DEPARTMENT OF NUCLEAR ENGINEERING

The Department of Nuclear Technology (former name) or the Department of Nuclear Engineering was established in 1972 with the main purpose to train students planning a career in nuclear energy. The department offers programs leading to degrees in Doctor of Engineering (D.Eng.) in Nuclear Engineering, Master of Engineering (M.Eng.), Master of Science (M.Sc.) in Nuclear Technology and Bachelor of Engineering in Nuclear and Radiological Engineering. The curriculum is a multidisciplinary one and structured to cover diversified principles of nuclear technology ranging from fundamental science and mathematics to specialized engineering applications. Areas of specialization include nuclear power engineering, environmental and industrial applications of radiation, nuclear instrumentation, radioisotope production, radiation processing, radiation protection and nuclear materials. Most of the graduates entered the government institutions such as Office of Atoms for Peace (OAP), Thailand Institute of Nuclear Technology (TINT) public and private universities, Electricity Generating Authority of Thailand (EGAT), Department of Medical Sciences and various industrial and medical sectors.

At present, the use of nuclear energy in industry is increasing. Thus, there is a need for personnel in this specialized field for safety control and research & development leading to proper, efficient and safe use of radioisotopes including develop techniques and instruments for in-house use. Furthermore, preparations of personnel with solid background in nuclear engineering is crucial to the future decision to use nuclear energy in generating electricity, if necessary.

HEAD :

Sunchai	Nilsuwankosit,	Ph.D. (Wisconsin)

ASSOCIATE PROFESSORS :

Somyot	Srisatit,	M.Eng. (Chula)
Supitcha	Chanyotha,	Ph.D. (Arizona)
Sunchai	Nilsuwankosit,	Ph.D. (Wisconsin)
Doonyapong	Wongsawaeng,	Ph.D. (Berkeley)

ASSISTANT PROFESSORS :

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LECTURERS :

Decho	Thong-Aram,	M.Eng. (Chula)
Chadet	Yenchai,	M.Sc. (Chula)
Phongphaeth	Pengvanich	Ph.D. (Michigan)
Somboon	Rassame	Ph.D. (Purdue)
Phannee	Saengkaew	Ph.D. (Magdeburg)

NAME OF THE DEGREE

: Doctor of Philosophy
: Ph.D.

ADMISSION

The applicant must submit an application under one of the following Admission Types.

Type 1.1: Ph.D. with Nuclear Background

The applicant must have a Master's Degree in Nuclear Engineering or Nuclear Technology; meet the requirements of the Graduate School; have a minimum grade point average of 3.50 (out of 4); and have at least one good-quality international publication (conference or journal).

Type 1.2: Master's continuing Ph.D with Nuclear Background

The applicant must have a Bachelor's Degree in Nuclear Engineering from Chulalongkorn University; meet the requirements of the Graduate School; obtain at least an honor-level grade; and have at least one international publication (conference or journal).

Type 2.1: Ph.D. with Non-Nuclear Background

The applicant must have a Master's Degree in Science or Engineering (non-nuclear); meet the requirements of the Graduate School; and have a minimum grade point average of 3.50.

Type 2.2: Master's continuing Ph.D. with Non-Nuclear Background

The applicant must have a Master's Degree in Engineering (non-nuclear) from Chulalongkorn University; meet the requirements of the Graduate School; and obtain at least an honor-level grade.

FIELDS OF STUDY

The student must concentrate on one of the following fields of study:
- Nuclear Engineering
- Nuclear Security and Safeguards

DEGREE REQUIREMENTS

The student entering under
- Admission Type 1.1 must pass 49 credits of dissertation course;
- Admission Type 1.2 must pass 74 credits of dissertation course;
- Admission Type 2.1 must pass 13 credits of the specific required courses (see COURSE REQUIREMENTS) and pass 36 credits of dissertation course;
- Admission Type 2.2 must pass 13 credits of the specific required courses (see COURSE REQUIREMENTS), pass 9 credits of the specific elective courses, pass 3 credits of the general elective courses, and pass 49 credits of dissertation course.

Every student must also
- pass total of 6 credits of the general required courses (see COURSE REQUIREMENTS);
- pass a qualification examination;
- present an acceptable dissertation and pass an oral examination; publish at least 1 research paper related to the dissertation work in an international research journal;
- present the dissertation work in a national or international symposium; and meet publication requirements of the Graduate School.

COURSE REQUIREMENTS

Courses are divided into prerequisite, general required, specific required, general elective, specific elective, and thesis courses. Course requirements may vary depending on the field of study and the study plan.
0) Prerequisite Courses

Student with insufficient background knowledge of mathematics and/or nuclear engineering must take

2111600 Nuclear Engineering I *

3(3-0-9)
2111631 Applied Mathematics in Nuclear Technology *
3(3-0-9)
*Non-credit course. Student is given S (atisfied) /U (nsatisfied) instead of letter grades.

Student with Admission Type 1.1 or 1.2 with insufficient practical knowledge of experimental nuclear must take ONE of the following courses

2111603 Radiation Detection and Measurements Laboratory *
1(0-3-7)
2111604 Radiation Detectors and Nuclear Instruments Laboratory * 1(0-3-7)
2111659 Methods and Instrumentation for Nuclear Security and Safeguards Laboratory *
1(0-3-7)
*Non-credit course. Student is given S(atisfied)/U(nsatisfied) instead of letter grades.

Student may be exempted from doing so upon receiving approval from the Programme Board. Proof of prior knowledge on the subject is required.

1) General Required Courses:

All of the following courses are required for all Admission Types (1.1, 1.2, 2.1, and 2.2) for the total of 6 credits.

2111801	Seminar in Nuclear Engineering I *	2(2-0-6)
2111802	Seminar in Nuclear Engineering II *	2(2-0-6)
2111803	Seminar in Nuclear Engineering III*	2(2-0-6)

*Non-credit course. Student is given S(atisfied) /U (nsatisfied) instead of letter grades.

2) Specific Required Courses:

The following courses are required for Admission Types 2.1 and 2.2 for the total of 13 credits

2.1) Nuclear Engineering Field of Study: All of the following courses are required for the total of 13 credits.

2111604	Radiation Detectors and Nuclear Instruments Laboratory	1(0-3-7)
2111613	Radiation Safety and Shielding	3(3-0-9)
2111642	Nuclear Reactor Engineering	3(3-0-9)
2111643	Nuclear Power Engineering	3(3-0-9)
2111663	Radiation Detectors and Nuclear Instruments	3(3-0-9)

2.2) Nuclear Security and Safeguards Field of Study: All of the following courses are required for the total of 13 credits.

