Jordan University of Science and Technology

Faculty of Engineering

Department of Nuclear Engineering

Undergraduate Curriculum for the bachelor's degree in Nuclear Engineering

2019

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Vision:

Towards excellence in nuclear engineering education, research, and effective utilization of nuclear energy.

Mission:

The mission of the Department of Nuclear Engineering is to be Jordan's center of excellence in nuclear engineering education and research and to lead Jordan's effort to develop its nuclear infrastructure, and to introduce nuclear power as part of its energy mix. The mission of the undergraduate program is to graduate qualified engineers who can contribute valuable engineering skills and knowledge toward the design, building and running of Jordan's first nuclear power plant.

Program Objectives:

The objectives of the Nuclear Engineering undergraduate program are to produce graduates who are capable of:

1. Apply and build on their knowledge to achieve furtherance and satisfaction in their chosen career or profession and to pursue post-graduate studies in disciplines related, but not limited, to nuclear engineering.
2. Conduct themselves with top-level professional and ethical standards undertaking risk management, security, safety, environmental and economic challenges to help meet the manpower needs of our country, region, and international community.
3. Engage in life-long learning and keep abreast of new developments in nuclear engineering through fruitful utilization of national current and future nuclear facilities, professional development and continuous education.
4. Employ their analytical and communication skills to demonstrate solid leadership, innovate solutions, and work under pressure effectively within multi-disciplinary teams.

Program Learning Outcomes:

To achieve its key objectives, the Nuclear Engineering program is designed to ensure that our graduating students achieve the following outcomes:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Study Plan of bachelor's degree in Nuclear Engineering

Numbering and coding system of courses of the study plan.

Course Coding

A two letters (or three letters, if necessary) and three 3-numbers code is given to each course offered by the dept. as shown below:

Department			Level/year	Field	Sequence
A	B	C	X	Y	Z

The Department codes (A, B, C) are selected as follows:

Code	Department	Code	Department
AE	Aeronautical Engineering	IE	Industrial Engineering
CE	Civil Engineering	ChE	Chemical Engineering
ME	Mechanical Engineering	BME	Biomedical Engineering
EE	Electrical Engineering	**NE**	**Nuclear Engineering**

Course Numbering

- The Nuclear Engineering courses are tabled and numbered in such a manner to recognize each course regarding its subject area, year or level, and semester offered.
- Ex. NE XYZ: The **NE** symbol in the course number denotes **Nuclear Engineering** and (XYZ) is a 3-digits number:

A. The first digit (X) denotes the year level of the course according to student's study plan as follows:

Code	Level/year
1	First year
2	Second year
3	Third year
4	Fourth year
5	Fifth year

B. The second digit (Y) denotes the course field subject as follows:

Second number	Field
0	Basics of nuclear engineering
1	Radiation and its applications
2	Safety and radiation protection
3	Thermal hydraulic and heat transfer
4	Reactor engineering and neutronics
5	Nuclear system analyses and control
6	Nuclear materials
7	Modeling and design
8	Special topics
9	Applied engineering applications, graduation project

C. The third digit (Z) denotes the course sequence in its subject area (Odd numbers represent first semester and even numbers represent second semester courses). Example: NE 521 means:

NE	5	2	1
Nuclear Engineering	5th year level	Safety and radiation protection	1st semester sequence / offering

Framework for NE B.Sc. Degree (160 Semester Credits)

The Bachelor of Science (B.Sc.) degree in Nuclear Engineering in the Faculty of Engineering at JUST is awarded in accordance with the Statute stated in the JUST regulations for B.Sc. awarding issued by the Deans' council based on the 1987 adjusted law for awarding scientific degrees and certifications at JUST and after the successful completion of 160 credit hours (C.H.). The 160 C.H. are distributed as shown in Table (1).

