첨단원자력공학부

1. 교육목표

첨단원자력공학부의 교육과정은 원자력 전문대학원 과정으로서 기계, 물리, 재료, 화학, 바이오, 환경공학 및 지질학을 아우르는 학제 간 융합교육을 통하여 원자력 분야의 차세대 기술 연구 및 개발을 선도할 최고 수준의 창의적 인재의 양성을 목표로 하고 있다. 여러 학문 분야와 관련을 맺는 종합학문으로서의 특성상, 본 대학원에서는 다양한 관련 분야의 학생들을 선발하여 원자력공학 관련 기초·응용 지식을 교육하고 연구와 병행하여, 융합적 사고가 가능한 원자력 전문 인력으로 배양함에 주안점을 두고 있다. 또한, 글로벌 인재양성을 위해 해외 유수의 대학, 연구소들과의 MOU 체결을 통하여 소속 대학원생들에게 각 대학 및 기관에서의 연수 및 공동연구, 단기 강좌 등 다양한 프로그램을 제공하며, 모든 강의 및 세미나를 영어로 진행함과 동시에 해외 초빙교수의 공동연구지도 및 강의를 통해서 국제화 역량을 키운다. 이러한 교육 프로그램들을 통하여 본 대학원의 소속 학생들은 원자력 분야의 전문적인 지식과 기술을 습득함은 물론, 타학문과의 연계성을 활용하여 차세대 국가 성장 동력이 될 수 있는 새로운 융합연구 영역을 개척하는 훈련을 받게 되며, 다양한 활동과 경험을 통해 국제적 감각과 리더십을 배양하여 미래의 선도형 연구자로서 성장해나가게 된다.

2. 교과과정 개요

원자력의 기초를 다질 수 있는 원자력공학, 원자로물리학, 고급원자로물리학및공학, 원자로실험 교과목을 개설하며, 원자력발전공학, 방사선계측, 방사성폐기물관리 등 맞춤 세부 전공과목의 개설을 통하여 분야별 심화 교육을 제공한다.

[교과이수 기본 방침]

가. 교과목 구성(2017학번부터 적용)

구분	학수번호	교과목명	비고
공통과목	NUCE501	원자력공학	이수구분은 전공선택임
	NUCE502	원자로물리학	
	NUCE718Q	고급원자로물리학및공학	
	NUCE702	원자로실험	
전공선택필수과목	NUCE510	원자력발전공학	이수구분은 전공필수임
	NUCE520	방사선계측	
	NUCE530	방사성폐기물관리	
전공선택과목	학수번호 십의 자리가 1		안전 분야
	학수번호 십의 자리가 2		물리 분야
	학수번호 십의 자리가 3		폐기물 분야
연구과목	NUCE800A	Seminar A	
	NUCE69901-09	석사논문연구	
	NUCE89901-09	박사논문연구	

나. 전공필수

- 2011학번 ~ 2013학번

원자력분야의 기초인 핵공학개론(NUCE501)과 원자로물리학(NUCE601)은 전공필수과목으로 모든 학생이 수강하도록 한다.

- 2014학번 ~ 2016학번

원자력분야의 기초인 핵공학개론(NUCE501), 원자로물리학(NUCE601), 방사성폐기물관리개론(NUCE602)은 전공필수과목으로 3과목 모두 수강하도록 한다. 본 학과 석사졸업 후 박사과정 연계 진학자의 경우, 석사 때 전공필수과목을 모두 이수하였으면 중복 수강 없이 면제된다.

다. 전공선택필수(2017학번부터 적용)

- 전공선택필수 3과목 중 2과목을 선택하여 필수로 수강하도록 한다.
- 공통과목 중 원자력공학(NUCE501)과 원자로물리학(NUCE502)은 필수로 수강하도록 한다.
- 학부 원자력학과 졸업생은 학기초에 원자력공학(NUCE501)과 원자로물리학(NUCE502)의 QE를 시행하여 합격시에 NUCE501과 NUCE502의 수강을 면제하여 준다. 단, 고급원자로물리학및공학(NUCE718Q)을 수강하여야 한다. 본 학과 석사졸업 후 박사과정 연계 진학자의 경우, 석사 때 전공선택필수과목을 모두 이수하였으면 중복 수강 없이 면제된다.

라. 전공선택

석사, 박사과정 동안 NUCE 학수번호를 가진 전공 선택과목을 2과목이상 이수한다.

마. 세미나

원자력 연구 분야의 새로운 동향을 폭넓게 습득하기 위하여 세미나를 석사과정 중 2학기 이상, 박사과정 중 4학기 이상, 석·박사통합 과정 중 6학기 이상 이수해야한다.