2111610	Nuclear Security	3(3-0-9)
2111651	Weapon Mass Destruction Nonproliferation	3(3-0-9)
2111658	Methods and Instrumentation for Nuclear Security and Safeguards	3(3-0-9)
2111659	Methods and Instrumentation for Nuclear Security and Safeguards Laboratory	1(0-3-7)

and select from ONE of the following courses

2111642	Nuclear Reactor Engineering	3(3-0-9)
2111643	Nuclear Power Engineering	3(3-0-9)

3) Specific Elective Courses minimum 12 credits

3.1) Nuclear Engineering Field of Study : Choose from the following courses; minimum of 9 credits are required.

2111603	Radiation Detection and Measurements Laboratory	1(0-3-7)
2111607	Environmental Radiation Measurements	3(3-0-9)
2111608	Practical Radiation Detection and Measurements	3(3-0-9)
2111609	Radiation Dosimetry	3(3-0-9)
2111616	Environmental Impact of Nuclear Power Plant	3(3-0-9)
2111621	Radiation Chemistry and Processing	3(3-0-9)
2111626	Industrial Radiation and Radioisotope Applications	3(2-3-7)
2111627	Material Analysis by Nuclear Techniques	3(3-0-9)
2111628	Radioisotope Production and Utilization	3(3-0-9)
2111629	Nuclear Chemical Engineering	3(3-0-9)
2111632	Numerical calculation for Nuclear Engineering	3(3-0-9)
2111640	Nuclear Reactor Control	3(3-0-9)
2111646	Radioactive Waste Management	3(3-0-9)
2111647	Nuclear Fuels and Nuclear Fuel Cycles	3(3-0-9)
2111648	Nuclear Power Plant Systems and Operation	3(2-3-7)
2111650	Introduction to Plasma Physics and Nuclear Fusion	3(3-0-9)
2111655	Computer Application in Nuclear Technology	3(3-0-9)
2111660	Industrial Radiation Imaging	3(3-0-9)
2111661	Experimental Nuclear Engineering	3(2-3-7)
2111662	Nuclear Electronics	3(3-0-9)
2111664	Digital Computer Interfacing for Nuclear Instrument	3(3-0-9)
2111666	Radiation Machines	3(3-0-9)
2111678	Nuclear Materials Engineering	3(3-0-9)
2111683	Current Topics in Nuclear Engineering	3(3-0-9)
2111687	Special Topics in Nuclear Engineering	3(3-0-9)

3.2) Nuclear Security and Safeguards Field of Study: Choose from the following courses; minimum of 9 credits are required.

2111652	Strategic Trade Control	3(3-0-9)
2111653	Nuclear Safeguards	3(3-0-9)
2111654	Nuclear Fuel Cycle and Environmental Impacts	3(3-0-9)
2111656	Physical Protection of Nuclear Materials and Facilities I	3(3-0-9)
2111657	Advanced Detection Technologies for Radioactive and Nuclear Materials	3(3-0-9)

4) General Elective Course

Both fields of study: Student must take 3 credits of the courses available in the Master of Engineering in Nuclear Engineering Program.

5) Dissertation

Number of required credits depends on student's admission type.

For Admission Types 1.1 and 2.2 : 49 credits of the following course

2111829 Dissertation
(Student may register for this course multiple times. The number of credits for each registration depends upon the agreement between the student and his/her thesis advisor.)

For Admission Type 2.1 : 36 credits of the following course

2111826 Dissertation
(Student may register for this course multiple times. The number of credits for each registration depends upon the agreement between the student and his/her thesis advisor.)

For Admission Type 1.2 : 74 credits of the following course

2111830 Dissertation
(Student may register for this course multiple times. The number of credits for each registration depends upon the agreement between the student and his/her thesis advisor.)

NAME OF THE DEGREE

: Master of Engineering
: M.Eng.

ADMISSION

The applicant must have received a Bachelor's Degree in engineering or a Bachelor Degree of equivalent related field, must meet the requirements of the Graduate School and also must pass the entrance examination administered by the department.

DEGREE REQUIREMENTS

A student must pass a minimum of 15 credits of the required courses and another 12 credits from elective courses, a total of 27 credits.

A student must present an acceptable thesis and pass an oral examination in the field of Nuclear Technology for a quantity of 12 credits.

A student who has fulfilled the requirements of the program with a passing grade not less than 3.00 within a period of study of not less than 4 regular semesters and not more than 8 regular semesters will be awarded the Degree of Master of Engineering in Nuclear Technology.

FIELDS OF STUDY

The student must concentrate on one of the following fields of study:

- Nuclear Engineering
- Nuclear Security and Safeguards

STUDY PLAN

In each field of study, two study plans are possible:
A-1 Full thesis plan
A-2 Coursework and thesis plan

DEGREE REQUIREMENTS

For A-1 plan, the student must

- pass 2 credits of the required courses (see COURSE REQUIREMENTS);
- pass a minimum of 37 credits of the thesis course;
- present an acceptable thesis and pass an oral examination;
- meet publication requirements of the Graduate School; and
- obtain "satisfied (S)" grade in all courses within the allowed period of study (no less than 4 and no more than 8 regular semesters).

For A-2 plan, the student must

- pass a minimum of 27 credits of the required and the elective courses (see COURSE REQUIREMENTS);
- pass total of 12 credits of the thesis course;
- present an acceptable thesis and pass an oral examination;
- meet publication requirements of the Graduate School; and
- obtain a passing grade point average (GPA) of no less than 3.00 within the allowed period of study (no less than 4 and no more than 8 regular semesters).

COURSE REQUIREMENTS

Courses are divided into prerequisite, general required, specific required, general elective, specific elective, and thesis courses. Course requirements may vary depending on the field of study and the study plan.

A-1 Plan

0) Prerequisite Courses

Student with insufficient background knowledge of nuclear engineering must take

2111600 Nuclear Engineering I * 3(3-0-9)
*Non-credit course. Student is given S (atisfied) /U (nsatisfied) instead of letter grades.

Student may be exempted from the course upon receiving approval from the Programme Board. Proof of prior knowledge on the subject is required.

1) General Required Courses

Both fields of study: The following courses are required for the total of 2 credits.

2111701	Seminar in Nuclear Technology I *	1(1-0-3)
2111702	Seminar in Nuclear Technology II *	1(1-0-3)

2) Thesis Course

Both fields of study: 37 credits of the following course are required.

2111812 Thesis
(Student may register for this course multiple times. The number of credits for each registration depends upon the agreement between the student and his/her thesis advisor. S(atisfied)/U(nsatisfied) is given instead of letter grades.)

