NUCLEAR ENGINEERING
COLLEGE OF ENGINEERING | THE UNIVERSITY OF UTAH

UNEP

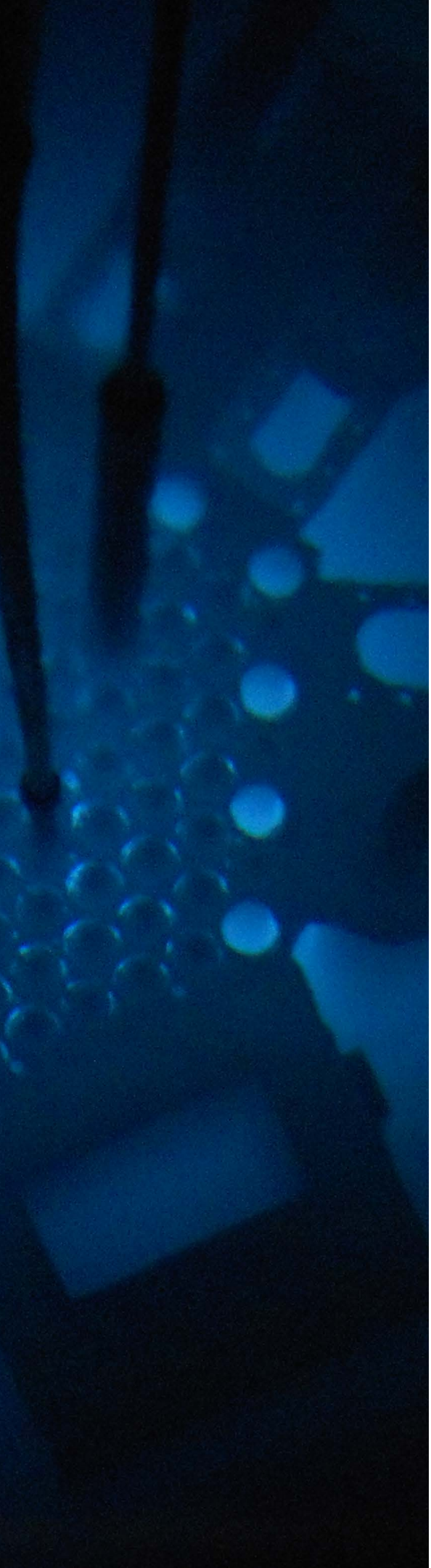
Utah Nuclear Engineering Program

PROGRAM HANDBOOK

Effective August 2018

http://www.nuclear.utah.edu/

Utah Nuclear Engineering Program
110 S. Central Campus Drive
Suite 2000
The University of Utah
Salt Lake City, UT 84112



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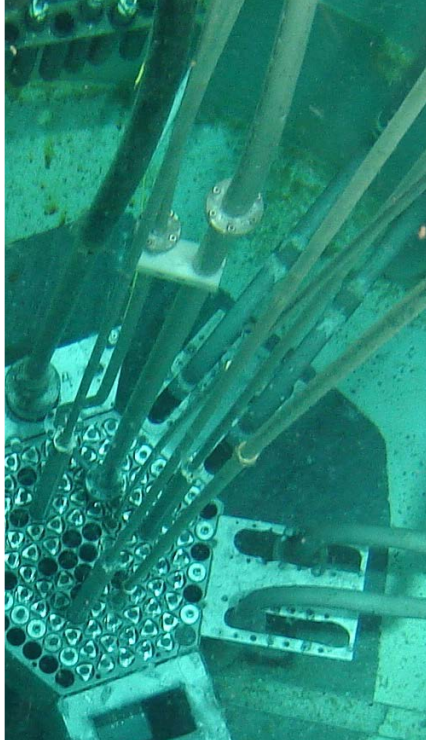
Introduction to Nuclear Engineering



Nuclear Engineering involves the application of a variety of science and engineering disciplines to enable the safe production of nuclear power, nuclear material security (including nuclear safeguards and nuclear forensics), and the utility of nuclear materials for the benefit of mankind (such as nuclear medicine).