Table 1: Distribution of credit hours

Classification	Credit hours		
	Compulsory	Elective	Total
University requirements	16	9	25
Faculty requirements	32	0	32
Department requirements	94	9	103
Total	142	18	160

Degree Requirements:

University Requirements (25 Credit Hours)

Students are required to study a total of 25 credit hours (16 compulsory and 9 electives), as follows:

a- Compulsory University Requirements: (16 Credit Hours)

Table 2: University compulsory courses (16 credit hours)

Course No.	Course title	Credit hours	Theoretical	Practical
MS 100 (1)	Military sciences	3	3	--
ARA 101	Arabic language	3	3	--
HSS 110	Social responsibility	3	3	--
HSS119(2)	Entrepreneurship and Innovation	2	2	--
LG 112	English language 2	3	3	--
HSS129	General skills	2	2	--

(1) This course is required from Jordanian students only; non-Jordanian students can take a substitute for this course from the university elective courses.

(2) Faculty of Engineering students must take "HSS119A" Introduction to Engineering Innovation and Entrepreneurship instead of "HSS119" Entrepreneurship and Innovation.

Notice: All non-Arabic speaking students in the university are required to study the following courses shown in Table (3):

Table 3: Courses for non-Arabic Speaking Students

Course No.	Course title	Credit hours	Theoretical	Practical
ARB 101A	Fundamentals of Arabic Language for non-Arabic speaking students (as a substitute for the course ARB 101)	3	3	--
HSS 110A	Social responsibility (in English) (as a substitute for the course HSS 110)	3	3	3

b- University Elective: (9 Credit Hours)

A total of 9 credit hours is required.

Faculty Requirements: (32 Credit Hours)

The faculty course requirements include a total of 32 credit hours, as shown in Table (4)

Table 4: Faculty of Engineering requirements

Course No.	Course title	Credit hours	Theoretical	Practical	Prerequisite or co-requisite
NE100*	Introduction in Engineering	1	1	--	--
NE114	Programming for Engineers	3	2	1	--
ME 100	Engineering Workshops	1	--	1	--
ME 200	Engineering Drawing - A	1	--	1	--
Math 101	Calculus 1	3	3	--	--
Math 102	Calculus 2	3	3	--	Math 101
Math 201	Intermediate Analysis	3	3	--	Math 102
Math 203	Ordinary Differential Equations I	3	3	--	Math 102
Phys 101	General Physics 1	3	3	--	---
Phys 102	General Physics 2	3	3	--	Phys 101
Phys 107	General Physics Lab	1	--	1	Pre/Co Phys 102
Chem 101	General Chemistry 1	3	3	--	---
Chem 102	General Chemistry 2	3	3	--	Chem 101
Chem 107	General Chemistry Lab	1	--	1	Pre/Co Chem 102
Total		**32**	**27**	**5**	

* Online Course

Department Requirements: (103 Credit Hours)

The course requirements include a total of 103 credit hours divided into two groups:

a) **Department Compulsory Courses (94 credit hours):** Students have to take 94 credit hours from Table (5):

Table 5: Department compulsory courses (94 credit hours)

Course Number	Course Name	Cr. hr.	Theoretical	Practical	Prerequisite or Co-requisite
EE 204	Introduction to Linear Systems	3	3	--	MATH 201, NE 114
EE 212	Electric Circuits Analysis	3	3	--	PHYS 102, Co Math 203
EE 213	Electric Circuits Lab	1	--	1	EE 212
IE 213	Mechanics of Materials 1	3	3	--	PHYS 101
ChE 242	Engineering Thermodynamics	3	3	--	MATH 203
EE 305	Numerical Methods for Engineers	3	3	--	MATH 203, NE 114
ME 343	Fluid Mechanics	3	3	--	PHYS 101, MATH 203
IE 351	Economics and Engineering Management	2	2	--	MATH 201
IE 363	Engineering Materials	3	3	--	Co IE 213
IE 367	Engineering Materials Lab	1	0	1	IE 363
ME 451	Heat Transfer	3	3	--	MATH 203, ME 343
ME 445	Thermo Fluid Lab.	1	--	1	Co ME 451
NE 201*	Ethics & Development of Nuclear Technology	1	1	--	---
NE 203	Fundamentals of Nuclear Science	3	3	--	Passing PHYS 102
NE 204	Applied Engineering Statistics	3	3	--	MATH 203
NE 206	Introduction to Nuclear Engineering	3	3	--	Passing NE 203
NE 311	Ionizing Radiation Detection & Measurement	3	3	--	NE 204, Passing NE 203
NE 312	Radiation Detection and Measurement Lab, I	1	--	1	NE 311