A-2 Plan

0) Prerequisite Courses

Student with insufficient background knowledge of nuclear engineering must take

2111600 Nuclear Engineering I * 3(3-0-9)
*Non-credit course. Student is given S (atisfied) /U (nsatisfied) instead of letter grades.

Student may be exempted from the course upon receiving approval from the Programme Board. Proof of prior knowledge on the subject is required.

1) General Required Courses

Both fields of study: The following courses are required for the total of 2 credits.

2111701	Seminar in Nuclear Technology I	1(1-0-3)
2111702	Seminar in Nuclear Technology II	1(1-0-3)

2) Specific Required Courses

2.1) Nuclear Engineering Field of Study: All of the following courses are required for the total of 13 credits.

2111604	Radiation Detectors and Nuclear Instruments Laboratory	1(0-3-7)
2111613	Radiation Safety and Shielding	3(3-0-9)
2111642	Nuclear Reactor Engineering	3(3-0-9)
2111643	Nuclear Power Engineering	3(3-0-9)
2111663	Radiation Detectors and Nuclear Instruments	3(3-0-9)

2.2) Nuclear Security and Safeguards Field of Study: All of the following courses are required for the total of 13 credits.

2111610	Nuclear Security	3(3-0-9)
2111651	Weapon Mass Destruction Nonproliferation	3(3-0-9)
2111658	Methods and Instrumentation for Nuclear Security and Safeguards	3(3-0-9)
2111659	Methods and Instrumentation for Nuclear Security and Safeguards Laboratory	1(0-3-7)

and select from ONE of the following courses

2111642	Nuclear Reactor Engineering	3(3-0-9)
2111643	Nuclear Power Engineering	3(3-0-9)

3) Specific Elective Courses minimum 12 credits

3.1) Nuclear Engineering Field of Study : Choose from the following courses; minimum of 9 credits are required.

2111603	Radiation Detection and Measurements Laboratory	1(0-3-7)
2111607	Environmental Radiation Measurements	3(3-0-9)
2111608	Practical Radiation Detection and Measurements	3(3-0-9)
2111609	Radiation Dosimetry	3(3-0-9)
2111616	Environmental Impact of Nuclear Power Plant	3(3-0-9)
2111621	Radiation Chemistry and Processing	3(3-0-9)
2111626	Industrial Radiation and Radioisotope Applications	3(2-3-7)
2111627	Material Analysis by Nuclear Techniques	3(3-0-9)
2111628	Radioisotope Production and Utilization	3(3-0-9)
2111629	Nuclear Chemical Engineering	3(3-0-9)
2111632	Numerical calculation for Nuclear Engineering	3(3-0-9)
2111640	Nuclear Reactor Control	3(3-0-9)
2111646	Radioactive Waste Management	3(3-0-9)
2111647	Nuclear Fuels and Nuclear Fuel Cycles	3(3-0-9)
2111648	Nuclear Power Plant Systems and Operation	3(2-3-7)
2111650	Introduction to Plasma Physics and Nuclear Fusion	3(3-0-9)
2111655	Computer Application in Nuclear Technology	3(3-0-9)
2111660	Industrial Radiation Imaging	3(3-0-9)
2111661	Experimental Nuclear Engineering	3(2-3-7)
2111662	Nuclear Electronics	3(3-0-9)
2111664	Digital Computer Interfacing for Nuclear Instrument	3(3-0-9)
2111666	Radiation Machines	3(3-0-9)
2111678	Nuclear Materials Engineering	3(3-0-9)
2111683	Current Topics in Nuclear Engineering	3(3-0-9)
2111687	Special Topics in Nuclear Engineering	3(3-0-9)

3.2) Nuclear Security and Safeguards Field of Study: Choose from the following courses; minimum of 9 credits are required.

2111652	Strategic Trade Control	3(3-0-9)
2111653	Nuclear Safeguards	3(3-0-9)
2111654	Nuclear Fuel Cycle and Environmental Impacts	3(3-0-9)
2111656	Physical Protection of Nuclear Materials and Facilities I	3(3-0-9)
2111657	Advanced Detection Technologies for Radioactive and Nuclear Materials	3(3-0-9)

4) General Elective Course

Both fields of study: Student must take 3 credits of the courses available in the Master of Engineering in Nuclear Engineering Program.

5) Thesis

For A1 plan

2111811	Thesis	12 credits

For A2 plan

2111817	Thesis	37 credits

NAME OF DEGREE

: Master of Science
: M.Sc.

ADMISSION

The degree of Master of Science in Nuclear Technology is offered under the general regulations of the Graduate School. The program is intended to those students who plan a career of research related to nuclear technology. The courses cover basic nuclear science & technology, radiation protection, radiation measurement, application of radiation and radioisotope, nuclear materials and radiation chemistry & processing. From November 2013, the program also includes courses related to nuclear security and safeguards.

To be eligible for admission to the program an applicant must hold a Bachelor's degree in science, applied science, technology or engineering. Applicants are required to take the entrance examination administered by the department**.**

DEGREE REQUIREMENTS

The program consists of 27 credits of courses, 12 credits of required courses and 15 credits of electives. To graduate a, student must present an acceptable thesis and pass an oral examination for a quantity of 12 credits.

A student who has fulfilled the requirements of the program with the cumulative GPA of not less than 3.00 with a period of study not less than 4 regular semesters and not more than 8 regular semesters will be awarded a Degree of Master of Science in Nuclear Technology with concentration in Nuclear Technology or in Nuclear Security and Safeguards.

FIELDS OF STUDY

The student must concentrate on one of the following fields of study:

- Nuclear Technology
- Nuclear Security and Safeguards

COURSE REQUIREMENTS

Courses are divided into prerequisite, general required, specific required, general elective, specific elective, and thesis courses. Course requirements may vary depending on the field of study and the study plan.

0) Prerequisite Courses

Student with insufficient background knowledge of nuclear engineering must take

2111601*	Introduction to Nuclear science and Technology	3(3-0-9)
2111631*	Applied Mathematics in Nuclear Technology	3(3-0-9)

*Non-credit course. Student is given S (atisfied) /U (nsatisfied) instead of letter grades.

Student may be exempted from the course upon receiving approval from the Programme Board. Proof of prior knowledge on the subject is required.

1) General Required Courses

Both fields of study: The following courses are required for the total of 2 credits.

2111701	Seminar in Nuclear Technology I	1(1-0-3)
2111702	Seminar in Nuclear Technology II	1(1-0-3)

2) Specific Required Courses

2.1) Nuclear Technology Field of Study: All of the following courses are required for the total of 10 credits

2111603	Radiation Detection and Measurement Laboratory	1(0-3-7)
2111608	Practical Radiation Detection and Measurement	3(3-0-9)
2111612	Radiation Protection	3(3-0-9)
2111684	Current Topics in Nuclear Technology	3(3-0-9)

2.2) Nuclear Security and Safeguards Field of Study : All of the following courses are required for the total of 10 credits.

