Description of Courses(Undergraduate Program)

NQE101 Nuclear and Quantum World 3:0:3(3)
Elementary particles such as atom, proton, neutron, electron and photon are wave-particles which are governed by quantum principles. This course introduces the basic concepts of quantum mechanics and quantum phenomena through historical reviews and non-mathematical approach, and discusses the major fields of nuclear and quantum engineering such as nuclear fission and fusion, quantum beam science, medical imaging, quantum imaging, quantum computing, etc. In addition to the technical aspects, the course discusses the impacts of energy development on international politics and environmental issues, and the role of quantum technology in the 21st century.

NQE201 Fundamentals of Nuclear and Quantum Science 3:0:3(4)
Quantum mechanics and nuclear physics are fundamental basis of nuclear and quantum engineering. In this course, the basic principles of quantum mechanics and nuclear physics are discussed, which includes particle-wave duality, wave function, Schrodinger equation, operator and eigenvalue equation, superposition principles, uncertainty principle, Hilber space, quantized energy levels, spin angular momentum and spin 1/2 particle quantum system. Based on these, nuclear structure, nuclear stability, and basic concepts of nuclear interactions are discussed.

NQE202 Introduction to Nuclear Engineering Ⅰ 3:0:3(4)
This course is designed to provide the basic understanding on the nuclear engineering to the undergraduate students interested in nuclear engineering. The fundamental principles and practical applications related to the utilization of nuclear energy from fission are introduced. The major topics included are brief review of nuclear reactions, radiations, interaction of radiation with matters including fission, types of nuclear reactors, neutron diffusion and moderation, nuclear reactor theory and heat transfer.

NQE203 Introduction to Nuclear Engineering Ⅱ 3:0:3(4)
This course is designed to cover the fundamentals of nuclear engineering in the following areas: nuclear reactor systems, nuclear fuel cycle, heat transfer in nuclear system, radiation protection, radiation shielding and nuclear power plant safety.

NQE204 Interaction of Radiation with Matters 3:0:3(4)
This course will give interaction of radiation such as electron, ion, neutron, electromagnetic wave with matters. The topics of the course include generation method, interaction of each quantum particle with matter, measurement and detection of quantum particles.

NQE211 Engineering Mathematics for Nuclear Engineers 3:0:3(4)
This course is designed to provide fundamental mathematical tools for learning nuclear engineering. Basic calculus and ordinary differential equation followed by vector analysis and partial differential equation which are essential for learning reactor physics, radiation engineering, heat transfer and fluid mechanics will be presented with plentiful examples from nuclear engineering. Furthermore, Fourier analysis and probability and statistics will be also slightly touched for Nuclear I&C and Risk Analysis.

NQE272 Introduction to Medical Physics 3:0:3(4)
This course deals with the fundamental principles of the major modalities of medical imaging; x-ray radiography and computed tomography, Gamma camera, SPECT and PET in the nuclear medicine, MRI, ultrasound imaging, and bioluminescence etc. This course also cover the physics of radiation interactions in the therapeutic radiological energy ranges used in radiation therapy, together with clinical linear accelerator basics, characteristics of clinical photon, electron and proton beams, and treatment planning systems and delivery techniques.

NQE281 Energy, Environment and Water 3:0:3(4)

This course introduces the energy, climate change and water problem and their technological solutions. Lecture will cover energy technologies (fossil, nuclear, solar, wind, hydro, etc.), energy system's environmental effect including global warming, fresh water problem which is strongly coupled with energy and global warming problem. Students are encouraged to investigate one of the important future technologies and have a chance to present their study at the end of the semester.

NQE301 Nuclear Reactor Theory 3:0:3(4)
This course is designed to introduce fundamental reactor theory related with neutron reaction, nuclear fission and chain reactions. Major subjects are : neutron slowingdown in infinite medium, neutron diffusion theory, few energy group approximation and criticality calculation, heterogeneous reactor, dynamics and reactivity feedback effects, and projects writing computational programs for reactor analysis (neutron slowingdown, two-group neutron diffusion equation, depletion calculation, point kinetics, etc).

NQE303 Radiation Measurement Experiments 2:3:3(6)
In this course, the fundamentals of nuclear electronics and principles of various detector types such as gas detector, semiconductor detector and scintillation detectors are introduced. Also various modalities of radiation detection such as counting, spectroscopy, dosimetry, imaging and timing measurement for alpha-ray, beta-ray, gamma-ray, x-ray and neutron and their analysis methods are discussed.

