Descriptions of Courses

❒ Undergraduate Program

NQE201 Fundamentals of Nuclear and Quantum Science

This course discusses the history and the basic theory of quantum mechanics, atomic and nuclear physics as an introduction to nuclear engineering and radiological science. It covers the relativity, waves and particles, atomic and nuclear models, many-electron atom, molecules and solid state, radiation and radioactivity, radiation interactions with matter, and the introduction to applications of radiation to industrial and nuclear medicine etc.

NQE202 Fundamentals of Nuclear Engineering Ⅰ

This course is designed to cover the basic engineering principles underlying the nuclear power plant design and operation. Major subjects are: ① various types of nuclear energy utilizations (nuclear fission / fusion for electricity generation, nuclear ship propulsion, nuclear rocket, nuclear battery, etc.) ② introduction to nuclear power reactors, ③ nuclear fuel cycles and radioactive waste disposal, ④ nuclear fuel cycles ⑤ fundamentals of nuclear reactor theory ⑥ heat transfer of nuclear reactors.

NQE203 Fundamentals of Nuclear Engineering II

For nuclear power plant design and operation, introductory comments on nuclear materials, radiation effects, corrosion damage, and nuclear fuels are included in this course. Introduction remarks on radiations, simple calculation on gamma ray and neutron shielding. Radiation effects, units and calculational methods are described basically. Various sources of radiation and standards of various radiation effects are explained. Also quantitative effects of radiation on human and corresponding radiation effects are calculated and analyzed. Reactor licensing, safety principles and dispersions of effluents from nuclear facilities are discussed. Finally reactor incidents, accidents and risk analysis are briefly introduced.

NQE261 Introduction to Medical Imaging

This course deals with useful mathematical concepts like fourier transform for image processing. And the principles of radiation medical imaging techniques will be studied like x-ray radiography, CT, SPECT, PET, etc. The concepts of magnetic resonance imaging and ultrasonic imaging will be also covered.

NQE271 Energy and Environment

Comparative assessment of resources and technologies for renewable energy, fossil energy, nuclear energy, and future energy. Evaluation of abatement technologies and strategies to reduce environmental impacts arising from the various energy uses in order for the food harmonization of energy supply and environmental preservation so as to sustain socioeconomic development.

NQE302 Nuclear Reactor Theory and Simulation

This course is designed to introduce fundamental reactor analysis related with neutron reaction, nuclear fission and chain reaction system. Major subjects are: neutron slowing down in infinite medium, neutron diffusion theory, approximation of few neutron energy group and criticality calculation, hetrogeneous reactor, dynamics and reactivity feedback effects, and projects running computer code systems of reactor analysis (neutron moderation, two-group neutron diffusion equation, depletion calculation, dynamics, etc).

NQE321 Design and Implementation of Nuclear Systems

In this course, many design constraints such as design basis, functions and technical specifications that govern the whole phases of design processes will be taught to point out drawbacks and enhancement directions of designed systems. In addition, through implementation of small-scale mockups, a chance for

enhancement directions that are suggested by students would be provided.

NQE341 Nuclear Chemistry and Experiments

In this course, all aspects of various nuclear reactions and chemical characteristics applied to nuclear engineering and technology will be handled. Radioactive decay, nuclear reaction, interactions between various radiations and materials, characteristics and generations of various radiations, production, utilization and characteristics of radionuclides, radioactive activation analysis and method, uses of radioactive tracers, radiochemistry, isotope separation and applications will be dealt with in this course. Each chapter will then be covered with related basic experiments.

NQE361 Interaction of Quantum Particles with Matter

This course will give fundamental physics about the interaction of quantum particles with matter. The topic of the course includes various interactions of quantum particles such as electron, ion, neutron, and photon with matters and measurement of the quantum particles.

NQE362 Radiation Biophysics

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 principles of radiation dosimetric instrumentations will be discussed together with domestic and international regulations for radiation protection. Finally, the principle and methodologies of radiation therapeutic technologies are discussed.

NQE371 Nuclear Energy Economics and Management

The construction of nuclear power plants typically require large capital investments and subsequent management demands careful economic assessment and forecasting of costs and profits. This course is intended to provide undergraduate students with the principles of engineering economics and their interrelationship with technology management and policy making as applied to the nuclear power industry. The emphasis will be placed on quantitative economic analysis for licensing, construction, operation, maintenance, and regulation of nuclear power plants.