2111610	Nuclear Security	3(3-0-9)
2111651	Weapon Mass Destruction Nonproliferation	3(3-0-9)

2111658 Methods and Instrumentation for Nuclear Security and Safeguards 3(3-0-9)
2111659 Methods and Instrumentation for Nuclear Security and Safeguards Laboratory 1(0-3-7)

3) Specific Elective Courses minimum 9 credits

3.1) Nuclear Technology Field of Study: Choose from the following courses; minimum of 9 credits are required.

2111604 Radiation Detectors and Nuclear Instruments Laboratory 1(0-3-7)
2111607 Environmental Radiation Measurements 3(3-0-9)
2111609 Radiation Dosimetry 3(3-0-9)
2111613 Radiation Safety and Shielding 3(3-0-9)
2111616 Environmental Impact of Nuclear Power Plant 3(3-0-9)
2111621 Radiation Chemistry and Processing 3(3-0-9)
2111626 Industrial Radiation and Radioisotope Applications 3(2-3-7)
2111627 Material Analysis by Nuclear Techniques 3(3-0-9)
2111628 Radioisotope Production and Utilization 3(3-0-9)
2111629 Nuclear Chemical Engineering 3(3-0-9)
2111632 Numerical calculation for Nuclear Engineering 3(3-0-9)
2111640 Nuclear Reactor Control 3(3-0-9)
2111646 Radioactive Waste Management 3(3-0-9)
2111647 Nuclear Fuels and Nuclear Fuel Cycles 3(3-0-9)
2111648 Nuclear Power Plant Systems and Operation 3(2-3-7)
2111650 Introduction to Plasma Physics and Nuclear Fusion 3(3-0-9)
2111655 Computer Application in Nuclear Technology 3(3-0-9)
2111660 Industrial Radiation Imaging 3(3-0-9)
2111662 Nuclear Electronics 3(3-0-9)
2111663 Radiation Detectors and Nuclear Instruments 3(3-0-9)
2111664 Digital Computer Interfacing for Nuclear Instrument 3(3-0-9)
2111666 Radiation Machines 3(3-0-9)
2111678 Nuclear Materials Engineering 3(3-0-9)
2111683 Current Topics in Nuclear Engineering 3(3-0-9)
2111686 Special Topics in Nuclear Technology 3(3-0-9)

3.2) Nuclear Security and Safeguards Field of Study: Choose from the following courses; minimum of 9 credits are required.

2111652 Strategic Trade Control 3(3-0-9)
2111653 Nuclear Safeguards 3(3-0-9)
2111654 Nuclear Fuel Cycle and Environmental Impacts 3(3-0-9)
2111656 Physical Protection of Nuclear Materials and Facilities I 3(3-0-9)
2111657 Advanced Detection Technologies for Radioactive and Nuclear Materials 3(3-0-9)

4) General Elective Course

Both fields of study: Student must take 6 credits of the courses available in the Master of Science in Nuclear technology Program.

5) Thesis

2111811 Thesis 12 credits

NUCLEAR AND RADIOLOGICAL ENGINEERING CURRICULUM
FIRST YEAR CURRICULUM
COMMON TO ALL ENGINEERING STUDENTS

COURSE NO.	SUBJECT	CREDITS
	THIRD SEMESTER	
2103213	ENG MECHANICS I	3
2103241	THERMODYNAMICS I	3
2111200	ESS NUC ENG	3
2111202	BAS NUC DET	3
2111203	NUC RAD LAB	1
2111204	HEA PHY RAD	3
2111205	INT NUC MAT	3
		19
	FORTH SEMESTER	
2104223	ENG STAT I	3
2111206	NUC PLA TEC	3
2102391	ELEC ENG I	3
2102392	ELEC ENG LAB I	1
2103351	FLUID MECHANICS I	3
2111208	NUC REAC ANALYSIS	3
5500208	COM PRES SKIL	3
		19
	FIFTH SEMESTER	
2100311	ENG ESSENTIALS	3
2111301	ENV ASP NUC	3
2111308	ELE CIR NUC	3
2111306	IND RAD MAT	3
2111307	IND RAD LAB	1
2111312	NUC3S	3
5500308	TECH WRIT ENG	3
		19

COURSE NO.	SUBJECT	CREDITS
	SIXTH EMESTER	
2111311	RAD MAC I	3
2111303	ENV ASP NUC	3
2111304	PRI NUC INS	3
2111305	NUC INS LAB	1
2111310	NUC REA SAF	3
2111309	NUC REA LAB	1
2111401	SEM NUC ENG	1
xxxxxxx	APPROVED ELECTIVES 3	
		18
	SUMMER SEMESTER	
2100301	ENGINEERING PRACTICE	2
	SEVENTH SEMESTER	
2104203	ENG MANAGEMENT	3
2111402	PRO NUC ENG I	1
2111444	SOC SCI NUE	3
xxxxxxx	APPROVED ELECTIVES	3
xxxxxxx	GENERAL EDUCATION	6
xxxxxxx	FREE ELECTIVE	3
		19
	EIGHTH SEMESTER	
2111403	PRO NUC ENG II	1
xxxxxxx	APPROVED ELECTIVES 3	
xxxxxxx	GENERAL EDUCATION	6
xxxxxxx	FREE ELECTIVE	3
		13

TOTAL CREDITS FOR GRADUATION = 145

COURSE DESCRIPTIONS IN NUCLEAR AND RADIOLOGICAL ENGINEERING (B.ENG.)

2111200 Essence of Nuclear Engineering 3(3-0-6)

Atomic physics and nuclear physics; interaction between radiation and matters; neutron calculations; types of nuclear reactors; generation of nuclear reactors; applications of nuclear technology and radioisotopes; research reactor; Thailand nuclear power program; other topics of interest in nuclear engineering.

2111202 Basic Principle of Nuclear Radiation Detection and Measurement 3(3-0-6)

Radiation sources; nuclear radiation properties; interaction of radiation with matter, statistics of radiation counting; characteristics of various nuclear radiation detectors; relative and absolute measurements.

2111203 Nuclear Radiation Detection and Measurement Laboratory 3(3-0-6)

Laboratory works on nuclear radiation properties; interaction of radiation with matter; characterization of various nuclear radiation detectors; statistical errors of radiation counting; relative and absolute measurements; nuclear radiation spectroscopy.