Job responsibilities of Nuclear Engineers include[1]:

- Discovery of superheavy elements and exotic isotopes;
- Development of advanced materials for nuclear power and nuclear medicine;
- Secure nuclear weapons and ensure the safe production of nuclear power through nuclear safeguards and nuclear forensics;
- Design or develop nuclear equipment including reactor cores, radiation shielding, and associated instrumentation;
- Direct operating or maintenance activities of operational nuclear power plants to ensure that they meet safety standards;
- Monitor nuclear facility operations to identify any design, construction, or operation practices that violate safety regulations and laws;
- Perform experiments to test whether methods of using nuclear material, reclaiming nuclear fuel, or disposing of nuclear waste are acceptable;
- Examine nuclear accidents and gather data that can be used to design preventive measures.

According to the U.S. Bureau of Labor Statistics approximately 41% of nuclear engineers are employed in the electric power generation, transmission, and distribution industry followed by 17% in Federal government, 16% in research and development, 9% in engineering services, and 6% in manufacturing. The diversity of employment opportunities is part of the excitement of becoming a nuclear engineer.

The Utah Nuclear Engineering Program (UNEP) addresses these challenges and opportunities by continually evaluating and adapting to the needs of the nuclear industry.

1 Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, 2016-17 Edition, Nuclear Engineers, on the Internet at https://www.bls.gov/ooh/architecture-and-engineering/nuclear-engineers.htm (visited December 18, 2016).

About UNEP

Our curriculum is designed to provide a comprehensive understanding of core engineering and scientific principles with application to a diverse range of nuclear engineering problems. It is challenging, multidisciplinary, and research-oriented at every stage of learning. We are passionate about nuclear engineering and focus on creative discovery and innovation built on a foundation of classroom knowledge, laboratory exploration, and computational skills.

UNEP offers a diverse education in nuclear engineering with programs in:

I. Undergraduate Minor in Nuclear Engineering
II. Masters Non-Thesis in Nuclear Engineering
III. Ph.D. in Nuclear Engineering

The Nuclear Engineering Program (UNEP) is equipped with 5,000 sq. ft. of radiation measurement facilities including a new alpha spectrometer, high purity germanium (HPGe) radiation detectors, liquid scintillation detector, and a staff to maintain those facilities. UNEP also supports a 100kW TRIGA reactor, a high energy radiation detection laboratory, and radiochemistry facilities. The UNEP is establishing itself as a premier nuclear forensics institution. Centrally located in the Southwest, the U has great access and collaborations with five national laboratories: LANL, INL, SNL, LLNL, and PNNL. This provides students with numerous opportunities to perform internships and for national lab personnel to serve on student advisory committees.

This graduate handbook provides the current minimum requirements pertaining to our program. It is important to recognize that University of Utah Graduate School policies state “the supervisory committee is responsible for approving the student’s academic program, preparing and judging the qualifying examinations subject to departmental policy, approving the thesis or dissertation subject, reading and approving the thesis or dissertation, and administering and judging the final oral examination (thesis or dissertation defense).” Thus, final degree requirements may exceed the minimum depending on the background of the student related to their research.

Undergraduate Minor in Nuclear Engineering

The Nuclear Engineering Program (UNEP) offers a minor in nuclear engineering. Students in any discipline may enter the minor if they have met the following required prerequisites:

- C- or better in PHYS 2220
- C- or better in CHEM 1220 or CHEM 1221
- C- or better in MATH 1220 or MATH 1320 or MATH 1321

To fulfill the requirements of the minor, students must complete the 16 credits of coursework listed below with a GPA of 3.3 or higher:

1. NUCL 3000: Nuclear Principles and Engineering (3 cr.)
2. NUCL 3100: Radiation Interactions (3 cr.)
3. NUCL 3200: Radiochemistry (3 cr.)
4. NUCL 4000: Nuclear Laboratory (1 cr.)
5. Nuclear-related technical electives (6 cr.)

Students must also maintain a cumulative GPA of 2.85 or higher to remain in good standing in the minor.

The 6 credits of nuclear-related technical electives may include NUCL 5000- and 6000-level courses[1] or nuclear-related courses from a student's home department. Available NUCL 5000- and 6000-level courses currently include:

- NUCL 5030/6030: Radiation Interactions
- NUCL 5032/6032: Radiochemistry II
- NUCL 5100/6050: Reactor Physics
- NUCL 6060: Reactor & Policy I
- NUCL 6061: Reactor & Policy II
- NUCL 6100: Nuclear Environmental Engineering
- NUCL 6220: Analytical Forensics

Students have the option of using approved technical electives that count towards the degree programs in their home department towards the 6 credits of required nuclear-related technical electives, making it possible to complete the nuclear engineering minor with only 10 additional credits beyond an engineering, math or science-related undergraduate degree. A list of UNEP-approved courses is available on the program website at: http://www.nuclear.utah.edu/minor.