NE 322	Radiation Protection and Dosimetry	3	3	--	NE 311
NE 340	Nuclear Reactors Theory	3	3	--	Passing NE 206, EE 305
NE 351	Signals and Control Systems	3	3	--	EE 212, Co EE 204
NE 372	Computational Techniques in Nuclear Engineering	3	3	--	NE 114, Co NE 340
NE 413	Radiation Detection and Measurement Lab II	1	--	1	NE 312
NE 431	Nuclear Reactors Thermal Hydraulics	3	3	--	CHE 242, ME 451
NE 441	Nuclear Reactors Analysis	3	3	--	Passing NE 340
NE 448	Nuclear Reactor Lab	3	2	1	NE 441, NE 413
NE 451	Nuclear Power Plant Systems and Operations I	3	3	--	NE 340, Co NE 431
NE 452	Nuclear Instrumentation & Control	3	3	--	NE 340, NE 351
NE 460	Fuel Cycle and Waste Management	3	3	--	NE 441
NE 465	Nuclear Reactor Materials	3	3	--	NE 340 & IE 363
NE 471	Radiation Interactions and Shielding Design	3	3	--	NE 311
NE 472	Modeling and Simulation of Nuclear Reactors	3	3	--	NE 441
NE 482	Nuclear Engineering Seminar	1	1	--	Completion of 100 Cr
NE 490**	Engineering Training	3	--	3	Completion of 117 Cr
NE 521	Nuclear Reactor Safety	3	3	--	NE 451
NE 591	Graduation Project I	1	--	1	Completion of 117 Cr
NE 592	Graduation Project II	3	--	3	NE 591, NE 490
TOTAL		**94**	**81**	**13**	

*** Online Course**

**** 8 weeks of practical training in a by-Faculty accredited institution pertaining to nuclear engineering**

b) Department Elective Courses (9 credit hours): The student should study at least 6 credit hours from the technical electives listed in Table (6). The remaining 3 credit hours should be chosen either from Table (7) or any course of (500) level in the college of Engineering curriculum.

Table 6: Nuclear Technical Electives

Course Number	Course Name	Cr. hr.	Theoretical	Practical	Prerequisite or Co-requisite
NE 500	Economic & Environmental Aspects of Nuclear Energy	3	3	--	NE 451
NE 501 *	Non-Power Applications of Nuclear Energy	3	3	--	NE 413 & NE 340
NE 525	Environmental Radioactivity	3	2	1	NE 413 & NE 322
NE 526	Nuclear Security and Safeguards	3	3	--	NE 465
NE 552	Nuclear Power Plant Systems and Operations II	3	3	--	NE 451
NE 560	Radiochemistry	3	2	1	NE 413 & IE 363
NE 571	In Core Fuel Management	3	3	--	NE 441, NE 472
NE 579	Nuclear Reactor Design Methodology	3	3	--	NE 472
NE 581	Special Topics in Nuclear Engineering	3	3	--	Department Approval
TOTAL		**24**	**22**	**2**	