2111204 Health Physics and Radiation Protection 3(3-0-6)

Basic concepts of radiation; interactions with tissue; biological effects of radiation; radiation detection and dosimetry; dose limits& regulatory issues; protection from external radiation; internal radiation hazard; surface contamination and decontamination; calculation of internal and external body radiation exposure dose; calculation of gamma and x-ray shielding; clinical applications.

2111205 Introduction to Nuclear Materials 3(3-0-6)

Nuclear fuel cycle; uranium resources in Thailand; uranium extraction from seawater; materials used in nuclear power plants; crystal structures of metals; point defect in metals; diffusion in solids; non-permanent and permanent deformation; dislocation theory; creep; grain and grain growth; generation of fission gas and release; effect of radiation on structure and properties of materials.

2111206 Nuclear Power Plant Technology 3(3-0-6)

Introduction to nuclear power plant technologies, pressurized water reactor, boiling water reactor, otheradvanced reactor types, Thermodynamics of nuclear power plants, rankine cycle, thermal design of nuclear reactors, reactor heat generation, single phase heat transfer, two phase heat transferin nuclear reactor.

2111208 Nuclear Reactor Analyis 3(3-0-6)

Production and characteristics of neutrons; the fission process; neutron diffusion theory; slowing-down theory; Fermi theory of the bare thermal reactor; one- and multi-group diffusion methods; basic principles of nuclear reactor kinetics.

2111301 Environmental Aspects of Nuclear Engineering 3(3-0-6)

Environmental Aspects of Nuclear Engineering al impact of nuclear power plants; Impact of nuclear fuel cycle; radionuclides released from nuclear power plants; atmospheric diffusion; marine diffusion; dispersion simulation using computer codes; types of radioactive waste; radioactive waste transport; radioactive waste management; spent fuel transport; spent fuel management.

2111303 Industrial Control Electronics 3(3-0-6)

Principle of industrial control systems; transducer devices e.g. temperature, pressure, humidity, strain/stress; signal conditioning; industrial equipment; analog and digital control system; data transmission/receiving with computer.

2111304 Principle of Nuclear Instrument 3(3-0-6)

Properties of radiation; interaction of radiation with matter; radiation detectors; standard NIM and CAMAC instrumentation system; principle of nuclear instruments e.g. low voltage power supply, high voltage power supply, pre-amplifier, main-amplifier, rate meter, single channel analyzer, counter and timer, multi-channel analyzer radiation detection system setting.

2111305 Nuclear Instrument Laboratory 1(0-3-0)

Operation of nuclear instrumentation laboratory e.g. low voltage power supply, high voltage power supply, pre-amplifier, main-amplifier, rate meter, single channel analyzer, counter and timer, radiation detection system setting.

2111306 Industrial Uses of Radiation and Radioactive Material 3(3-0-6)

Basic principle of nuclear techniques used for industrial application; radiation sources and equipment used for industrial application; industrial radiography and computed tomography; nuclear techniques used for industrial gauging; nuclear analytical techniques for on-line elemental analysis in industry; radioisotope tracers used in industrial processes; basic principle of radiation processing for industrial application.

2111307 Industrial Uses of Radiation and Radioactive Material Laboratory 3(3-0-6)

Laboratory works on nuclear techniques used for industrial application; industrial radiography and computed tomography; nuclear techniques used for industrial gauging; nuclear analytical techniques for on-line elemental analysis in industry; radioisotope tracers used in industrial processes.

2111308 Electronic Circuits for Nuclear Instruments 3(3-0-6)

Study the principles, behavior and characteristic of the passive/active electronic devices; electrical signal and waveform; designing and calculation of electronic circuits, including the power supply circuit, feedback, amplifier, Oscillator, Filters, logic. application of radiation measurement devices and in other areas; electronic circuits simulation on computer.

2111309 Nuclear Reactor Laboratory 3(3-0-6)

Condition: Prerequisite 2111208

Approaching of critically, control rod calibration, measurement of thermal neutron flux, measurement of fast neutron flux, profiling of axial flux, calibration of thermal power.

2111310 Nuclear Reactor Safety 3(3-0-6)

Condition: Prerequisite 2111206

Safety systems and functions of current and advanced reactor technologies, design basis accidents, severe accidents, safety analysis report, probabilistic safety analysis, technology of accident analysis, computer simulation of accidents, role of safety culture, current regulatory issues, significant nuclear accidents.

2111311 Radiation Machines I 3(3-0-6)

Particle Sources; Charge Particle Motion in Static Fields; Linear Transverse Motion; Acceleration and Longitudinal Motion; Beam Distribution; Guiding and Focusing; Accelerator; Laser; Cyclotron; Synchrotron; Other Auxiliary Components.

2111312 Nuclear Safety, Security, and Safeguards 3(3-0-6)

Condition: Prerequisite 2111201

Nuclear Safety; Nuclear Security; Nuclear Safeguards; Objectives; Interrelationship between Safety, Security, and Safeguards; National and International Policies; Related Law & Regulations; Related Regimes; Important Elements; Case Studies.

2111401 Seminar in Basic Nuclear Engineering 3(3-0-6)

Condition: Senior Standing or Consent of Faculty

Instructors provide research topics in nuclear technology to students; each student requires selecting a tentative project with a written report and making an oral presentation and discussion of relevance items of selected topic.

2111402 Project in Nuclear Engineering I 3(3-0-6)

Condition: Senior Standing or Consent of Faculty

Perform a preliminary nuclear engineering project in a team manner such that the processes comply with prescribed design processes including report documenting and presenting the project in a professional way.

2111403 Project in Nuclear Engineering II 3(3-0-6)

Condition: Prerequisite 2111402

Perform and complete a nuclear engineering project in a team manner such that the processes comply with prescribed design processes including report documenting and presenting the project in a professional way.

2111404 Microcontroller Programming and Interfacing 3(3-0-6)

Architecture and principle of microprocessor, microcontrollers, and peripheral devices;programming for control applications; interfacing methods and techniques with real world.

2111405 Vacuum Technology for Scientific Instrument 3(3-0-6)

Gas properties; relevant physical concept of vacuum system; vacuum gauge; vacuum pump; control valve; vacuum system design; cleaning techniques; applications of vacuum technology for scientific instruments and devices; leak detection techniques and maintenance.

2111406 Principle of Scientific Instrument 3(3-0-6)

Theory and principle of scientific instrument e.g. spectrophotometer, x-ray spectroscopy and radiography, electron microscopy; maintenance method for scientific instrument.

2111407 Basic scientific instrument maintenance 3(3-0-6)

Condition: Prerequisite 2111308

Using fault finding tools for investigation fault of device and electronic signal; scientific instrument structure and components study; fault diagnosis of Scientific Instruments; circuit analysis; replacement parts and accessories correctly; test the validity of the operation after maintenance.