NQE311 Numerical Methods and Computer Simulation 3:0:3(4)
This course is designed to provide NQE undergraduate students with basic numerical methods and computational skills (including, writing computer programs implementing basic algorithms). The course covers i) brief introduction to mathematical models dealt in nuclear and quantum engineering, ii) numerical approximation of functions and numerical calculus, iii) matrix theory and linear algebra, iv) numerical methods for ODEs, v) introduction to numerical methods for PDEs, and vi) basics of Monte Carlo simulation. To provide concrete ideas to the students taking the course, the example problems will be taken from various subjects covered in nuclear and quantum engineering.

NQE322 Introduction to Nuclear Thermal Hydraulics 3:0:3(4)
This course introduces the basic concepts of nuclear thermal hydraulics with the aim to help the students understand the principles and develop their capability to apply them. The course covers the rudiments of fluid mechanics, thermodynamics, and heat transfer, and transport phenomena of mass, momentum, heat, and energy based on the basic principles. The course also focuses on nuclear applications such as nuclear safety analysis and study of various thermal hydraulic phenomena.

NQE331 Nuclear I&C and Experiments 2:3:3(4)
This course is designed to provide the undergraduate students in nuclear and quantum engineering with the knowledge on basic electronic engineering and introductory nuclear power plant instrumentation and control systems by theoretic analysis and experiments.

NQE341 Nuclear Chemistry 3:0:3(4)
The first part of this class is designed to build a basic familiarity with radioactivity, nuclear reactions, radioisotopes, and basic chemical concepts regarding chemical thermodynamics and kinetics. The second part is focused on the chemical effects induced by nuclear reactions, the chemical analysis using radiotracers, the chemistry of transuranic elements, and environmental aspects of radionuclides.

NQE351 Introduction to Nuclear and Quantum Engineering Materials 3:0:3(4)
This course aims at conveying the basic understanding about various materials in nuclear and quantum engineering throughout clarifying property-microstructure-processing relation of the materials. Such goal will be achieved by offering the fundamental knowledge of atomic and crystallographic structures, imperfection, diffusion, microstructure, irradiation effects, mechanical

properties, phase equilibrium and transformation, thermal processing and welding metallurgy.

NQE363 Fundamentals of Neutron and X-ray Science 3:0:3(4)
Neutron and X-ray are very powerful tools to measure the structure and dynamics of materials. They have been instrumental for the advance of modern science and technology and their role in the 21st century becomes even more important. In this class, we will discuss the role of neutron & x-ray in modern science and technology, the principles of neutron & x-ray scattering, related sources and instrumentations, and scientific applications of neutron & x-ray.

NQE373 Introduction to Radiation Biology 3:0:3(4)
In this course, the basic concepts and definitions about radiation dosimetry are introduced and the biological effects on cells and human body organs are discussed. Also the external and internal dose calculation models and the principles of radiation dosimetric instrumentations will be discussed together with the domestic and international regulations for the radiation protection. Finally the principle and methodologies of radiation theraphutic technologies are discussed.

NQE382 Engineering Physics for Nuclear Engineers 3:0:3(4)
This course provides fundamentals of classical physics, by solving relevant engineering problems strategically designed based on one-, two- and many-body problems so that students learn necessary concepts of classical mechanics, statistical physics, thermodynamics and fluid dynamics.

NQE401 System Engineering of Nuclear Power Plants and Experiments 3:3:4(6)
Unified treatment of the design concept and overall description of components and system control in nuclear power plants. Discussion of engineering and operational principles of components such as steam generators, pressurizer, pumps, turbines, condensers, valves, BOP, CVCS. Emphasis on the basic concepts of thermodynamics associated with nuclear power plants. Performance of experiments of each component and simulation of the system through a micro-simulator.

NQE402 Nuclear and quantum Engineering Design Project 1:6:3:(4)
In this class the following items will be covered: design thinking, design methodologies (axiomatic design and others), creative problem solving, nuclear system design. And two term projects will be assigned to the students: design of nuclear systems or its applications (group project) and design of creative system (individual project)

NQE434 Nuclear Power Systems Control 3:1:3(6)
This course is designed to provide graduate and high level undergraduate students with control theories such as control action, stability analysis, state-space analysis and with the detailed analysis skills of nuclear power plant control subsystems such as reactor control system, feedwater control system, pressurized control system, and quantum engineering control systems.

