••• 첨단원자력공학부 •••

1. 교육목적

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 원자력공학개론, 원자로 물리학, 방사성폐기물관리개론 등의 공통전공 교과목을 개설하며, 에너지변환 및 발전공학, 원자력 안전공학, 고온원자로 수소 시스템, 고속 중성자 핵물리, 방사성폐기물관리특론, 환경복원공학 등 맞춤 세부 전공과목의 개설을 통하여 분야별 심화 교육을 제공한다.

◆ 교과이수 기본 방침

가. 전공필수

* 2011학번 ~ 2013학번

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

* 2014학번부터 적용

원자력분야의 기초인 핵공학개론(NUCE501), 원자로물리학(NUCE601), 방사성폐기물관리개론 중 2과목을 모든 학생이 수강하도록 한다.

나. 전공선택

석사, 박사과정 동안 NUCE학수번호를 가진 전공 선택과목을 2과목이상 이수한다.

다. 세미나원자력 연구분야의 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, 석박사통합과정 : 타 학과 대학원 과목 12학점까지 인정

◆ **학위수여 요건**

가. 논문연구계획서

박사 및 석 · 박사통합과정은 입학 후 4학기 이내에 제출해야 한다. 지도교수의 승인을 얻은 자는 한 학기 연장 할 수 있다.

나. 박사논문자격시험(Qualifying Examination, QE)

- 박사논문자격시험은 일 년에 두 번 실시한다. QE는 12월 마지막 주 혹은 1월 첫째 주 그리고 6월 마지막 주 혹은 7월 첫째 주에 실시한다.
- 입학 후 4학기 이내 QE를 통과한 석사과정 학생은 통합과정에 지원할 수 있다.
- 필기시험을 원칙으로 하며, 공통전공 중 2과목, 세부전공 중 1과목을 선택하여 합격하여야 한다.
- 각 과목별 100점 만점에 60점 이상 취득하면 합격으로 한다.
- 선택한 과목의 성적이 A-이상이면 시험을 면제한다.

다. 국제학술지 논문 게재

* 2011학번 ~ 2013학번

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

* 2014학번부터 적용

- 석사과정의 경우 학과인정 국제학술지에 1편 이상의 논문을 제1저자로 발표하여야 한다.
- 박사 및 석 · 박사통합과정의 경우 학과인정 국제학술지에 2편 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
전공필수	NUCE501	Fundamentals of Nuclear Engineering	3-0-3	
	NUCE601	Nuclear Reactor Physics	3-0-3	
전공선택	NUCE511	Heat Transfer Physics	3-0-3	
	NUCE512	Energy Conversion and Power Plant Technology	3-0-3	MEIE562
	NUCE513	Introduction to Finite Element Method	3-0-3	MEIE583
	NUCE514	Atomistic Simulation	3-0-3	AMSE509
	NUCE515	Phase Transformation	3-0-3	AMSE502
	NUCE516	Advanced Thermodynamics of Materials	3-0-3	AMSE501
	NUCE521	Radiation: detection, measurements and protection-(1)	3-0-3	
	NUCE522	Radiation: detection, measurements and protection-(2)	3-0-3	
	NUCE531	Catalysis	3-0-3	CHEB511
	NUCE532	Advanced Energy Engineering	3-0-3	CHEB771
	NUCE541	Radioactive Contaminants in Environment	3-0-3	
	NUCE542	Non-crystalline Inorganic Materials	3-0-3	AMSE506
	NUCE546	Bioremediation Engineering	3-0-3	EVSE590
	NUCE611	Two Phase Flow	3-0-3	MEIE775
	NUCE631	High Temperature Reactor and Hydrogen System	3-0-3	
	NUCE641	Biochemical Engineering · Nuclear Waste Management	3-0-3	
	NUCE642	Photonics Glasses	3-0-3	AMSE649
	NUCE741	Vitrification of Radioactive Waste	3-0-3	
	NUCE718A	ST:Probabilistic Safety(Risk) Assessment	3-0-3	
	NUCE718B	ST:Nuclear Energy	3-0-3	
	NUCE718C	ST:Fundamentals of Radioactive Waste Management	3-0-3	
	NUCE718D	ST:Radiation Safety Engineering	2-0-2	
	NUCE718E	ST:Nuclear Reactor Experiment	1-0-1	
	NUCE718F	ST:Fundamentals of Nuclear Safety1	3-0-3	
연구학점	NUCE69901-09	Master Thesis Research	가변학점	
	NUCE89901-09	Doctoral Dissertation Research	가변학점	
	NUCE800A-C	Seminar A-C	1-0-1	

4. 교과목개요

NUCE 501 Fundamentals of Nuclear 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.

NUCE 601 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.

NUCE 511 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).

NUCE 512/MEIE 562 Energy Conversion and Power Plant Technology·····(3-0-3)
This course aims to understanding advantages and disadvantages of currently usable energy sources. Principles of these developing systems to produce electricity will be discussed as well as the design methods and improvement of capabilities of various electricity-producing machines.

NUCE 513/MEIE 583 Introduction to Finite Element Method·····(3-0-3)
The finite element method plays an important role as a numerical analysis method for solving various engineering problems.
This course offers knowledge on the fundamental principles of finite element method, which is to interpret deformation of structures, heat transfer, fluid flow etc. This course also allows students to be familiar with application of the ANSYS and FEM systems.