*** Online Course**

Study Plan for the B.Sc. Degree in Nuclear Engineering

First Year (Preparatory Year for the College of Engineering)											
First semester						Second semester					
Course No.	Course Name	Credit Hours	Weekly hours		Prerequisite	Course No.	Course Name	Credit Hours	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
ME 200	Engineering Drawing A	1	-	3	-	NE 100	Introduction to Engineering	1	1	-	-
ME 100	Engineering Workshops	1	-	3	-	ARB 101	Arabic Language	3	3	-	-
HSS 119	Entrepreneurship and Innovation	2	3	-	-	MATH 102	Calculus 2	3	3	-	MATH 101
MATH 101	Calculus 1	3	3	-	-	CHEM 102	General Chemistry 2	3	3	-	CHEM 101
PHYS 101	General physics 1	3	3	-	-	CHEM 107	General Chemistry lab.	1	-	3	CHEM 102 (or Co.)
CHEM 101	General Chemistry 1	3	3	-	-	PHYS 102	General Physics 2	3	3	-	PHYS 101
NE 114	Programming for Engineers	3	2	2	-	PHYS 107	General Physics lab.	1	-	3	PHYS 102 (or Co.)
Total		**16**	**14**	**8**		**Total**		**15**	**13**	**6**	

SECOND YEAR											
First semester						Second semester					
Course No.	Course name	Total Credit	Weekly hours		Prerequisite	Course No.	Course name	Total Credit	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
EE 212	Electric Circuit Analysis	3	3	-	PHYS 102, Co MATH 203	NE 206	Introduction to Nuclear Engineering	3	3	-	Passing NE 203
HSS 129	General Skills	2	2	-	-						
IE 213	Mechanics of Materials 1	3	3	-	PHYS 101	CHE 242	Engineering Thermodynamics	3	3	-	MATH 203
MATH 201	Intermediate Analysis	3	3	-	MATH 102	EE 204	Introduction to Linear Systems	3	3	-	MATH 201
MATH 203	Ordinary Differential Equations	3	3	-	MATH 102	EE 213	Electric Circuits Lab	1	-	3	EE 212
NE 203	Fundamentals of Nuclear Science	3	3	-	Passing PHYS 102	NE 204	Applied Engineering Statistics	3	3	-	MATH 203
NE 201	Ethics & Development of Nuclear Technology	1	1	-	-	LG 112	English Language 2	3	3	-	-
Total		**18**	**18**	**-**		**Total**		**16**	**15**	**3**	

THIRD YEAR											
First semester						Second semester					
Course No.	Course name	Total credit	Weekly hours		Prerequisite	Course No.	Course name	Total credit	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
EE 305	Numerical Methods for Engineers	3	3	-	MATH 203, NE 114	ME 451	Heat Transfer	3	3	-	MATH 203, ME 343
						IE 367	Engineering Materials Lab	1	-	3	IE 363
ME 343	Fluid Mechanics	3	3	-	PHYS101, MATH 203	HSS 110	Social Responsibility	3	2	1	-
IE 351	Economics and Engineering Management	2	2	-	MATH 201	NE 312	Radiation Detection and Measurement Lab, I	1	-	3	NE 311
IE 363	Engineering Materials	3	3	-	Co IE 213	NE 322	Radiation Protection and Dosimetry	3	3	-	NE 311
NE 311	Ionizing Radiation Detection & Measurement	3	3	-	NE 204, Passing NE 203	NE 340	Nuclear Reactors Theory	3	3	-	PASSING NE 206, EE 305
NE 351	Signals and Control Systems	3	3	-	EE 212, Co EE 204	NE 372	Computational Techniques in Nuclear Engineering	3	3	-	NE 114, Co NE 340
Total		**17**	**17**	**-**		**Total**		**17**	**14**	**7**	

FOURTH YEAR											
First semester						Second semester					
Course No.	Course name	Total credit	Weekly hours		Prerequisite	Course No.	Course name	Total credit	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
ME 445	Thermo Fluid Lab.	1	-	3	Co ME 451	NE 448	Nuclear Reactor Lab	3	2	3	NE 441, NE 413
NE 413	Radiation Detection and Measurement Lab II	1	-	3	NE 312	NE 452	Nuclear Instrumentation & Control	3	3	-	NE 340, NE 351
NE 431	Nuclear Reactors Thermal Hydraulics	3	3	-	CHE 242, ME 451	NE 460	Fuel Cycle and Waste Management	3	3	-	NE 441
NE 441	Nuclear Reactors Analysis	3	3	-	Passing NE 340	NE 472	Modeling and Simulation of Nuclear Reactors	3	3	-	NE 441
NE 451	Nuclear Power Plant Systems and Operations I	3	3	-	NE 340, Co NE 431	NE 482	Nuclear Engineering Seminar	1	1	-	Completion of 100 Cr.
NE 465	Nuclear Reactor Materials	3	3	-	NE 340 & IE 363	UE	University Elective	3	3	-	-
NE 471	Radiation Interactions and Shielding Design	3	3	-	NE 311						
Total		**17**	**15**	**6**		**Total**		**16**	**15**	**3**	

