**엔지니어링 사이언스**

**DEPARTMENT OF ENGINEERING SCIENCE**

**1. Introduction**

**1) Background**

■ The ever changing science and technology necessitates an interfacial education that can translate the findings of basic and fundamental science to applied science.

■ Science and technology education interconnecting basic and translational research in biology, mathematics and engineering is necessary in order to produce human resources well-equipped for innovation and invention in health care.

■ A new science and engineering department is required for students who can lead various areas regardless of one’s major area of study.

■ An interdisciplinary, collaborative graduate department composed of leading scholars from different arenas of science as faculty members is on demand for truly integrative academic activities.

■ This calls for a need to break the ground rules of traditional graduate study, and to develop courses and research activities assisted by internationally renowned scholars who are not full-time employees of the University.

■ This also calls for a graduate program where the creativity of students is required components.

**2) What to expect**

■ Development of a competitive honors graduate program

■ Research-oriented faculty members who can secure external funding

■ Truly interdisciplinary research opportunities

■ Dual graduate degrees with other areas of study in the University

■ State of art research that spans physical sciences, life sciences and engineering

■ Internationally competitive and balanced human resource development for Engineering,

Mathematics, Physics, Chemistry, Biology, Biotechnology, Pharmacy majors

■ True internationalization through international scholars teaching team for both taught courses and research.

**3) Educational goals**

■ Human resource development for interdisciplinary needs.

■ Balanced study of science and engineering/technology

■ Honest and responsible scientists and engineers

**4) Post graduation**

Research positions in government and private sectors, consultants, professors, business creation

**2. Faculty members**

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| --- | --- | --- | --- | --- |
| Position | Full Name | Final Graduate School | Degree | Major |
| **1.** Professor | Joo, Sang Woo | University of Michigan | Doctor | Mechanical Engineering |
| **2.** Professor | Yong, Chul Soon | University of South Carolina | Doctor | Pharmacy |
| **3.** Associate Professor | Kim. Ki Hyeon | University of Myongji | Doctor | Physics |
| **4.** Associate Professor | Cho, Kyung Hyun | Kyungpook National University | Doctor | Genetic Engineering |
| **5.** Professor | Park, Ju Hyun | POSTECH | Doctor | Electrical Engineering |
| **6.** Professor | Lee, Jae un | Kyungpook National University | Doctor | Mathematics |
| **7.** Professor | Kim, Jae Ryong | Yeungnam University | Doctor | Medicine |
| **8.** Assistant Professor | Lee, Jintae | Rutgers University | Doctor | Chemical Engineering |
| **9.** Associate Professor | Kang, Mi Sook | University of Kyoto | Doctor | Chemistry |
| **10.** Assistant Professor | Banerjee A.  Narayan | University of Jadavpur | Doctor | Mechanical Engineering |
| **11.** Associate Professor | Shizhi Qian | University of Pennsylvania | Doctor | Mechanical Engineering |
| **12.** Professor | Ashutosh Sharma | University of Newyork | Doctor | Chemical Engineering |

**3. Curriculum**

**1) Basic courses**

**Integrated mathematics physics chemistry & biology (I, II) (3 credits each)**

Basic mathematics for graduate study integrated with all areas in physical and biological sciences and engineering. Rather than learning mathematics separately from other areas of science and engineering one learns mathematics with immediate applications in mind.

**Nonlinear dynamics in physical and life sciences 3 credit hours**

Study of nonlinear dynamics with applications in diverse areas in physical and nonlinear sciences. Fundamentals of nonlinear dynamics and integrated applications in all area of science and engineering.

**Fundamentals in nanobiotechnology 3 credit hours**

Fundamental principles and concepts in nanotechnology and biotechnology. Integrated study in parallel rather than serial introduction.

**Ethics and communication skills in science and engineering 3 credit hours**

Ethics in scientific research and communications. Actions against plagiarism and scientific misconduct. Effective and efficient scientific communications. Technical writing and presentations.

**Seminar in Engineering Science 1 credit hour**

Participation in Engineering Science seminars and assessment through written reports. Organization of scientific communications.

**2) Major courses**

**Cellular molecular bioengineering 3 credit hours**

The goal of Cellular molecular bioengineering discipline is to advance fundamental understanding of how biological systems operate and to develop effective biology-based technologies for applications across a wide spectrum of societal needs including breakthroughs in diagnosis, treatment, and prevention of disease, in design of novel materials, devices, and processes, and in enhancing environmental health.

**Micro/nano fabrication 3 credit hours**

This course will examine the fundamental mechanics of micro-structure and micro-device and also cover the problems regarding the production and operation of micro system Basic theory of the design, production and measurement of micro-nano system will be discussed and its applications will be introduced.

**Devices through nanotechnology 3 credit hours**

Nanotechnology is the application of scientific and engineering principles to make and utilize very small things.

These are different types of nanomaterials, named for their individual shapes and dimensions. Think of these simply as particles, tubes, and films that have one or more nanosized dimension. Nanoparticles are bits of a material in which all three dimensions of the particle are within the nanoscale. Nanotubes have a diameter that’s nanosize, but can be several hundred nanometers (nm) long or even longer. Nanofilms or nanoplates have a thickness that’s nanosize, but their other two dimensions can be quite large.