NQE383 Fundamental of Quantum Beam Engineering

This course is an introduction to the physics and engineering of the quantum beams such as the electron, proton, and photon beams. Topics include principles of quantum-beam generation, theories of charged particle acceleration, beam optics, measurement of the beam parameters, and the application of the quantum beams. The operating principles of the quantum-beam devices such as particle accelerators, electron microscopes, synchrotron radiation, free-electron lasers are also discussed.

NQE405 System Engineering of Nuclear Power Plants and Experiments

A unified treatment of the design concept and overall description of components and system control in nuclear power plants will be given in this course. This course also discusses engineering and operational valves, BOP, CVCS, and Engineered Safety Features. Emphasis is placed 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 is also included.

NQE408 Reactor Experiments

Through this course, students can learn the overview of the experimental nuclear reactor and carry out the various experiments using the experimental nuclear reactor. Main topics include the production of radioisotopes, the nuclear fuel burn-up measurement using gamma spectroscopy, the neutron activation analysis, the neutron radiography, and the measurement of the neutron flux. It also covers the operation

experience of the experimental nuclear reactor itself and the simulator program.

NQE409 Nuclear and quantum Engineering Design Project

This course provides students with opportunities to perform by group the actual applications by uniting the reactor physics, reactor control, heat transfer, safety analysis, materials, quantum engineering. This course makes the opportunity to integrate all previous topics from other courses and to apply them toward practical design issues.

NQE412 Monte Carlo Methods and Applications

The Monte Carlo method is a basic computer simulation technique that is now widely used in nuclear reactor design / analysis. More recently, the method is gaining increasing use also in other disciplines such as various basic science and engineering problems, and socio / economical models as well. This course deals with the fundamentals of 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, γ-ray, and charged particles such as electron and alpha particle) transport problems, (6) bio/nuclear medicine systems design, (7) multiple integrals and integral equations, (8) molecular dynamics and quantum Monte Carlo simulation, (9) socio/economics prediction models, and (10) optimization problems.

NQE421 Nuclear Thermal Hydraulics and Experiments

This course deals with the basic theory and experimental methods related to nuclear thermal-hydraulics. Major topics are: ① fluid mechanics and heat transfer in single and two-phase flows, ② heat exchanger design, ③ core thermal design, ④ measurement of various thermo-physical properties and important thermal-hydraulic variables used in nuclear thermal-hydraulics.

NQE426 Introduction to Ultra-small Scale Engineering

In this course, the following topics are studied: microtechnology; nanotechnology; applications to energy, environment, nuclear and quantum engineering, thermo-fluids engineering, manufacturing, and others; basic concepts such as self assembly, self replication, molecular manufacturing

NQE427 Risk and Reliability Engineering

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 had previous exposure to this subject. Both upper-class undergraduates and beginning graduates can benefit from the course. Some of the materials to be covered in the course are: application of probability theory and statistics in planning, analysis, and design of engineering systems, development of probabilistic models for risk and reliability evaluation, occurrence models, extreme value distributions, introduction to Bayesian statistical decision theory and its application in engineering decision-making.

NQE431 Nuclear and Quantum I&C and Experiments

This course is designed to provide high level undergraduate and graduate students in nuclear and quantum engineering with the basic electric and electronic knowledge such as electronic circuits, power electrics, power transmission and introductory instrumentation and control by theoretic analysis and experiments.

NQE435 Information Engineering for Nuclear and Quantum Applications and Experiments

This course is designed to provide high level undergraduate and graduate students in nuclear and quantum engineering with the basic knowledge on digital hardware, software, and cognitive engineering and with the capability of analysis and design of integrated man machine systems.

NQE441 Environmental Engineering of Nuclear Power

Environmental effects of nuclear power, and its environmental preservation and management, effluent and waste heat management of nuclear power and nuclear fuel cycle facilities, environmental dispersion of radioactive effluents, power plant and radioactive disposal siting and technical assessment of various technology will be covered.

NQE451 Nuclear and Quantum Materials and Experiments

Basic concepts and applications of nuclear materials are introduced, while laboratory practices are designed for experiencing property tests of the lectured materials. Lectures impart an essential knowledge of materials science, as well as the effects of radiation and environments on material properties. The experiments are concerned with mechanical tests and data analysis phase transformations, observation by optical and electron microscopes, corrosion tests, and irradiation effects.

NQE471 Experimental Quantum Engineering

This course will give fundamental theories and experiments related to the quantum engineering. The experiments include measurement of quantum particles, radiation, imaging, nano-characterization, and particle beam applications.

NQE472 Quantum Computer and Quantum Information

Quantum computation and quantum information are emerging new fields which are expected to revolutionize the way information is manipulated. In this course we discuss the basic concepts of quantum computation & information and their applications. In addition, current world-wide research activities will be discussed.