2111408 Ionizing Radiation Calibration and Dosimetry 3(3-0-6)

Radiation terminology and units; basic principle of radiation dosimetry for various kinds of ionizing radiation; low and high level radiation dosimetry; various types of radiation dosimeter; radiation calibration systems; radiation calibration techniques.

2111410 Plasma Physics and Applications 3(3-0-6)

Basic characteristics of plasma; motions of charge particles under electric and magnetic fields; Maxwell's equations; plasma as fluid; plasma oscillation; different types of waves in plasma; diffusion process in plasma; methods of plasma generation; plasma measurements; nuclear fusion and current technology; plasma applications in industry.

2111411 Nuclear Techniques for Material Analysis 3(3-0-6)

Theoretical principle; methodology; instrumentation and characteristics of nuclear analytical techniques e.g. thermal and fast neutron activation techniques, prompt gamma radiation measurement techniques, measurement of gamma radiation from inelastic neutron collision, charged particles induced x-ray and gamma-ray analytical techniques, x-ray fluorescence techniques, electron and X-ray microanalysis, x-ray diffraction, track-etch techniques.

2111412 Nuclear Technology in Medicine 3(3-0-6)

Condition : Prerequisite 2111201

Radiopharmaceuticals as radioactive tracers in medical imaging, functional studies, andtherapy for many diseases e.g. cardiovascular disease, digestive system, lung, skeleton, blood and nervous system etc., Positron emission tomography (PET), Radiotherapy; teletherapy and brachytherapy, Radioimmunoassay for measuring concentrations of antigens, Medical Radiography; computed tomography (CT); Magnetic resonance imaging (MRI)or magnetic resonance tomography (MRT),PET, Single-photon emission computed tomography (SPECT), mammography; dental radiology, Neutron therapy, Heavy-ion therapy.

2111416 Nuclear Techniques for Measurement and Inspection in Industrial Process 3(3-0-6)

Condition : Prerequisite 2111304

Radiation gauging for measurement of thickness, level, moisture and density; detection of corrosion and blockage; distillation column and packed column scan; industrial radiography and tomography; elemental analysis techniques; radiotracer techniques.

2111417 Nuclear Techniques for elemental Analysis 3(3-0-6)

Condition : Prerequisite 2111304

Principles of nuclear analytical techniques; advantages and limitations; x-ray fluorescence analysis technique; nuclear activation analysis techniques; prompt gamma-ray neutron activation analysis techniques; charged particle activation analysis techniques.

2111421 Thermal Hydraulics 3(3-0-6)

Condition : Prerequisite 2111206

Two-phase flow, conservation equations, flow patterns, void fraction modeling, pressure drop modeling, steam separation, flow instabilities, critical flow, bubble nucleation, pool boiling, subcooled and saturated flow boiling, boiling crises, transient analysis (single channel), loop analysis, condensation.

2111422 Nuclear Power Plant Simulation 3(3-0-6)

Condition : Prerequisite 2111206

Operational characteristics of nuclear power plants with the simulation computer programs, reactivity control systems, safety systems, and response to transients and accident situations.

2111423 Heat Transfer Process in Nuclear Power Plant 3(3-0-6)

Condition: Prerequisite 2111206

Heat production from a nuclear reactor, nuclear reactor cooling system, boiling and condensation, two-phase fluid, thermal energy-mechanical energy conversion, thermal cycle, efficiency improvement for heat transfer process, accident involving thermal system in a nuclear power plant and the emergency cooling system.

2111424 Radiation Transport 3(3-0-6)

Definitions and Assumptions regarding the radiation, interaction with the radiation, radiation transport theory, Pn approximation, Sn approximation, numerical calculation for radiation transport, monte-carlo technique.

2111425 Basic Nuclear Reactor Engineering 3(3-0-6)

Applying the nuclear reactor theory for the design and the operation of the nuclear theory, evaluation of the nuclear reactor's importance, safety by design for the nuclear reactor and the thermal system, the management on the operation of a nuclear reactor and the economics of the nuclear reactor's operation.

2111431 Nuclear Weapons and Nuclear Accidents 3(3-0-6)

History of nuclear weapon development; how nuclear weapons work; materials for construction of nuclear weapons; impact of nuclear weapons; current topics on nuclear weapons; Three Mile Island accident, Chernobyl accident and Fukushima accident; impacts on human and the environment; roles of International Atomic Energy Agency; potential of utilizing nuclear explosion for peaceful purposes.

2111432 Corrosion in Nuclear Power Systems 3(3-0-6)

Condition : Prerequisite 2111205

Structural metals in nuclear power plants; properties and fabrication of Zircaloy; aqueous corrosion of reactor components; structural integrity of reactor components under combined mechanical loading, neutron irradiation, and chemical environment.

2111434 Radiation processing and its applications 3(3-0-6)

Condition : Prerequisite 2111201

Radiation sources; chemical and physical effects of radiation; radiation effects to water, gases, monomers and polymers; polymer modification by radiation; radiation sterilization; development of material structures by radiation; radiation degradation of materials; food irradiation; radiation application in Agro-industry.

2111435 Radiation Detection Materials Development 3(3-0-6)

Reviews of radiation measurement and detection, types of radiation detectors and their characterizations, development of radiation detection materials; crystal synthesis by chemical processes; the methods of bulk-crystal growths e.g. Bridgman-Stockbarger technique

and Czochralski technique; thin-film growth by chemical and physical deposition e.g. epitaxial technique and sputter technique.

2111443 Nuclear Waste Disposal 3(3-0-6)

Radioactivity; radiation effects on living things;dose limit; various characteristics of radioactive wastemanagement; disposal technology of nuclear waste.

2111444 Social Sciences for Nuclear Engineering 3(3-0-6)

Economics, Project Management, Law and International obligations, Psychology, Communication with Public, Public Acceptance, education in Nuclear Engineering.

COURSE DESCRIPTIONS IN NUCLEAR ENGINEERING AND NUCLEAR TECHNOLOGY ENGINEERING (PH.D, M.ENG, AND M.SC.)

2111600 * Nuclear Engineering I 3(3-0-9)

Atomic physics and nuclear physics; interaction between radiation and matters; neutron diffusion; types of nuclear reactors; generation of nuclear reactors; nuclear fuel cycle; applications of nuclear technology and radioisotopes; nuclear weapons; Thailand nuclear power program.

2111603 * Radiation Detection and Measurements Laboratory 1(0-3-7)

Laboratory work on radiation measurements; statistical errors of radiation counting; characterization of radiation detectors; relative and absolute measurements; energy loss and penetration of charged particle through matter; interactions of photons with matter; interactions of neutrons with matter.