**Nonlinear control theory 3 credit hours**

Introduction to the nonlinear system analysis and design of nonlinear control systems. Analysis of nonlinear systems using phase plane method, describing function method, Lyapunov direct & indirect methods, and Popov/circle criteria. Design of nonlinear controllers using a variety of methods: liberalization, absolute stability theory, feedback liberalization technique, and sliding mode control.

**Robust adaptive control 3 credit hours**

Objectives

- To present the fundamental issue of performance/stability robustness tradeoff.

- To facilitate and enhance the student's understanding of robust control system analysis and design methods through the use of computer aided design software.

- To present the methodology for designing of adaptive control algorithms using direct and indirect adaptive schemes.

- To present the methodology for designing of linearizing adaptive control algorithms for a class of nonlinear systems.

Detail topics: Model uncertainty description. internal stability, nominal performance, robust stability, robust performance. Coprime factorization. Controller parameterization. Loopshaping. Model-matching problem. Stability margin optimization, Hinf optimization. Mixed sensitivity problem. Parametric robustness analysis, The adaptive problem statement. The identification problem and identification algorithms. Model reference adaptive control problem, Direct and indirect adaptive control, autotunning adaptive control.

**Physics of magnetism 3 credit hours**

An undergraduate degree in physics provides an excellent basis not only for graduate study in physics and related fields, but also for professional work in such fields as astrophysics, biophysics, engineering and applied physics, geophysics, management, law, or medicine. The undergraduate curriculum offers students the opportunity to acquire a deep conceptual understanding of fundamental physics. The core departmental requirements begin this process. The student then chooses one of two options to complete the degree. The focused option is designed for students who plan to pursue physics as a career. The flexible option is designed for those who are interested in other, perhaps nontraditional, career paths. Either option provides a considerable amount of time for exploration through electives. Students proceed at the pace and degree of specialization best suited to their individual capacities. Both options lead to the same degree: the Bachelor of Science in Physics.

**Special topics in solid state physics 3 credit hours**

APPLIED SOLID STATE PHYSICS

In second-half of the subject, the calculation method of energy bands, Fermi surfaces, the dielectric function of electron gas, the optical properties of crystal, defects, magnetism and superconductivity are treated.

**Special topics in new drug development 3 credit hours**

Principles and applications of enzyme sensor, microbial sensor, immuno-sensor, affinity sensor, and photo biosensor.

**Biochemistry 3 credit hours**

This course discusses the biochemistry of cellular constituents and relationship to cellular metabolism. Emphasis is placed on structure and function relationships of the major chemical components of living matter.

**Protein Engineering 3 credit hours**

Protein engineering is the process of developing useful or valuable proteins. It is a young discipline, with much research taking place into the understanding of protein folding and recognition for protein design principles.

**Mathematical methods for applied sciences 3 credit hours**

Applied mathematics is the mathematical study of general scientific concepts, principles, and phenomena that, because of their widespread occurrence and application, relate or unify various disciplines. The core of the program concerns the following principles and their mathematical formulations: propagation, equilibrium, stability, optimization, computation, statistics, and random processes.

**Advanced chemistry for nanobiotechnology 3 credit hours**

The research area of Nanobiotechnology is highly interdisciplinary providing unique opportunities for the development of convergence technology based on novel functional nano materials, devices and systems.

**Advanced Biological Chemistry 3 credit hours**

This subject deals with biomolecules, the principles of organic functional groups, structures of prokaryotic and eucaryotic cells, characteristics of water, enzymes, various biochemical metabolisms, nucleic acids, genetic information, and protein synthesis.

**Advanced Biochemical Engineering 3 credit hours**

This subject deals introductions of microbiology, biochemistry and molecular biology, reaction kinetics of enzyme and microorganism, analysis of suspended and immobilized microbial bioreactors, operation and control of bioreactors, and sterilization of process fluid.

**Advanced Transport Phenomena 3 credit hours**

This course is intended to be an introduction and application to the field of transport phenomena for graduate students of chemical engineering. Herein, we present the subjects of momentum transport, energy transport, and mass transport specified topics of viscous flow, heat conduction, convection, radiation and diffusion will be intensively educated. Students can learn the basic physical principles in the operation chemical processes and they will have the knowledge which they should have as a master or Ph.D of the engineering science field.

**Enzyme Engineering 3 credit hours**

It deals the basic concept of enzymes, enzyme kinetics, enzyme recovery and purification, enzyme immobilization, enzyme reactors, enzyme biosensors, industrial enzymes, enzyme reactions in nonaqueous solvents.

**Bioseparation Process 3 credit hours**

Separation of cells, insoluble particles and macromolecules, and various soluble products having different molecule sizes from fermentation broth, including filtration, microfiltration, centrifuge, cell disruption, extraction, adsorption, chromatography, precipitation, ultrafiltration, electrophoresis, crystallization, and drying.

**Biosensor Engineering 3 credit hours**

Principles and applications of enzyme sensor, microbial sensor, immuno-sensor, affinity sensor, and photo biosensor.

**3) Research courses**

**Independent research (3 credit hours)**

**Master thesis (1-4 credit hours)**

**Doctoral thesis (1-8 credit hours)**