NQE486 Introduction to Fusion Reactor Systems

Fundamentals of high temperature plasma in which fusion reactions occur are discussed and conditions for the utilization of nuclear fusion energy are 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.

NQE487 Scientific Oral English in Nuclear and Quantum Engineering

Two 20th century revolutions have changed our perceptions of space, time, cause and effect: relativity and quantum theory. This course is based on a lecture series by Professor Richard Wolfson of Middlebury College, Vermont, entitled Einstein's Relativity and the Quantum Revolution; Modern Physics for Non-Scientists. Most classes will consist of a prerecorded (DVD) 30 minute lecture by Dr. Wolfson followed by class discussion. The purpose of the class is to engage students in English oral conversation and discussion using scientific vocabulary and concepts to improve their communication skills.

NQE488 Special Topics in Nuclear and Quantum Engineering I

This course covers special and important areas of nuclear and quantum engineering that are not covered or emphasized by other courses. The content is variable, as chosen by the instructor.

NQE489 Special Topics in Nuclear and Quantum Engineering II

This course covers special and important areas of nuclear and quantum engineering that are not covered by the given courses. The content is variable, as chosen by the instructor.

NQE490 B.S. Thesis Research

NQE495 Independent Research

NQE496 Seminar

Seminar is given by the staff of the department or invited guest speaker on topics of recent interest in the entire 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.

❐ Graduate Program

NQE511 Nuclear Reactor Kinetics

This course is designed to cover the dynamics of nuclear systems. Major topics are: ① delayed neutrons and inhour equations, ② response to constant, step, and time-dependent reactivities, ③ the mechanisms of feedback - linear and nonlinear feedback models, ④ transfer functions, ⑤ linear and nonlinear stability criteria, ⑥ Lyapunov method, and ⑦ limit cycles and nonlinear oscillations.

NQE512 Nuclear Reactor Analysis and Design

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. The course also includes recent methods (*e.g.*, the 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 and Quantum Particle Transport Theory and Computation

This course is designed to cover the particle transport solution theory, numerical algorithms, and computational methods for continuous, one-group, multi-group neutron and radiation transport phenomena. Major topics are: singular eigenfunction expansion, Green's function, spherical harmonics, discrete ordinates, integral transport, even-parity transport, method of characteristics, Boltzmann-Fokker-Planck transport methods for various quantum particle (neutrons, photons, electrons, positrons, protons, etc) transport phenomena, applied to the design of various nuclear reactors, radiation shielding facilities, analysis of radiation and energy deposition profiles in systems such as nuclear fusion reactor, accelerator, nuclear bio-medical equipment, semiconductor electronics system, and nuclear imaging problems such as nuclear prospecting, nuclear assay, computed tomography.

NQE520 Nuclear Reactor Engineering

The primary objective of this course is to cover the engineering analysis in the design of nuclear fission power reactors. Major topics include: ① a brief description of the various types of nuclear power plants currently in use or under serious consideration, ② thermal-hydraulic analysis of nuclear reactors, ③ analysis of operational and accident transient sequences, ④ nuclear and thermal-hydraulic transient, and ⑤ engineering aspects of nuclear reactor safety.

NQE521 Nuclear Thermal-Hydraulics I

The primary objective of this course is to cover the fundamental subjects of nuclear reactor thermal-hydraulics. Major topics are: ① Fundamentals of heat transfer mechanisms and fluid mechanics. ② Energy and core flow distribution, heat transfer by conduction and convection of incompressible single and two-phase fluid flow in reactors. ③ Applications of single and two-phase flow in core thermal design and safety analysis of nuclear reactors. ④ Current research topics of the nuclear thermal-hydraulics concerned with safe and effective heat removal from the reactor core for power production.

NQE522 Nuclear Power Plant Design Project

The objective of this course is to accumulate the composite design experiences of the core and other equipments using the principles of nuclear engineering. Important considerations follow: unique design of the reactor core satisfying the parameters of the particular reactor type; the output of power and the limit temperature, etc; the size of core; the number, interval and operating temperature, etc. of fuel rods must be determined by computational codes. Also, it is important to estimate the cost price for a reactor system containing heat exchangers, steam generators, condensers, turbines, etc.

NQE523 Nuclear Reactor Safety Ⅰ

This course deals with safety objectives, safety features, safety analysis methods and diagnostic techniques for a nuclear power plant. The probabilistic safety assessment is emphasized, which includes the deterministic analysis for transient state and design basis accident, and the system reliability, the severe accident generation rate and phenomena. It also deals with the TMI and Chernobyl accidents and other severe reactor accidents as practical examples.