Any questions regarding acceptable alternative electives should be directed to the undergraduate Academic Advisor, Alexi Crabb.

1 An undergraduate student must have a cumulative GPA of 3.2 or higher and instructor permission to enroll in a NUCL 6000-level course.

Graduate Degrees in Nuclear Engineering

The Nuclear Engineering Program (UNEP) offers graduate programs leading to the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees in Nuclear Engineering. Faculty areas of research include: radiation detection, nuclear forensics, reactor physics, nuclear safeguards, and radiochemistry.

All information in this handbook and forms referenced in this document can be found at the program website, http://www.nuclear.utah.edu/. In addition to this handbook, all graduate students must abide by the rules and regulations set forth in the Graduate School Handbook http://gradschool.utah.edu/graduate-catalog/.

Admission

Admission to the graduate program is based on the applicant's academic records, Graduate Record Exam (GRE), letters of recommendation, personal statement, special aspects of the applicant's professional and educational background, and faculty availability. To apply to the program, students should proceed to: https://app.applyyourself.com/AYApplicantLogin/fl_ApplicantLogin.asp?id=utahgrad.

Applications are reviewed by faculty in the Nuclear Engineering Program. Once reviewed, the application is returned to the Graduate Admissions Office with a recommendation. The University Graduate Admissions Office makes the final decision on all graduate admissions. All supporting documentation must be submitted by the dates listed below or your application may not be processed.

The Program deadline to apply is as follows:

December 1st – International students for Fall Semester, to be considered for funding
January 1st - Domestic students for Fall Semester, to be considered for funding
March 1st - All students for Fall Semester, general admission
September 1st – International students for Spring Semester
October 1st – Domestic students for Spring Semester

The following minimum requirements shall be met in order to be accepted into the Non-Thesis M.S. Nuclear Engineering Program:

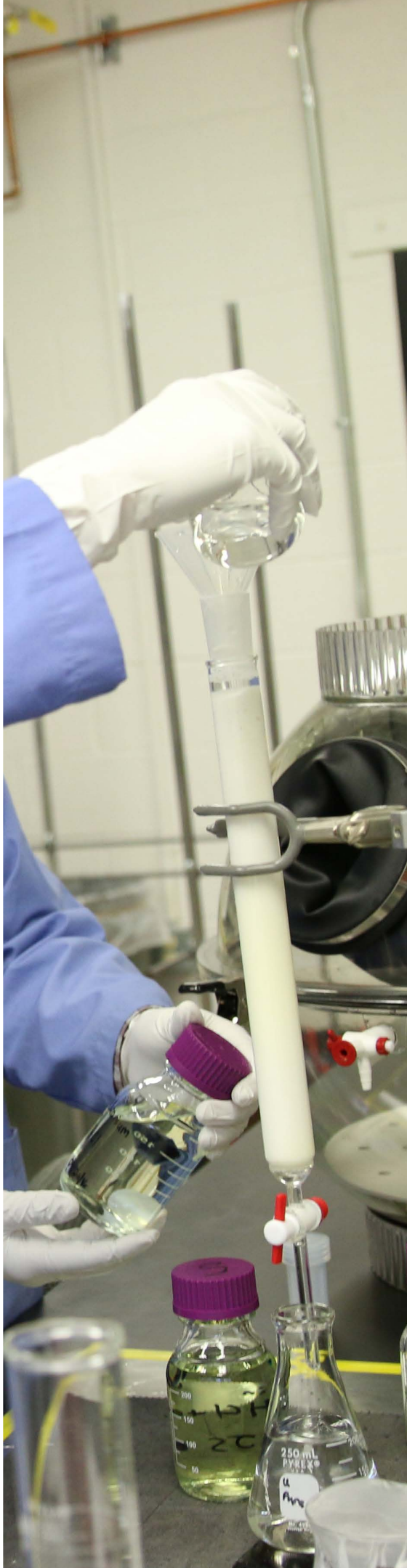
1. A bachelor degree from an accredited institution of higher learning in one of the branches of engineering or in mathematics, physics, computer science, chemistry, biology, or in a related science field. Students in non-engineering majors must have completed at least three semesters of calculus.
2. A minimum grade point average (GPA) of 3.0 (out of 4.0) in the undergraduate degree. A GPA below a 3.0 will be considered on a case-by-case basis.

