(SEMICONDUCTOR PHYSICS)

The purpose of semiconductor physics is to provide a basis for understanding the characteristics, operation, and limitations of semiconductor. This course begins with the introductory physics, moves on to the semiconductor material physics, and then covers the physics of semiconductor. The contents are the crystal structure of semiconductor material, the quantum theory of solids, the semiconductor in equilibrium, carrier transport phenomena, nonequilibrium excess carriers and the p-n junction.

방사선물리 3 credit

(RADIATION PHYSICS)

This course is designed to teach about radiation. Especially it deals with interaction of particles(α and β particles, heavy ions, and heavy protons, etc.) with matter, interaction of photons with matter and radiation detection and measurement.

방사선 시뮬레이션 3 credit

(RADIATION SIMULATION)

This course consists of two categories, one is the lecture of development of radiation imaging devices and therapeutic devices, the other is the lecture of radiation simulations that are related to diagnostic technologies and the treatment skill improvement.

방사선치료 물리학 3 credit

(PHYSICS OF RADIATION THERAPY)

The object of this course is to help students to enhance careers in clinical applications; being required physically practical knowledge in a radiation therapy. And the course simultaneously introduces and provides theories and processing in order to apply for the designated field.

분광학 3 credit

(SPECTROSCOPY)

The theory of absorption and emission of light, widths and profiles of spectral lines, and spectroscopic instrumentation are lectured in this class. Also, topics on Doppler limited absorption and fluorescence spectroscopy, Raman spectroscopy, and high resolution sub-Doppler laser spectroscopy techniques are included.

비선형광학(1) 3 credit

(NONLINEAR OPTICS Ⅰ)

Outline of nonlinear optics is explained and the scope of the nonlinear optics is defined. The topics in the scope include density matrix formalism in two level system, nonlinear polarization, multiple resonance spectroscopy, and multi wave mixing.

비선형광학(2) 3 credit

(NONLINEAR OPTICS Ⅱ)

Various topics in nonlinear optics are included in this lecture such as coherent Raman spectroscopy, absorption of multi-photon, optical coherence, and transient effect.

생물의학 물리 3 credit

(BIOMEDICAL PHYSICS)

This course provides students with an overview of the biology of cancer and of the current methods used to diagnose and treat the disease. It also make students enable to adopt biological phenomena in depth, vital signs, vital ingredients on the quantitative, qualitative analysis and its clinical application for the physics.

액정물리 3 credit

(PHYSICS FOR LIQUID CRYSTAL)

This course is for studying on the physical properties of liquid crystal, such as optical anisotropy, dielectric anisotropy, and crystalline at aligned surface. In addition, the way these physical properties are applied to various optical devices is introduced intensively. Through such process, students promote the ability analyzing and designing electro-optical characteristics of the liquid crystal devices.

의료방사선 특론 3 credit

(ADVANCED MEDICAL RADIATION)

This course covers aspects of medical diagnosis, radiation treatment measurement techniques, nuclear medicine, and measuring technique for water absorption of radioactive nuclide dose through lecture and experiments. Students develop their own the ability to measure and evaluate through radiation (radioactive) measurement and evaluation training.

의학물리 3 credit

(MEDICAL PHYSICS)

This subject is intended for a semester introductory course offering the basic topics in medical physics. It emphasizes the importance of physical applications such as medical ultrasound and thermography, lasers in medicine, biomechanics, application of electricity and magnetism in medicine and computers in medicine.

자성물리 3 credit

(PHYSICS OF MAGNETISM)

This course is designed to study the theory of magnetism and the magnetic materials. It has been chosen to consider diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism,

ferrimagnetism, and their applications.

It especially deals with the various magnetic materials and the method of mesuring the magnetic properties.

핵물리학 3 credit

(NUCLEAR PHYSICS)

This course was prepared for the graduate student who requires a grounding in nuclear physics. It has been attempted to cover a number of important topics, for example, nuclear properties, radioactive decays, nuclear reaction, accelerators, nuclear structure, and nuclear fission and fusion.

III-Ｖ족화합물반도체소자특론 3 credit

(SPECIAL TOPICS IN Ⅲ-ⅤCOMPOUND SEMICONDUCTOR DEVICES)

The purpose of Special topics in Ⅲ-ⅤCompound Semiconductor Devices consider high-electron-mobility transistor (HEMT), vertical cavity surface emitting laser (VCSEL), IR-detector, light emitting diode (LED), laser and solar cells (SC) to understand device structures and operation mechanism base on the quantum mechanics in compound semiconductor hetero-structures.

뫼스바우어분광학 3 credit

(MÖSSBAUER SPECTROSCOPY)

Mössbauer Spectroscopy is designed to study the microscopic magnetic properties of magnetic materials.;Especially, it focus on the isomeric shifts, the electric quadrupole splittings and the magnetic hyperfine fields in the nucleus of the magnetic materialFor that reason, through the Mössbauer Spectroscopy we can learn the micromagnetic structure of the magnetic materials.

응용뫼스바우어분광학 3 credit

(ADVANCED MÖSSBAUER SPECTROSCOPY)

Mössbauer Spectroscopy takes center stage as one of the most excellent microscopic research tools in modern physics. And the applicstions of the Mössbauer effects was widely used at the field of atomic physics, solid state physics, chemistry, biology, geology, metallurgical engineering, and so on.

This course is designed to learn the various applications of Mössbauer spectroscopy.

반도체나노구조특론 3 credit

(SPECIAL TOPICS IN SEMICONDUCTOR NANOSTRUCTURES)

The purpose of Special Topics in Semiconductor Nanostructures consider semiconductor quantum dots, quantum rings and nanowires. This course is helpful for the students who studied the fundamental semiconductor physics. The main focus is to understand grouwth mechanism of various semiconductor nanostructures and carrier interaction, carrier dynamics and optical properties resulted from nanostructures.