NQE441 Environmental Engineering of Nuclear Power 3:0:3(4)
Environmental effects of nuclear power and radiations are covered broadly. Radiological assessment methods and characterizing the various radiation sources are deals directly with analysis. Liquid effluent management and dispersion of gaseous radioactive nuclides and transport or migration of radioactivity through surface water, underground water and biosphere are described. Finally, environmental pathway modeling is examined and compared.

NQE452 Application of Nuclear and Quantum Engineering Materials 3:0:3(4)
The development of the next-generation nuclear energy systems and radiation-application systems requires understanding of various nuclear engineering materials. In this course, basic principles on the inter-relationship between the microstructure, process and properties of metals, ceramics, composites for nuclear applications are presented. The properties of nuclear engineering materials for fuel, fusion, radiation applications are discussed.

NQE471 Experiments in Quantum Engineering 2:3:3(4)
This course is designed to provide opportunities for the undergraduate students to (1) learn fundamental approaches and skills for experimentally investigating quantum engineering problems, (2) learn the theoretical foundations for the methods used, and (3) practice innovative thinking for more realistic applications. Topics covered in this course include, but not limited to: x-ray radiography, computed tomography, modifications of materials by electron irradiation, synthesis of novel materials by electron irradiation, and synthesis of nanoscale materials and their characterization with neutron/x-ray scattering experiments.

NQE481 Introduction to Nuclear Fusion Engineering 3:0:3(4)
Fundamentals of high temperature plasma in which fusion reactions occur are discussed and conditions for the utilization of nuclear fusion energy will be introduced. Various technological and physical issues for the engineering feasibility of nuclear fusion reactor systems are discussed. The important issues including nuclear reaction cycle, reactor power balance, reactor material, first wall, tritium breeding, neutron activation, various confinement types, tokamak concept, ITER etc will be covered. In addition, on-going and planned fusion experiments will be introduced.

NQE484 Writing English Essays for Engineers 3:0:3(4)
This course is intended for students with limited experience writing in English. Sentence variety, effective sentences, topic sentences, and paragraph development will be studied. Grammar, editing, and listening skills will be practiced. Students will write short answer essay exams, a personal statement letter, and a research paper. Class-work time will be directed among pair and group work, peer evaluation and teacher interaction.

NQE485 Special Topics in Nuclear and Quantum Engineering Ⅲ 1:0:1(4)
Course covers the special field of nuclear and quantum engineering which is not covered by the given courses. The content can be variable and will be chosen by the instructor.

NQE488 Special Topics in Nuclear and Quantum Engineering Ⅰ 2:0:2(4)
Course covers the special field of nuclear and quantum engineering which is not covered by the given courses. The content can be variable and will be chosen by the instructor.

NQE489 Special Topics in Nuclear and Quantum Engineering Ⅱ 3:0:3(4)
Course covers the special field of nuclear and quantum engineering which is not covered by the given courses. The content can be variable and will be chosen by the instructor.

NQE490 B.S. Thesis Research 0:6:3

NQE495 Independent Research 0:6:1

NQE496 Seminar 1:0:1
Seminar is given by the staff of the department or invited guest speaker on topics of recent interest in the overall field of nuclear engineering, including the design and operation of nuclear reactors, reactor kinetics, heat transfer, energy conversion, radiation shielding, nuclear fuel cycle and management, nuclear materials and safety, and radiation technology etc.

Description of Courses(Graduate Program)

NQE502 Principles and Applications of Nuclear Engineering 3:0:3(4)
This course is designed to provide the key knowledge of the nuclear engineering to the graduate students with non-nuclear background interested in nuclear engineering. For this, the fundamental principles and practical applications related to the utilization of nuclear energy from fission are introduced. The major topics included are interaction of radiation with matters including fission, types of nuclear reactors, neutron diffusion and moderation, nuclear reactor theory, heat generation and transfer, radiation protection and dose calculation, and nuclear safety.

NQE503 Radiation Science, Technology and Applications 3:0:3(4)
This course is designed to provide fundamentals of radiation science and technology to those who did not major in nuclear and/or radiological engineering in their undergraduates. The course contents include 1) interaction of radiation with matters, 2) radiation dosimetry and measurements, 3) radiation health effects and regulations, and 4) radiation applications.