NQE524 Simulation of Nuclear and Quantum System

This course provides students with an understanding of numerical analysis, artificial intelligence and simulation methodologies which can be applied in nuclear and quantum engineering. To solve the partial differential equations, finite difference method, finite element method, Monte Carlo method and so on are discussed. In the artificial intelligence section, the course covers expert system, neural network, fuzzy theory, and other artificial intelligence language. Students can understand about uncertainty problem and sensitivity study in computer codes.

NQE526 Quantum and Micro Energy Transport

This course provides students with an 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

Upon reviewing the history of gas-cooled reactors, hydrogen-production gas-cooled reactors are 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.

NQE532 Nuclear and Quantum Instrumentation Systems

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 and quantum instrumentation systems with the knowledge on instrumentation and sensor theory, various process instrumentation techniques as well as many nuclear power plant instrumentation systems and quantum engineering instrumentation systems.

NQE534 Nuclear and Quantum Control Systems

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, feed-water control system, pressurized control system, and quantum engineering control systems.

NQE536 Compact Nuclear Simulator Operation Experiment

This course is designed to provide high level undergraduate and graduate students with the opportunity to operate nuclear power plants under normal conditions, as well as learn how to handle abnormal and emergency conditions, all using compact nuclear simulators.

NQE540 Nuclear Chemical Engineering

Overall chemical engineering process technologies and principles applicable to nuclear engineering are covered and described. Newly developed applied technology for nuclear fuel cycle will be discussed in detail. Radioactivity and decay chain analysis method, technology or processes 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 Radioactive Waste Management

This course is designed to provide students with knowledge of technology for the general management of radioactive waste generated during the operation of the nuclear power plant and nuclear fuel cycle facility. This including the treatment and disposal of the wastes. Background information on the sources of the gaseous, liquid and solid radioactive waste, and process and treatment facilities, solidification and volume reduction technology, packaging and transportation, storage methods of the wastes and spent nuclear fuel, design, safety and construction of the waste repositories, migration of the radionuclide at the subsurface, environmental monitoring and protection, repository safety assesment, decontamination and decommissioning, and management of spent nuclear fuel is covered.

NQE551 Nuclear Materials

Nuclear materials are introduced with an emphasis on structural integrity on the basis of materials science. Effects of microstructure and dislocation substructure on mechanical properties, deformation and fatigue properties in various temperatures and environments. Fracture mechanical analysis of crack propagation, stress corrosion cracking, irradiation effects, and recent developments of nuclear materials are included in view of theory and applications.

NQE552 Integrity of Nuclear Structural Materials

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, and environmental fatigue are discussed as a case study to help the student understand the relationship between materials ageing and structural integrity.

NQE561 Radiation Measurement Systems

This course introduces the generation, amplification, transfer and measurement of the electronic signal from various radiation detectors based on the physics theory of the electronics signal and noise. Also it deals with the design methods of radiation counting, spectroscopy, timing and imaging system.

NQE562 Radiation Imaging Instrumentation

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 imagers together with emission and transmission tomographies and laminography, which can be extended into 3-dimensional imaging techniques.

NQE563 Radiation Biology

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.

NQE571 NMR Engineering

This course introduces the basic theory of nuclear magnetic resonance (NMR) phenomena, NMR imaging techniques, NMR spectroscopy techniques and related equipments. 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 Optics

This course introduces the theory of neutron optical phenomena and the theory of neutron scattering for condensed matter research. The contents include the elements of quantum mechanics, the fundamental properties of neutron, the neutron nuclear scattering and magnetic scattering, a brief introduction to the neutron optical device and neutron scattering instruments. A few practical examples of neutron scattering experiments are also discussed.

NQE573 NMR Engineering

This course introduces the basic theory of nuclear magnetic resonance (NMR) phenomena, NMR imaging techniques, NMR spectroscopy techniques and related equipments. 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.

NQE575 Nuclear Energy Policy

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

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

This course deals with the methodologies of several plasma generations. For this, it contains the basic principles of low-temperature plasmas and etc. In addition, several cases of industrial applications of plasma are studied.

NQE583 Particle Accelerator Engineering

This course will give fundamental physics and applications of charged particle accelerators. The topics of the course include principles of particle acceleration, application of accelerators, characteristics of several kinds of accelerators. The fundamental characteristics of the charged particle beams passing through RF cavity and beam optical components are also discussed.

NQE595 Technical Writing in Nuclear and Quantum Engineering

This course deals with 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 hypothetical 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.