SUMMER SESSION					
Course No.	Course name	Total credit	Weekly hours		Prerequisite
			Lecture	Lab	
NE 490	Engineering Training	3	-	-	Completion of 117 credit hours
Total		**3**	**-**	**-**	

Fifth YEAR											
First semester						Second semester					
Course No.	Course name	Total credit	Weekly hours		Prerequisite	Course No.	Course name	Total credit	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
	Department Elective	3	3	-	-		Department Elective	3	3	-	-
	Department Elective	3	3	-	-	UE	University Elective	3	3	-	-
UE	University Elective	3	3	-	-						
NE 521	Nuclear Reactor Safety	3	3	-	NE 451	MS 100	Military Sciences	3	3	-	-
NE 591	Graduation Project I	1	-	-	Completion of 117 Cr	NE 592	Graduation Project II	3	-	-	NE 490, NE 591
Total		**13**	**12**	**-**		**Total**		**12**	**9**	-	

Nuclear Engineering Department Course Description

NE 201: Ethics & Development of Nuclear Technology (1, 0) 1Cr. (This course can be offered electronically)
Ethical issues arising from the development of nuclear technology, and our ability to address, deal, and resolve them. Case studies will be emphasized. The course also addresses issues important to the Nuclear Engineering profession, individual working skills, team working, oral presentation, and writing skills.

Pre: None

NE 203: Fundamentals of Nuclear Science (3, 0) 3Cr.
Atomic and nuclear physics, atomic models, relativity, dual properties of matter, quantum numbers and mechanics, atomic and nuclear structure, the hydrogen atom and many-electrons atoms, nuclear transformations (alpha, beta, and gamma decay), and chart of nuclides, nuclear structure, and nuclear models. Other topics related to nuclear sciences and technology.

Pre: Passing Phys 102

NE 204: Applied Engineering Statistics (3, 0) 3Cr.
Basic concepts of probability; rules of probability, conditional probability, independence conditional probability. Random variables: introduction, discrete and continuous, probability mass and density functions, cumulative distribution function. Common discrete and continuous distributions. Descriptive Statistics: Describing and summarizing data sets, Histogram, Statistical distributions; Inferential statistics: hypothesis testing, significance levels. Correlation, simple linear and multiple regression. The goodness of fit tests.

Pre: MATH 203

NE 206: Introduction to Nuclear Engineering (3, 0) 3Cr.
Fundamentals of atomic-scale units; mass, binding energy, and energy levels; types of nuclear reactors and nuclear power; components of nuclear power station; fission chain reaction kinetics; interaction of neutron with matter; interactions of gamma radiation with matter; interaction of charged particles with matter; nuclear data preparation and cross-section data library.

Pre: Passing NE 203

NE 311: Ionizing Radiation Detection and Measurement (3, 0) 3Cr.
Radiation Sources and their characteristics, review on the interaction of radiation with matter, Statistical fluctuation and error propagation, Characteristics of various nuclear radiation detectors. Gas-filled detectors, scintillation detectors, semiconductor diode detectors, neutron detection techniques

Pre: NE 204, Passing NE 203

NE 312: Radiation Detection and Measurement Lab I (0, 3) 1Cr.
Nuclear electronics, radiation detection, and counting instrumentation, counting statistics, radiation survey, half-life, and decay schemes.

Pre: NE 311

NE 322: Radiation Protection and Dosimetry (3, 0) 3Cr.
Principles of radiation protection, biological effects of radiation, radiation risk assessment, external and internal dosimetry.