NQE510 Nuclear Reactor Kinetics 3:0:3(4)
This course is designed to cover the dynamics of nuclear systems. Major subjects are : ① delayed neutrons and inhour equations, ② response to constant, step, and time-dependent reactivities, ③ mechanisms of reactivity feedbacks, ④ reactivity measurements, ⑤ reactivity stability theory etc.

NQE512 Nuclear Reactor Analysis and Design 3:0:3(4)
This course is designed to cover the nuclear reactor analysis and design, introduction of neutron transport equation, approximation of diffusion theory, solution of few-group and multi-group neutron diffusion equation, calculation of energy distribution of fast and thermal neutrons, and homogenization to heterogeneous reactors. It also include recent methods (ex. nodal method) to predict the spatial and temporal distribution of neutrons, This course includes several projects running design computer code systems under realistic reactor design situation

NQE513 Neutron/Radiation Transport Theory and Computation 3:0:3(4)
This course is designed to cover the neutron/radiation transport theory and its computation. It includes nuclear data evaluation and processing, computational methods, and numerical algorithms for continuous, one-group, multi-group neutron and radiation transport computational formulations, that can be applied to the design of various nuclear reactors, radiation shielding facilities, analysis of radiation distribution in systems such as nuclear fusion reactor, accelerator, nuclear bio-medical equipment, and nuclear imaging problems in nuclear prospecting, nuclear assay, and computed tomography.

NQE514 Monte Carlo Methods and Applications 3:0:3(4)
This course deals with fundamentals of the Monte Carlo methods: (1) random variables and random number generation, (2) sampling procedures, (3) analog Monte Carlo, (4) non-analog Monte Carlo and variance reduction techniques, and then applies the methods to a selection of representative benchmark problems from several application areas: (5) radiation particle (neutron, gamma-ray, and charged particles) transport problems, (6) eigenvalue problems, (7) multiple integrals and integral equations, and (8) optimization problems.

NQE517 Fast Reactor Design and Analysis 3:0:3(4)
This course deals with the essential principles, characteristics, and applications of the fast reactors utilizing fast neutrons. Major design characteristics of fast reactors are studied in terms of the core design, reactor kinetics, and fuel management, safety, etc. Special attention is paid to core analysis methodologies and the passive safety characteristics.

NQE521 Reactor Thermal-Hydraulics 3:0:3(4)
The primary objective of this course is to cover the physical phenomena and models for thermal-hydraulics design and analysis of the core of a nuclear reactor including convection in the core, two-phase flow dynamics, two-phase heat transfer, and drift-flux/two-fluid models. Based on the understanding of the physical phenomena and models, we deal with fuel thermal analysis, core thermal analysis, and LOCA safety analysis related to core thermal design. Core thermal design methodology is learned based on thermal design principles.

NQE522 Nuclear Power Plant Design Project 3:0:3(4)
The objective of this course is to accumulate the composite design experiences of the core and other equipments using the principles of nuclear engineering. Unique design of reactor core satisfying the parameters of the particular reactor type, the output of power and the limit temperature, etc., the size of core and the size, the number, the interval and the operating temperature, etc. of fuel rods must be determined by computational codes. It also includes an estimate of the cost price for a reactor system containing heat exchangers, steam generators, condensers, turbines, etc.

NQE523 Nuclear Reactor Safety 3:0:3(4)
The course provides safety goals, characteristics, analysis methods and diagnosis techniques. Both deterministic and probabilistic analyses related with transients, design basis accidents and PSA level 2 and 3 are emphasized. The course covers actual plant accidents. Also, students deduct and discuss safety issues in case-studies.

NQE524 Simulation of Nuclear and Quantum System 3:0:3(4)
This course provides students with understanding of analysis methods, artificial intelligence and simulation methodologies which can be applied in nuclear and quantum engineering. Methodologies related with neutron transport, thermohydraulics, safety analysis and structural mechanics are discussed. In the artificial intelligence part, the course includes expert system, neural network, fuzzy theory, and other artificial intelligence language. Students can understand uncertainty problem and sensitivity study in computer codes.

NQE526 Quantum and Micro Energy Transport 3:0:3(4)
This course provides students with understanding of quantum and micro energy transport phenomena. This course covers the concept of energy carriers - phonon, electron and photon, and analytical methods based on molecular dynamics simulation. This course will make discussions on applied areas such as thermoelectric power generation and cooling, heat conduction and phase change in thin film, and micro measurement techniques.