The following minimum requirements shall be met in order to be accepted into the Ph.D. Nuclear Engineering Program:

1. A bachelor degree from an accredited institution of higher learning in one of the branches of engineering or in mathematics, physics, computer science, chemistry, biology, or in a related science field. Students in non-engineering majors must have completed at least three semesters of calculus.
2. A minimum grade point average (GPA) of 3.5 (out of 4.0) in the undergraduate degree or a minimum GPA of 3.0 in a graduate degree. A GPA below the requirements will be considered on a case-by-case basis.
3. A minimum combined score of 300 on the quantitative and verbal section of the GRE with a minimum of 155 on the quantitative section of the GRE.

The requirements given above are minimum standards. Meeting the minimum requirements does not guarantee that an applicant will be accepted into the graduate program. Decisions regarding acceptance or rejection of any applicant are made based on the qualifications of the applicant compared to other applicants, the needs of the Program, any restrictions or restraints under which the Program is operating, and other unnamed considerations.

In addition to the general admission requirements, the Nuclear Engineering Program requires international applicants to satisfy the University of Utah's Admission's Office minimum English Proficiency scores. Minimum scores should be at least 550 on the written, 213 on the computer-based, or 80 on the internet-based Test of English as a Foreign Language (TOEFL). Applicants may also take the International English Language Testing System (IELTS) which requires a score of 6.50. The TOEFL or IELTS are not required for international students who have earned a B.S. or higher degree from an accredited university in the United States in the last two years. International students may be encouraged to take ESL 1050, Introduction to Expository Composition (for ESL Speakers), and ESL 1060, Advanced Expository Writing (for ESL Speakers).



Financial Assistance

Financial assistance is available to qualified students on a competitive basis in the form of teaching assistantships, research assistantships, graduate assistantships, University of Utah research fellowships, industry-sponsored design and research fellowships. The professor in charge of the particular research contract or grant makes decisions regarding sponsored research assistantships. If a student is interested in a teaching assistantship or research assistantship, they need to apply to the Program by the appropriate deadline. Current students should contact their advisor directly. Financial support is competitively awarded to graduate students pursuing research degrees. Those following a professional or non-thesis degree are ineligible for financial support. Students who work for the Program as a teaching assistant, research assistant, or a graduate assistant may qualify for the Tuition Benefit Program provided they meet the other requirements. Complete requirements can be found at: www.gradschool.utah.edu.

Graduate research assistant and graduate assistant positions are determined by individual faculty members. Recommendations for teaching assistant positions are sent by the program after the application deadline. An international student selected for a graduate teaching assistant position (GTA) will need to go through the International Teaching Assistant (ITA) clearance process administered by Graduate School. The ITA program requires all students to have taken the iBT or ILTS. Students go through the ITAP Spoken English Evaluation prior to completing the ITA orientation workshop. If students are unable to satisfactorily complete the Spoken English Evaluation and the ITA training, they will be ineligible to receive the teaching assistant position.

If a student is being paid through the program as a Graduate Research or Teaching Assistant, students must meet with their committee chair to complete the semi-annual Student Performance Review form and submit with the Registration Approval form for both fall and spring registration.

Minimum Course Requirements

M.S. Degree

The Nuclear Engineering Program (UNEP) requires all Non-Thesis M.S. students to complete 30 credit hours of graded coursework. The 30 credit hours of graded coursework must include the following two core courses:

1. NUCL 6030: Radiation Interactions (3 cr.)
2. NUCL 6050: Reactor Physics (3 cr.)

In addition, students must complete four additional NUCL electives from the list below:

1. NUCL 6032: Graduate Radiochemistry (3 cr.)
2. NUCL 6060 Reactor & Policy (3 cr.)
3. NUCL 6100: Nuclear Environmental Engineering (3 cr.)
4. NUCL 6220: Analytical Nuclear Forensics (3 cr.)
5. NUCL 7000: Health Physics (3 cr.)
6. NUCL 7100: Nuclear Instrumentation (4 cr.)
7. NUCL 7500: Nuclear Safeguards (3 cr.)
8. MET E 6210: Nuclear Materials (3 cr.)