NQE598 Special Topics in Nuclear and Quantum Engineering Ⅰ

This course covers an important area(s) of nuclear and quantum engineering that is not covered by the given curriculum courses. The content is variable from year to year, and is selected by the instructor.

NQE599 Special Topics in Nuclear and Quantum Engineering II

This course covers the special field of nuclear and quantum engineering which is not covered by the given courses. The content are chosen by the instructor and may vary.

NQE621 Nuclear Thermal-Hydraulics II

This course covers advanced topics of the nuclear thermal-hydraulic design and analysis of the core of a nuclear reactor along with the related current reactor thermal-hydraulic research topics. The major topics here are ① reactor thermal hydraulic design problems, ② transient analysis of a single and multiple heated channels, ③ thermal analysis of the spent fuel storage canister, ④ analysis of hypothetical severe reactor accidents, ⑤ source term uncertainty analysis, ⑥ hypothetical core disruptive accident of an LMFBR, and ⑦ cureent research topics of the nuclear thermal-hydraulics. (prerequisite: NE421)

NQE623 Nuclear Reactor Safety II

This course is a continuation of NE523. Reliability, risk analysis and reactor safety, the problems of higher degree are emphasized. In particular, important safety problems of reactor are selected and reviewed. It also includes the case-studies with participating students discussing. (prerequisite: NE523)

NQE624 Nuclear Fuel and Core Design

This course presents basic theory and practical applications of thermal-hydraulic, mechanical, and uncertainty analysis to fuel and core design. Discussion of methodology on how these parts are coordinated and integrated to yield economical and safe fuel and core design.

NQE625 Numerical Methods in Reactor Engineering Analysis

This course deals with the numerical methods for analyzing the problems of nuclear reactor engineering. Finite difference method and finite element method are studied in order to find solutions of heat transfer, fluid dynamics, component structure design and system transient analysis.

NQE631 Nuclear and Quantum Instrumentation and Control Design.

This course is designed to provide graduate students who want to understand and develop 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: NE532)

NQE651 Radiation Effects on Reactor Materials

Characterization of the different radiation sources, interaction with reactor materials, and resulting radiation damage are analysed in terms of metal crystalline defects and physical properties of reactor materials. Radiation damage induced core material property change, water or liquid metal side corrosion, diffusion and reaction of fission products, structural stability of metal or nonmetallic materials, radiation hardening or embrittlement and swelling are studied and analysed in terms of lattice defect interaction with energetic

neutron.

NQE653 Nuclear Reactor Fuel Elements

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 core materials are explained.

NQE675 Special Topics in Nuclear Energy Policy

This 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 so these topics can be used as the input of the decision making for new nuclear policy.

NQE726 Special Topics in Nuclear Safety Analysis

This course discusses on numerical and physical models of computer codes developed for nuclear safety analysis. Emphasis are placed on development of mathematical and numerical models, and solution techniques, of two-phase flow. This course treats physical models of separated flow such as flow-regime map, wall friction and heat transfer, interfacial friction and heat transfer, and bifurcation phenomena. In this course, students are to develop a simple two-phase code and perform class practice for various events.

NQE727 Special Topics in Probabilistic Risk Assessment

This course deals with the methodologies and applications of PRA, and computer codes. Among the methodologies, there are probabilistic analysis and accident result analysis. The former includes data processing, fault tree, human error, common mode error and uncertainty analysis. The latter includes containment vessel state, core exposure and melting, pressure vessel melting penetration, core-concrete reaction, atmosphere source terms, radioactive nuclide dissipation and public result. This course also covers various applications as the decision-making.

NQE735 Special Topics in Information Engineering for Nuclear and Quantum Applications

This course is designed to help the graduate students understand the state-of-the-art research activities in information engineering for nuclear and quantum applications and have them participate in research through individual projects. (prerequisite: NQE534)

NQE743 Special Topics in Nuclear Chemical Engineering

The application of nuclear chemical engineering related to the overall facilities of nuclear power and fuel cycle will be introduced and discussed. The advanced topics of characteristics and effects of various radioactive materials, properties and characteristics of fission products, nuclear and radiochemistry, various nuclear fuel cycle alternatives, isotope separation, storage and reprocessing of spent nuclear fuel, treatment and disposal of radioactive wastes, environmental impacts and environmental friendly nuclear power assessment will be covered and carefully reviewed.

NQE960 M.S. Thesis Research

NQE965 M.S. Independent Research

NQE980 Ph.D. Thesis Research

NQE966 Seminar (M.S.)

NQE986 Seminar (Ph.D.)

The seminar course is composed of lectures 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.