Pre: NE 311

NE 340: Nuclear Reactors Theory (3, 0) 3Cr
Review on neutron interactions, center of mass system, differential cross-section, compound nucleus formation model, optical model, theory of total neutron cross-section, Doppler broadening, neutron current and flux, neutron transport theory, one-speed neutron diffusion theory, neutron moderation in hydrogenous and non-hydrogenous medium, slowing down density , conditions for criticality of nuclear reactors, Four and six-factor formula, neutrons economy, infinite reactor, reflector saving, and boundary conditions.

Pre: Passing NE 206, EE 305

NE 351: Signals and Control systems (3, 0) 3Cr.
Discrete and continuous-time signals and systems: classifications, convolution and impulse response. Fourier series and Fourier transform. Laplace transform. Z-transform. Introduction to control theory. Applications in nuclear engineering.

Pre: EE 212, Co EE 204

NE 372: Computational Techniques in Nuclear Engineering (3, 0) 3Cr.
This course is designed to keep the nuclear engineering student up to date with modern techniques, programming languages, and computer codes in nuclear engineering. Methods of modeling radiation problems, the generation of pseudo-random numbers, sampling from a different probability distribution, simulation designs, validation of a simulation model, variance reduction techniques. Introduction to modern computer codes used in nuclear engineering.

Pre: NE 114, Co NE 340

NE 413: Radiation Detection and Measurement Lab II (0, 3) 1Cr.
Gamma, alpha, and beta detectors, gamma spectroscopy, coincidence counting, proportional counters, HPGe detectors, spectrum analysis, scintillation detectors for charged particles. Neutrons moderation and interactions experiments.

Pre: NE 312

NE 431: Nuclear Reactors Thermal Hydraulics (3, 0) 3Cr.
Reactor heat generation and removal, steady- and unsteady state conduction in reactor elements; single-phase, two-phase, cooling, core thermal design.

Pre: CHE 242, ME 451

NE 441: Nuclear Reactors Analysis (3, 0) 3Cr.
The Multi-group diffusion theory, diffusion method, heterogeneous reactors, reactor kinetics, changes in reactivity, the neutronic behavior of fission reactors, thermal neutron spectra, fine group whole spectrum calculations and coarse group constant generation.

Pre: Passing NE 340

NE 448: Nuclear Reactor Lab (2, 3) 3Cr.
Experimental measurements of basic nuclear reactor parameters, flux measurement, reactor period, approach to critical. Reactor operation and reactor safety. Neutron activation analysis.

Pre: NE 413, NE 441

NE 451: Nuclear Power Plant Systems and Operations I (3, 0) 3Cr.
Description of light waterpower plants systems, NSSS system, secondary systems, reactor safety systems, plant layout, steam cycles, electrical, mechanical, and nuclear system components, practical aspects of NPP system operation

Pre: Co NE 431, NE 340

NE 452: Nuclear Instrumentation & Control (3, 0) 3Cr.
Nuclear digital I&C (Instrumentation & Control) that is related to the systems, which receive thousands of plant field signals and process them to control the nuclear plants in normal and abnormal conditions.

Pre: NE 340, NE 351

NE 460: Fuel Cycle and Waste Management (3, 0) 3Cr.
The front and back end of the fuel cycle, management of radioactive, hazardous and mixed waste generated by all segments of the nuclear fuel cycle and users of radioisotopes; includes treatment, storage, and disposal technologies.

Pre: NE 441

NE 465: Nuclear Reactor Materials (3, 0) 3Cr.
Nuclear reactor materials, fuel element, fission gas swelling, void swelling, cladding, moderators, materials thermal properties, chemical behavior, and radiation damage. Displacements cascade damage and crystal effects (focusing/channeling), collective effects, fast neutron damage, sputtering, point defect formation and diffusion, defects reaction theory, hardening, embrittlement, and irradiation creep.

Pre: NE 340 & IE 363

NE 471: Radiation Interactions and Shielding Design (3, 0) 3Cr.
Basic principles of radiation interactions and transport especially as related to the design of radiation shields. Radiation sources, nuclear reactions, radiation transport, photon interactions, dosimetry, buildup factors, and fast neutron shielding.