2111604* Radiation Detectors and Nuclear instruments laboratory 1(0-3-7)

Laboratory works on electronics circuit of radiation detectors, nuclear pulse shaper and discriminator circuits; inspection and calibration of Nuclear Instrument Module, pulse amplifier, single channel analyzer, multichannel analyzer, time to amplitude converter and some special nuclear instruments; experiment on parameters that affect energy resolution of the spectroscopy system and pulse pile-up rejection.

2111607 Environmental Radiation Measurements 3(3-0-9)

Natural sources of radiation and man-made sources of radionuclides; instrumentation for radiation detection and measurement; measurement techniques and procedures for environmental samples; sampling and sample preparation for analyses in laboratory; statistical treatment of radioactivity measurements; laboratory and field radiation measurements.

2111608* Practical Radiation Detection and Measurements 3(3-0-9)

Nuclear radiation basics; sources of nuclear radiation; types of radioactive decay; statistical errors of radiation counting; interactions of nuclear radiation with matter; characteristics and utilization of various nuclear radiation detectors; relative and absolute measurements; gamma and X-ray spectroscopy; charged-particle spectroscopy; neutron detection and spectroscopy.

2111609 Radiation Dosimetry 3(3-0-9)

Basic principle of radiation dosimetry for various kinds of radiation: charged particle radiation, gamma radiation and neutron; low and high level radiation dosimetry; various types of radiation dosimeter.

2111610* Nuclear Security 3(3-0-9)

Nuclear security; overview of related legal framework; interrelationships between nuclear safety, security and safeguards; nuclear and radiation threat by non-State actors; counterterrorism; chemical biological,radiological and nuclear security of nuclear and nuclear (CBRN) Weapons; basic elements of nuclear security; planning nuclear materials and other radioactive materials outside regulatory control; information security; security culture.

2111612 Radiation Protection 3(3-0-9)

Basic concepts of radiation; biological effects of radiation on human body; dose limits; protection from external radiation; Internal radiation hazard; surface contamination and decontamination; radiation dosimetry; calculation of internal and external radiation exposure dose; calculation of gamma and x-ray shielding.

2111613 Radiation Safety and Shielding 3(3-0-9)

Definitions and basic concepts of radiation safety; biological effects of radiation: protection, dose limits; regulation concerning radioactive materials; transportation of radioactive materials; accidents and emergency procedure; gamma radiation and x-ray shielding; radiation shielding from nuclear reactor.

2111616 Environmental Impact of Nuclear Power Plant 3(3-0-9)

Radionuclides released from nuclear power plant, dispersion in the atmosphere; dispersion in aquatic environment; radiation dose calculation; food chain; reactor siting; accident risk analysis; emergency management.

2111621 Radiation Chemistry and Processing 3(3-0-9)

Radiation sources; chemical and physical effects of radiation; radiation effects to water, gases, monomers and polymers; polymer modification by radiation; radiation sterilization; food irradiation; radiation degradation of materials.

2111627 Material Analysis with Nuclear Techniques 3(3-0-9)

Condition: Prere 2111608 or 2111663

Theoretical principle; methodology; instrumentation and characteristics of nuclear analytical techniques e.gl thermal and fast neutron activation techniques, prompt gamma radiation measurement techniques, measurement of gamma radiation from inelastic neutron collision,

charged particles induced x-ray and gamma-ray analytical techniques, x-ray fluorescence techniques, electron and X-ray microanalysis, x-ray diffraction, track-etch techniques.

2111628 Radioisotope Production and Utilization 3(3-0-9)

Radioisotope production; nuclear reactor-produced radioisotopes; special techniques to produce radioisotope; radioisotopes derived from generators; accelerator produced isotopes, labelled compounds; dispensing and quality control; radioisotope utilization.

2111629 Nuclear Chemical Engineering 3(3-0-9)

Production of fissiles and nuclear reactor materials; isotope separation; property of spent nuclear fuel; separation of remaining and newly producing fissiles from spent nuclear fuel.

2111631 Applied Mathematics in Nuclear Technolog 3(3-0-9)

Ordinary differential equations; linear differential equations with constant coefficients; Laplace transform, vector analysis; finite differences; gamma and beta functions; Fourier series and integral.

2111632 Numerical Calculation For Nuclear Engineering 3(3-0-9)

Numerical technique for differential,integration and finding; matric manipulation; data interpolaion; finite difference; simulation with Monte Carlo technique.

2111640 Nuclear Reactor Control 3(3-0-9)

Condition: Prere 2111642

Phylosophy of nuclear reactor and plant control; elementary physics of reactor control; nuclear reactor kinetics; nuclear reactor control radiation instruments; nuclear reactor control mechnisms; nuclear reactor control problems; computer simulation of nuclear reactor power.

2111642 Nuclear Reactor Engineering 3(3-0-9)

Production and characteristics of neutrons; the fission process; neutron diffusion theory; slowing-down theory; Fermi theory of the bare thermal reactor; one- and multi-group diffusion methods; basic principles of nuclear reactor kinetics and nuclear reactor control.

2111643 Nuclear Power Engineering 3(3-0-9)

Condition: Prerequisite consent of faculty

Power reactor systems; vapor power cycle; reactor heat generation; reactor heat transport, single phase flow, two- phase flow; reactor core thermal analysis; practices using PC-based simulators of nuclear power plants for operations under normal and abnormal conditions.

2111646 Radioactive Waste Management 3(3-0-9)

Nature of radioactive wastes; origin of low-high radioactive wastes; characteristics, forms and quantity of radioactive wastes; storage and transportation; waste management technologies; radioactive waste management plans in various countries.

2111647 Nuclear Fuels and Nuclear Fuel Cycles 3(3-0-9)

Condition: Prerequisite 2111642

Characteristics of fuel-element materials; design of fuel-elements; fuel-element fabrication; fuel cycles in nuclear reactors; properties of irradiated fuel; spent fuel reprocessing; economics of nuclear power.

2111648 Nuclear Power Plant Systems and Operation 3(2-3-7)

Condition: Prerequisite consent of faculty

Functions, equipment and operation of the main systems of a nuclear power plant; how each system is controlled, principles of overall unit operation and control, reactor safety and protection for the public; experiments used PC-based simulators of nuclear power plants for operations under normal and abnormal conditions.

2111650 Introduction to Plasma Physics and Nuclear Fusion 3(3-0-9)

Basic characteristics of plasma, methods of plasma generation; nuclear fusion process, problems and current status of fusion technology; single-particle motions, effects of electric and magnetic field on plasma motion; maxwell's equations, fluid equation of motion; plasma oscillation, different types of waves in plasma; diffusion process in plasma, plasma resistivity; hydrodynamic equilibrium, various types of instability in plasma.