[교과과정 이수학점]

- 2011학번 ~ 2013학번

	교과학점	연구학점	총 이수학점
석사과정	15	13	28
박사과정	12	20	32
석·박사 통합과정	24	36	60

- 2014학번부터 적용

	교과학점	연구학점	총 이수학점
석사과정	18	10	28
박사과정	15	17	32
석·박사 통합과정	30	30	60

※ 타 학과 과목 취득학점 인정

- 타 학과 학부 400단위 과목 6학점까지 인정
- 석사과정 : 타 학과 대학원 과목 6학점까지 인정
- 박사, 석·박사통합과정 : 타 학과 대학원 과목 12학점까지 인정

[학위수여 요건]

가. 논문연구계획서

- 박사 및 석·박사통합과정은 입학 후 4학기 이내에 제출을 원칙으로 하되, 지도교수의 승인을 얻은 자에 한해 최대 6학기 이내 제출을 허용한다.

나. 박사논문자격시험(Qualifying Examination, QE)

- 박사논문자격시험은 일 년에 두 번 방학기간 중에 실시한다.
- 입학 후 4학기 이내 QE를 통과한 석사과정 학생은 통합과정에 지원할 수 있다.
- 각 과목별 100점 만점에 60점 이상 취득하면 합격으로 한다.
- 선택한 과목의 성적이 A-이상이면 시험을 면제한다.
- 시험과목

▸ 2011학번 ~ 2016학번

필기시험을 원칙으로 하며 전공필수 중 2과목, 전공선택 중 1과목을 선택하여 총 3과목을 합격하여야 한다.

▸ 2017학번부터 적용

필기시험을 원칙으로 하며 전공선택필수 3과목(원자력발전공학(NUCE510), 방사선계측(NUCE520), 방사성폐기물관리(NUCE530)) 중 2과목과 원자력공학(NUCE501), 원자로물리학(NUCE502) 총 4과목을 합격하여야 한다.

다. 국제학술지 논문 게재

- 박사 및 석·박사통합과정의 경우 학과인정 국제학술지에 1편 이상의 논문을 제1저자로 발표하여야 한다.

라. 학위논문심사

- 석사는 지도교수 포함 3인 이상, 박사 및 석·박사통합과정의 경우 지도교수 포함 5명 (최소 한 명은 과외, 본교 대학 교수가 과반수 이상)의 심사위원회를 통과하여야 한다.

3. 전공과목 일람표

이수구분	학수번호	교과목명	강-실-학	비고
전공선택 (공통)	NUCE501	원자력공학	3-0-3	
	NUCE502	원자로물리학	3-0-3	
	NUCE718Q	고급원자로물리학및공학	3-0-3	
	NUCE702	원자로실험	1-1-1	
전공필수 (전공선택필수)	NUCE510	원자력발전공학	3-0-3	
	NUCE520	방사선계측	3-0-3	
	NUCE530	방사성폐기물관리	3-0-3	
전공선택 (안전)	NUCE511	열전달물리학	3-0-3	
	NUCE518	원자력열수력학 1	3-0-3	
	NUCE519	원자력열수력학 2	3-0-3	
	NUCE611	이상유동	3-0-3	
	NUCE711	확률론적안전성평가	3-0-3	
전공선택 (물리)	NUCE523	플라즈마물리	3-0-3	
	NUCE524	방사선안전	3-0-3	
	NUCE718M	가속기의원리와기술	3-0-3	
	NUCE526	방사광과학과응용	3-0-3	
	NUCE721	방사선차폐와몬테카를로분석	2-2-3	
전공선택 (폐기물)	NUCE533	환경방사성오염물질	3-0-3	
	NUCE534	비정질세라믹스	3-0-3	
	NUCE731	고급방사성폐기물관리	3-0-3	
	NUCE732	방사화학	3-0-3	
	NUCE733	화학적폐기물관리및처분	3-0-3	
연구	NUCE69901-09	석사논문연구	가변학점	
	NUCE89901-09	박사논문연구	가변학점	
	NUCE800A	세미나A	1-0-1	

4. 교과목 개요

NUCE501 Nulcear Engineering ····· (3-0-3)

This course will cover an introduction to nuclear power plants, interaction of radiation with matter, neutron cross sections, diffusion theory, criticality calculations, reactor kinetics, neutron slowing down theory, heat transport and temperature distribution in reactor core, and reactivity feedback. The objective of this course is to learn the fundamental concepts and tools for the analysis of nuclear fission reactors.