NQE527 Gas-cooled Reactors and Hydrogen 3:0:3(4)
With reviewing the history of the gas-cooled reactors, the hydrogen-production gas-cooled reactors is studied. This course teaches the basic principles of Brayton cycle, nuclear fuel/core design, and safety with the introduction of the gas-cooled fast reactors. We discuss the principle of hydrogen production through electrolysis and thermochemical process. We analyze a fuel-cell/turbine cycle and the economy of the various options of the hydrogen-production gas-cooled reactors.

NQE528 Introduction to Risk and Reliability Engineering 3:0:3(4)
The main focus of the course will be on the principles and methods for assessing technological risks and reliability. The course is intended to provide a rudimentary background for those who have not been exposed to the subject. Either graduate students or upper-class undergraduates can benefit from the course. The course will emphasize the applications based on probabilistic analysis.

NQE529 Nuclear System Design Course 3:0:3(4)
Design methodologies including axiomatic design is introduced and are applied to nuclear systems. Design examples in the nuclear energy and radiation applications is introduced and how the design principles are applied to real design is explained.

NQE533 Nuclear Power Plant Instrumentation and Control Systems 3:1:3(6)
This course is designed to provide graduate and high level undergraduate students who want to understand and to have skills on analysis and design of nuclear power plant instrumentation and control systems with the knowledge on instrumentation and sensor theory, various process instrumentation and control techniques as well as many real world nuclear power plant instrumentation and control systems.

NQE535 Human Factors Engineering in Nuclear Power Plants 3:0:3(4)
Human play important roles in operation and maintenance of NPPs. It can be easily revealed by seeing that the human is nearly 50% responsible in NPP incidents and accidents. Human factors engineering in nuclear engineering is to understand human factors well and apply those knowledge to nuclear power plant design and many others. This course is developed to provide graduate students and senior undergraduate students with knowledge and theory in nuclear human factors engineering.

NQE537 Wireless Power Electronics 3:0:3(4)
Introduce the development process of the On-Line Electric Vehicles developed by KAIST as a future electric vehicle solution for oil shortage and CO2 emission problems, and newly adopt the「Mobile Power Electronics」that deals with "IT technology that changes the world" of wireless power transfer technology applied to transportations, robots, mobile information devices, and home appliances.

NQE538 Smart Grid and Power Electronics 3:0:3(4)
Smart grids as well as renewable energies such as wind power and solar power are introduced, and various converters such as rectifiers, inverters, and cyclo-converters are explained. Useful power circuit analysis methods including switching function modelling, circuit DQ transformations, and phasor transformations are introduced, and hundreds of practical applications on power electronics circuit examples are widely covered.

NQE540 Nuclear Chemical Engineering 3:0:3(4)
Overall chemical engineering process technologies and principle applicable to nuclear engineering are covered and described. Technology applied and newly developed for nuclear fuel cycle will be discussed in detail. Radioactivity and decay chain analysis method, technology or process applied to front-end fuel cycle, characteristics and analysis of nuclear spent fuels, fission products, and actinide, fundamentals of nuclear water technology and isotope separation methods are described in detail

NQE541 Nuclear Waste Management 3:0:3(4)
The course introduces fundamental principles and major issues of nuclear waste management. The coverage focuses on spent nuclear fuel and high-level waste. Modeling to describe the behavior of waste forms, packages, and the repository system, transport of radionuclides in the subsurface environment, and human risk are discussed.

NQE542 Chemistry of Actinides 3:0:3(4)
The lecture deals with fundamentals of the physical and chemical properties of actinide elements. Basic chemical reactions of actinides in aquatic systems and their essential aspects pertinent to waste disposal safety are introduced. Furthermore, actinide chemistry relevant to future nuclear fuel cycle is discussed.

NQE543 Nuclear Power Plant Water Chemistry 3:0:3(4)
This course provides basics of reactor water chemistry, chemistry control and applications, and guidelines which are of critical importance for controlling thermal corrosion of SSCs (structure, system, and components) and coolant activity level in the primary and secondary reactor coolant in nuclear power plants.

NQE545 Radiation Chemistry 3:0:3(4)
If a materials is irradiated with radiation, chemical and physical properties of the materials is changed. In this course, the chemical changes and the mechanism induced by irradiation is investigated. Also, various applications of radiation is included.