The remainder of the 30 credit hours may be acquired from the following options with approval of the student's supervisory committee:

- Up to 3 credits of independent research, taken as NUCL 5900 or 6900.
- Up to 12 credits of technical electives offered by other departments in engineering, science, and math-related disciplines.

Ph.D. Degree

The Doctor of Philosophy in Nuclear Engineering is awarded in recognition of distinguished scholarship and original contributions to knowledge. Although formal courses are required, the award is made primarily for creative scholarship rather than for accumulation of credits in courses. Thus, it is of prime importance that students begin research at the earliest possible time. Students may enter the Ph.D. program with a previous M.S. degree in nuclear engineering or a nuclear engineering-related field or may enter the program directly following a bachelor degree program (see Admissions Requirements).

M.S. to Ph.D.

The Nuclear Engineering Program requires all Ph.D. students with a previously awarded M.S. degree in nuclear engineering or a nuclear engineering-related field to complete a minimum of 18 additional credit hours of graded coursework and 14 credit hours of dissertation research. The 18 credit hours of graded coursework must include the following four core courses, which will serve as the basis for a student's qualifying exam:

1. NUCL 6030: Radiation Interactions (3 cr.)
2. NUCL 6050: Reactor Physics (3 cr.)
3. NUCL 7000: Health Physics (3 cr.)
4. NUCL 7100: Nuclear Instrumentation (3 cr.)

In addition, students must choose a minimum of two additional NUCL electives from the list below:

1. NUCL 6032: Graduate Radiochemistry (3 cr.)
2. NUCL 6060 Reactor & Policy (3 cr.)
3. NUCL 6100: Nuclear Environmental Engineering (3 cr.)
4. NUCL 6220: Analytical Nuclear Forensics (3 cr.)
5. NUCL 7500: Nuclear Safeguards (3 cr.)

If a student has proficiency in a core course(s) from their M.S. degree, then the student may replace the core course(s) with a NUCL elective or other related course that complements the student's research. However, students will still be required to demonstrate proficiency in topics covered by the core courses during their Qualifying Exam.

Direct Admit Ph.D. (B.S. to Ph.D.)

The Nuclear Engineering Program (UNEP) requires all direct admit Ph.D. students to complete a minimum of 30 credit hours of graded coursework and a minimum of 14 credit hours of dissertation. The 30 credit hours of graded coursework must include the following four core courses, which will serve as the basis for a student's qualifying exam:

1. NUCL 6030: Radiation Interactions (3 cr.)
2. NUCL 6050: Reactor Physics (3 cr.)
3. NUCL 7000: Health Physics (3 cr.)
4. NUCL 7100: Nuclear Instrumentation (3 cr.)

In addition, students must choose a minimum of two additional NUCL electives from the list below:

1. NUCL 6032: Graduate Radiochemistry (3 cr.)
2. NUCL 6060 Reactor & Policy (3 cr.)
3. NUCL 6100: Nuclear Environmental Engineering (3 cr.)
4. NUCL 6220: Analytical Nuclear Forensics (3 cr.)
5. NUCL 7500: Nuclear Safeguards (3 cr.)

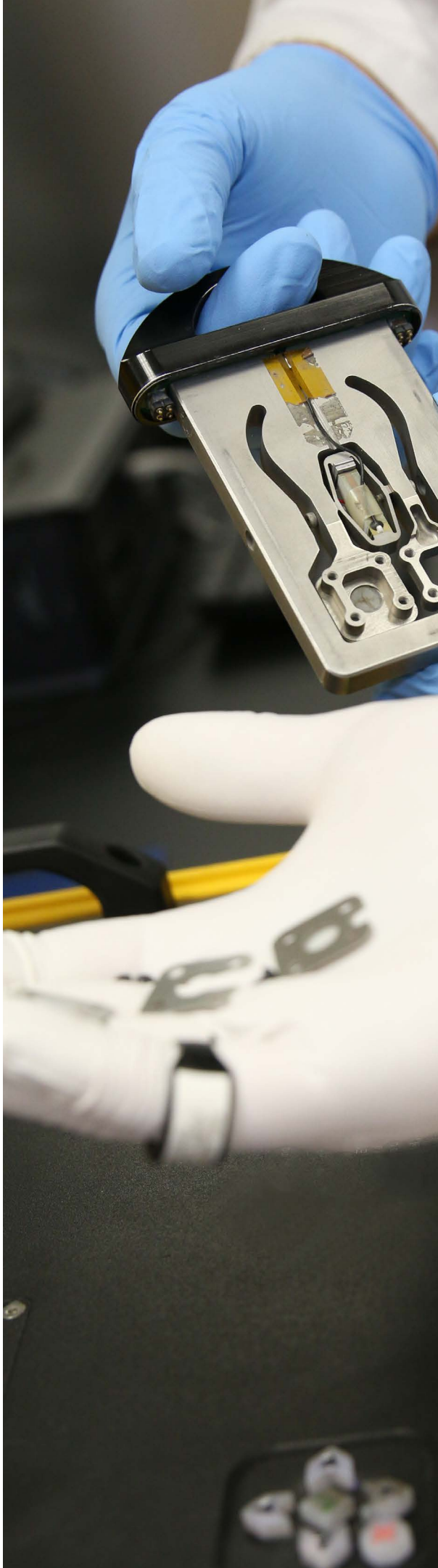
The remainder of the 30 credit hours may be acquired from the following options with approval of the student's supervisory committee:

- Up to 3 credits of independent research, taken as NUCL 6900 or 7900
- Up to 12 credits of technical electives offered by other departments in engineering, science, and math-related disciplines that complement the student's research

An M.S. degree will be granted after completion of at least 30 hours of coursework, successful completion of the qualifying exam, and submission of one peer-reviewed first-author paper from a journal approved by the committee..

Continuous Registration Requirements

Graduate School requires graduate students to be registered from the time of admission through completion of all requirements for the degree they are seeking, unless granted an official Leave of Absence (domestic students only) or Vacation Semester (international students only). This policy does not include summer registration for domestic students.
All students must be continuously enrolled for a minimum of three (3) credit hours each semester (full time is considered 9 credit hours) from the time of formal admission through completion of all requirements, comprehensive exam, and thesis/dissertation (if applicable) for the degree they are seeking. The Nuclear Engineering Program requires all Graduate Research Assistant (GRA) on payroll during summer semester to register for 3 credits of thesis research credits (NUCL 6970 or 7970), unless a student is no longer tuition benefit eligible. During summer semesters, the tuition benefit program allows only 3 credit hours of tuition benefit, so if students want to take a course instead of thesis or dissertation credits, contact the program graduate advisor.



Leave of Absence and Vacation Semesters

Domestic students who want to take a leave of absence for fall or spring semester must complete a Request for Leave of Absence form and have it approved by his/her supervisory committee two weeks prior to the start of the leave semester. Domestic students who wish to take summer semester off do not need to file a leave of absence. However, registering for three credits will be required for summer if a student is being paid as a Graduate Research Assistants (GRA) and tuition benefit eligible. International students are required to be registered continuously full time in fall, spring and summer. Students who do not register for each semester will need to apply for a Vacation Semester with the help of the International Student and Scholar Office. In summer, international students can register for 3 credits of Thesis Research (NUCL 6970 or NUCL 7970) to be considered full time or 9 hours of coursework to meet INS regulations. Contact International Student and Scholar Services for further information and complete the necessary paperwork.

International students must file for a Vacation Semester if they are not going to register for any semester. International students taking a Vacation Semester during summer must register for Fall courses before leaving.

Anyone on program funding becomes ineligible for either a Vacation Semester or a Leave of Absence and remain on payroll. If a student does not comply with the university or program continuous enrollment policy, his/her records will be inactivated and will need to reapply for admission to the program.

Graduate Advisor and Supervisory Committee

The graduate academic advisor will assign a temporary advisor to new graduate students in their specified area of interest. The temporary advisor approves the first semester of the student's registration. Students need to set up their supervisory committee during their first semester in the program. If a student does not have their committee set up by the time of registration they will not be given the class numbers and will postpone registration.

M.S. Supervisory Committee

The supervisory committee for an M.S. student consists of three voting members. Two of the voting members must be UNEP core faculty members. The third voting member can be from within the program, including affiliated faculty, or may be from outside the program. An individual from the engineering industry may be a voting member with approval by the Director of Graduate Studies and the Graduate School.

Ph.D. Supervisory Committee

The Ph.D. Supervisory Committees consist of five voting members. Two of the voting members must be UNEP core faculty members. The third and fourth members are regular faculty members from another department within the University of Utah. The fifth voting member can be from within the Program or may be outside the

Program if this enhances the ability of the committee to supervise the student's work. An individual from the engineering industry or a National Laboratory may be a voting member with approval by the Director of Graduate Studies and the Graduate School.