NUCE502 Nuclear Reactor Physics ····· (3-0-3)

This course is an introduction to the theory of nuclear fission reactors including neutron transport theory, the P1 approximation, and diffusion theory. In addition, it lectures on criticality calculations, which are crucial for reactor interpretation, as well as reactor kinetics, neutron slowing down theory, and numerical solution of the diffusion equation.

NUCE718Q Advances of Nuclear Reactor Physics and Engineering ····· (3-0-3)

The course covers the theory of nuclear fission reactors including multiplication factor, scalar flux and net current, reaction rates, diffusion theory, criticality calculations, reactor kinetics, neutron slowing down theory, and numerical solution of the diffusion equation. An introduction to heat transport in reactor core is also provided.

NUCE702 Nuclear Reactor Experiment ····· (1-0-1)

This course consists of the introduction lecture of reactor experiment, and the practical experiments using KUCA (Kyoto University Critical Assembly) in Japan. The KUCA is a multi-core-type critical assembly. Students visit the facility and participate in three major experiment: approach to criticality, control rod calibration, and measurement of reaction rate. The subjects cover overall topics of nuclear reactor and help students to understand the essence of nuclear reactor physics and radiation detection.

NUCE510 Nuclear Power Plant Engineering ····· (3-0-3)

The overall objective for this course is to have the students understand fundamentals behind the nuclear power plant design and analysis. To achieve the objective, the course provides some basic concepts essential to practical engineering which will be frequently met in the nuclear power plant areas. To this end, the key theories for the analysis of components constructing the plant will be addressed based on the thermodynamic cycles as well as fundamentals. Characteristics of the major components are also learned throughout the lecture.

As a practical application point of view, theoretical backgrounds of a thermal-hydraulic analysis computer code, MARS, will be introduced for familiarity, because it is most widely applied to the analyses of the nuclear power plant as well as experimental facilities in the nuclear thermal-hydraulic research areas.

NUCE520 Radiation Detection ····· (3-0-3)

In this course, students learn these 1. Fundamental principle of radiation detection like particle characteristics and an interaction, 2.Operating Principle of radiation detector for different particles, 3. Measurement technique like data statistics and handling, and spectroscopy.

NUCE530 Radioactive Waste Management ····· (3-0-3)

This course is designed for the senior undergraduate and the graduate students of nuclear science, nuclear engineering, environmental science and engineering, biology, geology, and chemistry to provide an overview of fundamentals of radioactive waste management. This course includes nuclear fuel cycle (front and backend), radioactive wastes generation and types, radiation source/measurement/effects/nuclear waste incineration, actinide chemistry, mechanisms of microbiological effects on radionuclide immobilization in the environment, treatment technology of radioactive wastes, waste form development and testing methods, geological storage and disposal of

wastes, modeling of radionuclide transport, decontamination/decommissioning methods, and risk assessment/safe analysis of repository. The primary goal of this course is to provide the students for understanding of radioactive wastes, immobilization of different waste forms and its management practices so that student will be able to work effectively with nuclear and environmental engineers in industry or academic institutions.

NUCE511 Heat Transfer Physics ····· (3-0-3)

This is a graduate course describing atomic-level kinetics (mechanisms and rates) of thermal energy storage, transport (conduction, convection, and radiation), and transformation (various energy conversions) by principal energy carriers. These carriers are: phonon (lattice vibration wave also treated as quasi-particle), electron (as classical or quantum entity), fluid particle (classical particle with quantum features), and photon (classical electromagnetic wave also as quantum particle).

NUCE518 Nuclear Thermal-Hydraulics-1 ····· (3-0-3)

NUCE519 Nuclear Thermal-Hydraulics-2 ····· (3-0-3)

NUCE611 Two Phase Flow ····· (3-0-3)

This course will discuss pressure drop in two phase flow, heat transfer phenomena and phase change such as condensation and boiling phenomena. Based on these, applied design technology and malfunction in normal operation of steam generator, condenser and nuclear reactor will be analyzed. Also, flow boiling crisis and instability in two phase flow will be examined.

NUCE711 Probabilistic Safety Analysis ····· (3-0-3)

Basic Concepts of Risk and Nuclear Safety, The Nature of Nuclear Power Plant Accidents, Nuclear Power Plant Safety Systems, Risk Assessment Methodology 1. Event Tree and Fault Tree, 2. Level 1, 2, and 3 PSA, 3. External PSA, Reliability Analysis and Major Nuclear Core Melt Down Accidents

NUCE523 Plasma Physics ····· (3-0-3)

This course is intended for the fundamentals for the use of E&M (electricity and magnetism), charged particles or e-beam, and plasmas for biomedicine and some basics of molecular biology and thermodynamics included.