NQE551 Nuclear Reactor Metallurgy 3:0:3(4)
In this course, the mechanical properties and behaviors of structural materials in nuclear power plants are described in view of the microstructure and environment. The phase transformation and microstructure are explained and their impact on strength and properties are described. The microstructure and property changes due to welding of stainless steels are described, and later their impact on corrosion resistance are discussed. The corrosion and corrosion-related cracking phenomena in nuclear power plants are discussed in view of alloying elements and microstructure. Finally, the mechanisms of failure by fatigue and fracture of nuclear structural materials are introduced focusing on the role of microstructure.

NQE552 Integrity of Nuclear Structural Materials 3:0:3(4)
The ageing and integrity concerns on the structural materials of key components are one of the major obstacles for the safe operation and life extension of nuclear power plants. In this course, various ageing phenomena in nuclear power plants are explained in terms of operating conditions the materials are exposed. The effects of ageing on the integrity of the components are evaluated and the proper management programs for ageing are proposed and discussed. For this, the subjects like design characteristics of components, surveillance programs, inspections and non-destructive tests, structural and flaw analysis are treated. Finally, integrity issues like PTS, environmental fatigue, and are discussed as case study to help the student understand the relationship between materials ageing and structural integrity.

NQE553 Nuclear Fuel Engineering 3:0:3(4)
Nuclear fuel and cladding material behavior in nuclear reactor cores are introduced in terms of swelling, fission gas release, and creep. The irradiation and temperature effects are treated in view of theory and experiment, Nuclear fuel design, fabrication, performance assessment models, reliability analysis, and recent trends of nuclear fuel materials are explained.

NQE555 Mechanics of Irradiated Materials 3:0:3(4)
Throughout this course, the students will study about the fundamentals of dislocations and diffusion, the most important factors for the mechanical behavior of solid materials. Then, it will be covered how irradiation can affect their behavior and mechanical properties. The recent experimental and computational techniques to investigate the influence of irradiation on mechanical properties will also be introduced.

NQE561 Radiation Measurement Systems 3:0:3(4)
This course introduces the generation, amplification, transfer and measurement of the electronic signal from various radiation detectors based on the physics theory of the electronic signal and noise. Also it deals with the design methods of radiation counting, spectroscopy, timing and imaging system.

NQE562 Radiation Imaging Instrumentation 3:0:3(4)
This course deals with the analysis and design methods of various radiation imaging devices used in medical diagnostics and non-destructive tests. It also covers the 2-dimensional x-ray radiography and advanced gamma-ray images together with emission and transmission tomographies and laminography, which can be extended into 3-dimensional imaging techniques.

NQE563 Radiation Biology 3:0:3(4)
This course covers the effects of ionizing radiation at the molecular, cellular, organ and organism levels with emphasis on mammalian systems, including cellular concepts, major organ systems, transuranics, nuclear war, radiotherapy and cancer in experimental animal and human exposure groups.

NQE564 Physics of Medical Imaging 3:0:3(4)
This is an introductory course at graduate level to the basic elements of various medical imaging modalities such as radiography, magnetic resonance imaging (MRI), single photon emission computed tomography (SPECT), positron emission tomography (PET), computed

tomography (CT), and ultrasound imaging. Although focus of the lectures will be upon mastering fundamentals of the imaging physics, cutting-edge issues will also be discussed to stimulate graduate research in the related areas.

NQE571 NMR Engineering 3:1:3(6)
This course introduces the basic theory of nuclear magnetic resonance (NMR) phenomena, NMR imaging techniques, NMR spectroscopy techniques and related equipment. In addition to the basic principles of NMR techniques, some examples of NMR applications in biomedical research, nanoporous materials and NMR quantum computations are discussed and some basic NMR experiments related to lectures are performed.

NQE572 Neutron Nano-Characterization 3:0:3(4)
Neutron scattering is a very powerful technique to measure atomic & nano-scale structures and dynamics of condensed matter including nano-materials, bio-materials, magnetic materials, and so on. In this class, we will discuss the basic concepts of neutron scattering and various neutron scattering techniques such as small-angle neutron scattering, reflectometry, triple-axis spectroscopy, and neutron spin-echo spectroscopy. Based on these, representative examples of neutron scattering in nano-materials will be introduced.

NQE575 Nuclear Energy Policy 3:0:3(4)
Historical development and utilization of Nuclear Energy are reviewed from the dawn of atomic age. This important alternative energy technology is evaluated comparatively in terms of techno-economic, socio-political and environmental aspects of nuclear energy uses. The nuclear energy utilization programs of major countries, regional or global basis are assessed for the characterization of different nuclear energy policy. In view of the established international nonproliferation regime and International Atomic Energy Agency (IAEA), the prospect of Nuclear Energy Policy Alternatives should be analysed in conformity with changing policy issues.