NUCE 514/AMSE 509 Atomistic Simulation·····(3-0-3)
This course aims to nurture students' ability to utilize atomistic simulation (molecular dynamics, Monte Carlo) methods in Material researches. This course also offers students to learn basic theories and techniques of atomistic simulation by using computer software in order to apply them to individual researches.

NUCE 515/AMSE 502 Phase Transformation·····(3-0-3)

This course examines the fundamental concepts of thermodynamics for phase transformation, and studies nucleation, growth, coarsening, spinodal decomposition, cellular precipitation, and maraging transformation etc, which are phase transformation phenomena.

NUCE 516/AMSE 501 Advanced Thermodynamics of Materials ····· (3-0-3)
This course reviews the fundamental principles of thermodynamics and instructs the students their applications to real materials processing problems. The concepts of basic thermodynamic law, equilibrium, solutions, statistical thermodynamics, defects, surfaces and electrochemistry will be used to illustrate the role of thermodynamics in materials science.

NUCE521,522 Radiation: detection, measurements and protection I&II ····· (3-0-3)
This course will introduce the fundamental physics of radiation detection, measurements and data analysis. The basic principles on radiation protection based on the radiation properties will be also given to the students. The most attention will be paid to the detection of neutrons.

NUCE 531/CHEB 511 Catalysis ····· (3-0-3)
This course examines catalyst reaction's basic principles, such as absorption and desorption, surface reaction, with the molecular perspective. This course will lecture on catalyst manufacture, examining the characteristics of catalysts' surface, methods to measure the reaction speed, the relationship between catalyst structure and activity, and the relationship between reaction speed equation and reaction apparatus. This course also lectures on characteristics and operation principles of the metal catalyst, oxidized catalyst, acid-base catalyst, homogeneous catalyst etc.

NUCE 532/CHEB 771 Advanced Energy Engineering ····· (3-0-3)
This course introduces various types of main energy sources, i.e. oil, coal, natural gas, nuclear power, solar energy, hydrogen, biomass, and the conversion and preservation techniques. It also offers an optimal energy system in the future based on examining availability and economic feasibility of the energy sources.
Finally, this course will lecture on each energy system's social influence, particularly its influence on environment.

NUCE 541 Radioactive Contaminants in 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.

NUCE 542/AMSE 506 Non-crystalline Inorganic Materials ····· (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.

NUCE 546/EVSE 590 Bioremediation Engineering ····· (3-0-3)
Analyzing the cause and effect of various kinds of environmental pollutions including air and water, this course offers solutions to these problems with theoretical approach.
The course will lecture on how to analyze the characteristics of wastes produced in factories, how to collect the sample, as well as its management method.

NUCE 611/MEIE 775 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.

NUCE 631 High Temperature Reactor and Hydrogen System ····· (3-0-3)
This graduate level course will focus on the hydrogen generation with nuclear power and associated systems studies. The topics covered include global energy issues, hydrogen as a key energy carrier, key features and design of high temperature reactor (HTR) systems, engineering and physical principles of a HTR including reactor kinetics, thermalhydraulics, materials, fuels and safety, application and methods of generating hydrogen or hydrogen rich gas using HTR heat and/or electricity, coupling of reactor heat transport systems to hydrogen plant, and associated coupled system dynamics, control and safety analysis.

NUCE 641 Biochemical Engineering · Nuclear Waste Management ····· (3-0-3)
This course aims to cover the recent advances of the interactions of microorganisms with radionuclides relevant to nuclear fuel cycle including those nuclides released from nuclear fuel reprocessing plants; the mechanisms of microbial transformations of actinides, fission and activation products; the implications on disposal of low-level waste in shallow land burial grounds, intermediate-level waste in engineered facilities, and high-level waste in deep geological formations; and the potential application of microbes and plants in the remediation of contaminated sites and long-term management of waste repository sites.

NUCE 642/AMSE 649 Photonics Glasses ····· (3-0-3)
This course aims to teach students most up-to-date research trend and theories on photon's movement, e.g., laser, optical communication, display etc, principles and manufacture of photonic glasses, and optical characteristics. Based on this, this course will offer fundamental theories on optical character's changes followed by nano-structure of glasses, and the guidance for further development.

NUCE 741 Vitrification of Radioactive Waste ····· (3-0-3)

The objective of this course for graduate students is to gain knowledge of key aspects of vitrification of radioactive wastes, including waste glass formulation (based on the processing responses and product quality); glass viscosity and electrical conductivity (as functions of temperature and composition); crystallization and phase separation; chemical durability; property–composition modeling and experimental design; conversion of melter feed to molten glass; corrosion of melter components; foaming; volatilization. The focus will be on both science and technology so the students are prepared for conducting research into vitrification of radioactive wastes with the aim of achieving excellence in science and technology of vitrification.

NUCE 718A–F Special Topics in NUCE ····· (3–0–3)
These courses are for the special topics for advanced subjects and recent new discoveries in experiments as well as theoretical and simulation studies related with NUCE research fields.
This course deals with special, high class theories, up–to–date research areas, and new research technique in the field of advanced nuclear engineering.

NUCE 699 Master Thesis Research ····· (credit varies)
Students will conduct Master Thesis Research under the guidance of advisors.

NUCE 899 Doctoral Dissertation Research ····· (credit varies)
Students will conduct Doctoral Dissertation Research under the guidance of advisors. Students will conduct Master Thesis Research under the guidance of advisors.

NUCE 800 A–C Seminar A–C ····· (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.