2111651* Weapon Mass Destruction Nonproliferation 3(3-0-9)

Issues concerning the proliferation of nuclear, chemical, and biological weapons; introduction to nuclear and radiological terrorism; international nuclear nonproliferation framework; weapon technologies of mass destruction; nuclear proliferation issues in South Asia.

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2111652* Strategic Trade Controls 3(3-0-9)

National and international contexts of export control; threats of nuclear prokiferation to the state and business sectors, international export control framework; instruments for export control; catch-all concepts; intangible technology transfers, dual-use controls; end-use method.

2111653* Nuclear Safeguards 3(3-0-9)

Safeguarding nuclear material and facilities; monitoring principles and technologies; sefeguards issues; international framework of nuclear material safeguard; nuclear proliferation threat; radiological threat; detectinlg nuclear and other radioactive materials; roles of intelligence; A. Q. Khan's network; counter proliferation of nuclear weapons; nuclear material safeguard in various countries.

2111654* Nuclear Fuel Cycle and Environmental Impacts 3(3-0-9)

Technology of nuclear fuel cycle; technologies used in manufacturing, safety handling, and disposing of nuclear materials and by-products; social environmental,

and health impacts of materials used in each major step in the fuel cycle; potential of nuclear proliferation.

2111655 Computer Application in Nuclear Technology 3(3-0-9)

Calculation of gamma-ray shielding calculation of primary and secondary x-ray shielding; radioactivity calculation; radiation imaging; application of data acquisition for computed tomography reconstruction.

2111656* Physical protection of Nuclear materials and Facilities I 3(3-0-9)

Principles of physical protection of nuclear materials and facilities: detection, delay, response; threat identification and analysis; vital area analysis; international physical safeguard framework; internal threats.

2111657* Advanced Detection Technologies for Radioactive and Nuclear Materials 3(3-0-9)

Condition: PRER. 2111608 or 2111658 or 2111663

Detection and identification of the types of nuclear materials; chemical and radiological characteristics of nuclear materials from raw materials to various finished products; detection technologies; nuclear forensics.

2111658* Method and Instrumentation for Nuclear Security and Safeguards 3(3-0-9)

Counting statistics; radiation detection; gamma detection; neutron detection; detection of charged particles; gamma spectroscopy; activation analysis; destructive analysis; non-destructive analysis; quantitative nuclear material material measurements; survey devices; use of detectors at port.

2111659* Method and Instrumentation for Nuclear Security and Safeguards Laboratory 1(0-3-7)

Use of gamma, neutron, and charged particle detection systems; gamma spectroscopy method; activation analysis; quantitative nuclear material measurements; uses of various survey and detection devices at port.

2111660 Industrial Radiation Imaging 3(3-0-9)

Condition: Prerequisite consent of faculty

Principles of industrial radiography and tomography; advantages and disadvantages; x-ray and gamma-ray radiography; neutron radiography; x-ray and gamma-ray computed tomography; neutron computed tomography; radiation imaging equipment.

2111661 Experimental Nuclear Engineering 3(2-3-7)

Condition: PRER. 2111663 or 2111642

Nondestructive testing methods; industrial radiography using x-rays and gamma-rays and neutrons; equipment for x-ray and gamma-ray radiography; x-ray and neutron computed tomography.

2111662 Nuclear Electronics Engineering 3(3-0-9)

Condition: Prerequisite consent of faculty

Outline of nuclear electronics; nuclear measuring systems; shaping of signals for spectroscopy; radiation detection circuit; high voltage bias power supply; pulse amplifier; pulse height and shape discriminators; timing circuit; single channel and multichannel analyzer; digital counter and ratemeter; energy resolution in spectroscopy systems.

2111663* Radiation Detectors and Nuclear Instruments 3(3-0-9)

Principle of radiation detection process; modes of detector operation; NIM and CAMAC standards for modular nuclear instrumentation; configurations of nuclear measurement systems; properties of radiation detectors; operation characteristics of various radiation detector; operation characteristics of various radiation detectors; nuclear pulse signal processing; radiation spectroscopy; nuclear instrumentation; application of counting statistics and error prediction in nuclear radiation measurement.

2111664 Digital Computer Interfacing for Nuclear Instruments 3(3-0-9)

Condition: Prerequisite: 2111608 or 2111663 or consent of faculty

Standard of nuclear instrument modules; nuclear instrumental system; electronic signal conditioning and interfacing for nuclear instrument; standard data bus of parallel and serials type; analog and digintal data conversion; uses of microcomputer and microcontroller interfacing for manipulation of nuclear instrument system.

2111666 Radiation Machines 3(3-0-9)

Principle and structure of radiation machine; mechanism of charge particles acceleration; electron and ion beams generation; electromagnetic and electrostatic lens; high vacuum technology; hight voltage power supply; basic refrigeration; operation of various types of accelerator and radiation machine; industrial and research applications of radiation machines.

2111678 Nuclear Materials Engineering 3(3-0-9)

Condition: Prerequisite consent of faculty

Nuclear fuel cycle; materials and thermal aspects of nuclear reactors; crystal structures of solids; point defects; diffusion in solids; elastic behavior of solids; dislocations in solid and creep deformation; grain and grain boundaries; cavities in solids; fission product behavior in nuclear fuel; radiation damage and fast-neutron irradiation effects in metals; introduction to the High-Temperature Gas-Cooled Reactor Technology.

2111683 Current Topics in Nuclear Engineering 3(3-0-9)

Current topics in nuclear engineering field are selected, summarized and discussed by the students with faculty participation.

2111684 Current Topics in Nuclear Technology 3(3-0-9)

Current topics in nuclear technology field are selected, summarized and discussed by the students with faculty participation.

2111686* Special Topics in Nuclear Technology 3(3-0-9)

Special topics in nuclear technology; presentations and discussions led by instructors, concluding.

2111687* Special Topics in Nuclear Technology 3(3-0-9)

Students' selection, summaries and discussion of special topics in nuclear engineering, with faculty participation.

2111701 Seminar in Nuclear Technology I S/U

Instructors provide research topics in nuclear technology to students and each student is required to summarize with written report and oral presentation.

2111702 Seminar in Nuclear Technology II S/U

Condition: Prerequisite: 2111701

Instructors provide research topics in nuclear technology to students each student required to conduct experimental research with written report and oral presentation; discussion of topics related to research works.

2111811 Thesis 12(0-0-0)
THESIS

2111817* Thesis 37(0-0-0)
THESIS

2111829* Dissertation 49(0-0-0)
DISSER

2111826* Dissertation 36(0-0-0)
DISSER

2111830* Dissertation 74(0-0-0)
DISSER