NQE581 Nuclear Fusion Engineering 3:0:3(4)
This course deals with principles and design of nuclear fusion systems. It contains the basics of nuclear fusion, fusion reactor analysis, experiments for inertial capture and magnetics, plasma heating, economic and environmental problems, and so on. It also covers the case study of nuclear plasma fusion system designs.

NQE582 Applied Plasma Engineering 3:0:3(4)
This course deals with the methodologies of several plasma generations. For this, it contains the basic principles of low-temperature plasmas and etc. And it studies several cases of industrial applications of plasma.

NQE583 Engineering of Charged Particle Beams 3:0:3(4)
This course will give fundamental physics and applications of charged particle beams such as electron beam and ion beam. The topics of the course include generation methods of charged particle beams, beam optics in electromagnetic fields, measurement of charged particle beams, and interaction of charged particles with matters.

NQE584 Radiation Protection and Regulations 3:0:3(4)
This course is designed to provide knowledge for safety regulation including evaluation and inspection on four major parts of radiation protection, radiation safety regulations, environmental radiation/radioactivity safety, and safety & security of radiation sources. Every lecture focuses on the regulatory experience, international regulatory information and trends, and up-to-date technologies of safety regulations.

NQE585 Introduction to Nuclear Safety Regulation 3:0:3(4)
This course is designed to introduce nuclear safety regulation, which will be a basis of consecutive advanced courses on installation safety regulation and radiation safety management. Major subjects include: Concept of Safety Regulation, Legal and Organizational Infrastructure, Safety Culture, Licensing Process, Safety Review and Inspection, Quality

Assurance, Regulatory Effectiveness and Prospects on Future Regulatory System.

NQE586 Safety Regulation for Nuclear Installations 3:0:3(4)
This course is designed to provide the appropriate knowledge specifically needed for actual regulation of safety review and inspection, and involves the following four disciplines: Safety Evaluation, Structures & Site Evaluation, Mechanical and Material Engineering, and I&C and Electrical Power Engineering. Every lecture includes the regulatory experience for the NPPs, international regulatory and trends, and up-to-date technologies of nuclear safety regulations.

NQE587 Regulation for Nuclear Fuel Cycle and Emergency Preparedness 3:0:3(4)
This course is designed to provide knowledge for safety regulation including evaluation and inspection on major parts of (front & back end) fuel cycle, and nuclear/radiological emergency preparedness. Every lecture focuses on the regulatory experience, international regulatory information and trends, and up-to-date technologies of safety regulations.

NQE588 Advanced Design Project 1 for Nuclear and Quantum Engineering 0:9:3
This class is offered for the students in Renaissance Ph.D. program and the students who are interested in the system design. At the beginning of the semester, projects is given to the students and the results are evaluated at the end of the semester. Object systems are nuclear energy systems and radiation application systems (for medical, science, etc.)

NQE589 Advanced Design Project 2 for Nuclear and Quantum Engineering 0:9:3
This class is offered for the students in Renaissance Ph.D. program and the students who are interested in the system design. At the beginning of the semester, projects is given to the students and the results are evaluated at the end of the semester. Object systems are nuclear energy systems and radiation application systems (for medical, science, etc.)

NQE591 Gneral Plasma Physics for Nuclear Fusion 3:0:3(4)
This course is designed to help students build their ability to understand basic plasma concepts for nuclear fusion and plasma applications. Topics include discharge processes and application of plasmas, motion of charged particles in electric and magnetic fields, plasmas as fluid, diffusion, waves in cold fluid plasmas, and kinetic theory and nonlinear effects.

NQE595 Technical Writing in Nuclear and Quantum Engineering 3:0:3(4)
Writing a technical paper for publication in English. The course presents the requirements for publishing in a professional journal in nuclear and quantum engineering. Each student will write preliminary documents and a final paper for real or imaginary publication. Class-work time will be directed among pair and group work, peer evaluation and teacher interaction. The final paper will be orally presented to the class in a format similar to a professional meeting.

NQE597 Special Topics in Nuclear and Quantum Engineering Ⅲ 1:0:1(4)
Course covers the special field of nuclear and quantum engineering which is not covered by the given courses. The content can be variable and will be chosen by the instructor.