Pre: NE 311

NE 472: Modeling and Simulation of Nuclear Reactors (3, 0) 3Cr.
Numerical solution of neutron transport and diffusion equations, 3-D matrix flux in a nuclear reactor, Analysis of radiation transport problems by Monte Carlo method, use of MCNP code, nuclear reactor neutronics modeling and simulation, reactor thermal-hydraulic modeling.

Pre: NE 441

NE 482: Nuclear Engineering Seminar (1, 0) 1 Cr.
Seminar of nuclear engineering issues, each lecture is presented by a faculty member or invited local and international nuclear engineers, researchers, policymakers, and industry people. Students are also asked to give presentations on selected topics.

Pre: Completion of 100 Cr

NE 490: Engineering Training (0, 9) 3Cr.
Training at a nuclear or radiation facility, which is involved in the design or utilization of nuclear energy.

Pre: Completion of 117 Cr

NE 500: Economic & Environmental Aspects of Nuclear Energy (3, 0) 3Cr.
Economics of nuclear power, economic and environmental impact, the nuclear fuel cycle. Impact on design, plant sitting, regulation, and international laws.

Pre: NE 451

NE 501: Non-Power Applications of Nuclear Energy (3, 0) 3Cr. (This course can be offered electronically)
Applications of nuclear energy in space exploration, agricultural, medical, industrial, and biomedical, and other related non-power generation fields.

Pre: NE 413, NE 340

NE 521: Nuclear Reactor Safety (3, 0) 3Cr.
Nuclear reactor safety and probabilistic risk assessment. Analysis and evaluation applied to reactor design for accident prevention and mitigation; protective systems and their reliability, containment design, emergency cooling requirements, reactivity excursions and the atmospheric dispersion of radioactive material.

Pre: NE 451

NE 525: Environmental Radioactivity (2, 3) 3Cr.
Radioactivity in the environment, traces in the air, water, soil. Pathways of contamination.

Pre: NE 413 & NE 322

NE 526: Nuclear Security and Safeguards (3, 0) 3Cr.
This course focuses on the key elements of nuclear security and safeguards. It examines methods for planning and evaluating nuclear security activities at the State and facility level, establishing nuclear security culture in different types of nuclear and radiological installations, and examines information security measures. Topics include an overview of the subject area, legal framework, principles of safeguards, nuclear materials accountancy, information security, interrelationships between safety, security and safeguards, security culture, and applications of nuclear security.

Pre: NE 465

NE 552: Nuclear Power Plant Systems and Operations II (3, 0) 3Cr.
LW power plant systems requirements and design parameters. Systems required for steam production, cooling of core in all modes of operation, and safe and efficient plant operation. NPP blueprints and systems components recognition, and processes flow. Safety analysis report.

Pre: NE 451

NE 560: Radiochemistry (2, 3) 3Cr.
The chemistry of radioactive material, transuranic elements, the effect of radiation on the chemical properties of a material.

Pre: NE 413, IE 363

NE 571: In core Fuel Management (3, 0) 3Cr.
In core fuel management, and optimization of fuel cycle loading and design, reactor vender's codes.

Pre: NE 441, NE 472

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NE 579: Nuclear Reactor Design Methodology (3, 0) 3Cr.
Application of reactor theory and other engineering disciplines in the fundamental and practical design of nuclear reactor systems for power applications. Use of computer codes in calculations, design, and optimization.

Pre: NE 472

NE 581: Special Topics in Nuclear Engineering (3, 0) 3 Cr.
Special nuclear engineering issues that are not covered in the current curriculum, problems related to recent developments and practice, as well as related current literature.

Pre: Department Approval

NE 591: Graduation Project I. 1Cr.
Nuclear Engineering Graduation Design.

Pre: Completion of 117 Cr

NE 592: Graduation Project II. 3Cr.
Nuclear Engineering Graduation Design. Meeting with the instructor, Final Report, and presentation.

Pre: NE 490, NE 591