NUCE524 Radiation Safety ····· (3-0-3)

The knowledge of radiation expected ,when radioactive isotopes, radiation generators, and nuclear power plants are used, is introduced. The principle and practical methods to minimize the radiation exposure are given. Students will understand the radiation and study the detection techniques, the radiation effects to human body, the protection principle to prevent the radiation exposure, and etc. Safety-related issues in different applications of various radiations are given to students.

NUCE718M Particle Accelerator Technologies ····· (3-0-3)

This course covers subjects related with the principles and technology in the Light source accelerators. The key words covered in this course are; Introduction to accelerator physics

(Storage ring and XFEL) and technology, Magnet technology, Vacuum system, Diagnostics technology, laser system.

NUCE526 Synchrotron Radiation Science and Applications ····· (3-0-3)

The first applications of synchrotron radiation were in the field of solid-state physics. But, its use now is ubiquitous in all the physical and natural sciences, with also significant medical applications. 'Samples' studied at beamlines range from man-made inorganic materials and devices, natural minerals and rocks, environmentally significant specimens, cultural heritage materials, biologically relevant molecules. The class covers the properties of the important beamline experimental techniques and their principles, and also, introduce to free electron lasers and an overview of the most common experimental techniques and applications.

NUCE721 Radiation Shielding and Monte Carlo Simulation ····· (2-2-3)

The radiation produced in utilizing radioactive isotope, radiation generator, and nuclear power plant is introduced. This course consists of how to protect the radiation to minimize the radiation exposure and how to use well-known Monte Carlo codes. Safety-related issues in different applications of various radiations are given to students. This helps students to understand the principle of shielding analysis using Monte Carlo codes (FLUKA, PHITS, MCNP) with fundamental knowledge of Monte Carlo calculation. The practice course of each codes will be given to students.

NUCE533 Radioactive Contaminants in the Environment ····· (3-0-3)

This course provides the graduate students for an overview of fundamental radiochemistry and hydrogeochemistry associated with environmental nuclear wastes on soils and groundwater. Because the environmental concerns of the fate and transport of radioactive contaminants in subsurface environments are significantly increasing and the nuclear waste management is also depending on the interaction of the radioactive contaminants on mineral surfaces in soils and aquifers, an increasing understanding of fundamental radiochemistry and hydrogeochemistry in contaminant transport and remediation processes is strongly needed.

NUCE534 Noncrystalline Ceramics ····· (3-0-3)

This course teaches basic theories and the most up-to-date research trend on principles and generation of Photonics glasses which are applied to the movement and generation of photon, laser, optical communication, display, etc.

NUCE731 Advances of Radioactive Waste Management ····· (3-0-3)

This course provides the graduate (or senior) students for advanced understanding of radiochemistry, radionuclide speciation, aqueous geochemistry and modeling, mineralogy, groundwater hydrology, low-temperature solid waste form development, geomicrobiology, mechanisms of microbial transformations of actinides, fission and activation products, the impacts of microbial activity on disposal of low-level wastes in shallow land burial grounds, intermediate-level waste in engineered facilities, and high-level waste in deep geological formations, microbial gas generation from radioactive wastes, environmental contamination and remediation methods, bioremediation of contaminated sites, vitrification of radioactive wastes, and decontamination methods and technology development.

NUCE732 Radiochemistry ····· (3-0-3)

This radiochemistry course is designed for graduate students in the nuclear engineering or other engineering departments, and the chemistry department, who are beginning their careers in radiochemistry. The objective of this course is to introduce the theories and fundamental understanding of radiochemistry. Topics to be covered the nuclear stability, including the fundamental principle of radioactive(alpha-, beta-, and gamma-) decay, the interaction of radiation with the matters, and their measurements through alpha/gamma spectrometry, and gross alpha/gross beta counting. In addition to the protection from the exposure of radioactivity dealing in the laboratory. furthermore, the usage of radioactive tracers in chemical kinetics, the separation chemistry, and the environmental chemistry will be also covered in the course. Each student from this course will be able to work effectively with nuclear engineers and the environmental radio-chemist in the nuclear industry or the academic institutes.

NUCE733 Chemical Process for Waste Management and Decontamination ····· (3-0-3)

NUCE699 Master Thesis Research ····· (credits varies)

Students will conduct Master Thesis Research under the guidance of advisors.

NUCE899 Doctoral Dissertation Research ····· (credits varies)

Students will conduct Doctoral Dissertation Research under the guidance of advisors. Students will conduct Master Thesis Research under the guidance of advisors.

NUCE800A Seminar A ····· (1-0-1)

Weekly seminars are organized throughout a semester. Prominent speakers whose work related with various fields of nuclear engineering and physics are invited for the seminar.