NQE598 Special Topics in Nuclear and Quantum Engineering Ⅰ 2:0:2(4)
Course covers the special field of nuclear and quantum engineering which is not covered by the given courses. The content can be variable and will be chosen by the instructor.

NQE599 Special Topics in Nuclear and Quantum Engineering Ⅱ 3:0:3(4)
Course covers the special field of nuclear and quantum engineering which is not covered by the given courses. The content can be variable and will be chosen by the instructor.

NQE625 Computational Analysis in Nuclear System 3:0:3(4)
This course is designed for graduate student level who are interested in designing and performing safety analysis of existing nuclear power plants and the next generation nuclear power plants. The course will try to make the students understand basic 1D Thermal Hydraulics code and 3D CFD code for nuclear component analyses.

NQE628 Application of Probabilistic Safety Assessment 3:0:3(4)
The course provides an introduction to the fundamentals of plant risk assessment and the new issues of probabilistic risk assessment. Methods of risk model development and their quantification with software tools are included. The topics of the course cover plant risk model, its uncertainty analysis, and recently emerging technical issues such as passive system risk assessment, human reliability, digitalized plant risk assessment, software reliability assessment, and automatic diagnostic features.

NQE631 Nuclear and Quantum Instrumentation and Control Design. 2:3:3(6)
This course is designed to provide graduate students who want to understand and get skills for designing nuclear and quantum I&C systems with detailed analysis skills of subsystems, system integration methods, and pertinent theory and technology. (prerequisite subject : NQE532)

NQE654 Materials for Nuclear Fuel Cycle 3:0:3(4)
This course is designed to provide an overview of functional materials for nuclear applications and to introduce the key materials for nuclear fuel cycle. The course includes basic materials science of uranium, plutonium, thorium, functional materials for nuclear power reactor, spent fuel storage and waste management.

NQE656 Advanced Nuclear Systems and Materials 2:3:3(6)
In this course, the materials and environments of the generation-IV reactors and fusion reactors, and the key material issues under active research. The properties and strengthening mechanisms of ferritic martensitic steels and nickel-base superalloys are explained in view of those high temperature nuclear environments. The materials degradation in various environments such as, liquid-metal, super-critical water, super-critical CO2, high temperature helium, and so on, are described. Finally, the impact of the surface damage to high temperature properties are discussed. To encourage the participation of students, students' seminar on selected topics are included as well as lectures.

NQE675 Special Topics in Nuclear Energy Policy 3:0:3(4)
Course deals with the evaluation of the modern nuclear energy policy program and the development of analysis methodology for solving various related issues. Also the cost-benefit, risk-benefit, Del-Phi, and the socio-political factor analysis will be discussed in order to be used as the input of the decision making for the new nuclear policy.

NQE692 Plasma Kinetic theory 3:0:3(4)
This course is designed to help students to understand how kinetic theory is applied to described plasma behaviors. Coulomb collision effects, various collision operators based on small angle scattering, velocity space diffusion, fast ion slowing down, plasma turbulence and associated transport are taught.

NQE693 Magnetic Confinement for Fusion Energy 3:0:3(4)
This course is designed to provide students a basic understanding of macroscopic behavior of plasmas confined by magnetic fields for fusion energy production such as equilibrium and stability. Magnetohydrodynamic (MHD) model is derived and applied to plasma equilibrium and stability problems so that students can raise physical insights about fusion plasma physics.

NQE726 Special Topics in Nuclear Safety Analysis 2:3:3:(6)
Discussion on numerical and physical models of computer codes developed for nuclear safety analysis. Emphasis on development of mathematical and numerical models, and solution techniques, of two-phase flow. Treatment of physical models of separated flow such as flow-regime map, wall friction and heat transfer, interfacial friction and heat transfer, bifurcation phenomena. Development of a simple two-phase code and performance of class practice for various events.

NQE960 M.S. Thesis Research

NQE965 M.S. Independent Research

NQE980 Ph.D. Thesis Research

NQE966 Seminar(M.S.) NQE986 Seminar(Ph.D.) 1:0:1
Seminar is given by the staff of the department or invited guest speaker on topics of recent interest in the overall field of nuclear engineering, including the design and operation of nuclear reactors, reactor kinetics, heat transfer, energy conversion, radiation shielding, nuclear fuel cycle and management, nuclear materials and safety, and radiation technology etc.