Core Faculty Members (as of August 2018)

Edward Cazalas
Tara Mastren
Luther McDonald

Curriculum Development Plan

All students will need to complete a Curriculum Development Plan (CDP) during their first semester attending the University of Utah. The CDP is intended for the student and advisor to set out a plan for what courses are needed for the degree and to select a supervisory committee. For MS students, the completed and signed CDP must be submitted prior to registering for the second semester, and Ph.D. students submit prior to their third semester registration. The University does not allow graduate students to take 4000 level or lower courses for graduate credit.

Performance Review

All funded M.S. and Ph.D. students are required to meet with their Committee Chairperson to discuss their academic and research progress prior to registering for the next semester. Performance Reviews must be submitted to the graduate academic advisor to receive registration permission codes for Fall and Spring semesters, beginning their second semester. The Performance Review is submitted with each fall and spring with the Registration Approval Form and Tuition Benefit Form.

Transfer of Graduate Credit, Credit Limitations

At the discretion of the student's supervisory committee, a maximum of six credits of graduate coursework taken at another institution may be counted toward the MS degree. Transfer courses cannot be used toward another degree, must have a minimum 'B' grade, and must be taken prior to admission to Nuclear

Engineering at the University of Utah. To receive credit, the student's advisor must submit a letter of support to the Program to have the course(s) petitioned to the Admissions Office. If the petition is accepted, students must list the course(s) on his/her Application for Admission to Candidacy form or Program of Study. Students who attend the University of Utah as an undergraduate may have up to 6 credit hours count towards their graduate degree. The credits cannot be used to complete the requirements for the undergraduate degree. If a student took courses as an undergraduate and would like to have them count towards their degree, then he or she should complete the University's form, Undergraduate Petition for Graduate Credit. This form is located on the Graduate School website.

Grades and Probationary Status

Candidates for all graduate degrees are required to maintain a 3.0 or higher GPA in course work counted toward the degree. Candidates are also required to make forward progress towards their degree. Failure to do so will result in the student being placed on probation. Only one course (maximum of 4 credit hours) with a grade of C+ or C may be accepted for credit toward a graduate degree. If a graduate student's average GPA in courses on his/her approved CDP falls below 3.0, the student will automatically be placed on probationary status. Please see the Probation form on the Program website. Funded students will lose their ability to qualify for Tuition Benefit without a 3.0 GPA and could lose their funded position.

Program of Study

The Program suggests the Program of Study is submitted, reviewed, and signed by the Supervisory Committee at the time of the Qualifying Examination. The Graduate School requires students to submit their Program of Study, two months prior to the start of their final semester. The Program of Study must include a record of all the courses taken for the Ph.D. degree. Refer to the section on coursework for minimum requirements. A completed Program of Study form is to be submitted to the Academic Advisor: November 1 for Spring April 1 for Summer July 1 for Fall.

Qualifying Exam (Ph.D. Students Only)

The first checkpoint in a doctorate student's career is the Qualifying Exam (QE) which evaluates a student's fundamental knowledge in the four core courses. The exam is administered in the 4th semester of graduate study, but no later than the end of the third year.

The Qualifying Examination consists of two basic components:

- A written qualifying examination during the fourth semester administered during Spring break.
- Submission of a research proposal and an oral examination during the fifth semester.

The Written Examination covers the basic fields of Nuclear Engineering as taught in the four core graduate courses. The level of competency will be set at the advanced graduate level. Students must receive a minimum of 70% to move on to the research proposal. A score of 60 – 70% will yield a conditional pass. Students receiving a conditional pass must meet with their Supervisory Committee prior to moving on to the research proposal. Any score below a 60% is a failure. Students failing the written portion of the QE may not take the research proposal in the same year.

The research proposal is to be related to the student's dissertation project and must be approved by the Supervisory Committee. The proposal must contain some original work performed by you at the University of Utah. The proposal must also contain an authoritative review of the topic, and extensive bibliography, and experimental details of proposed research. Students are encouraged to use the current proposal format required by the Department of Energy – Nuclear Energy University Program (DOE-NEUP). The research proposal will be formally submitted to the Supervisory Committee at the beginning of the 5th semester and a 45-minute seminar will be presented to the faculty and students. The Supervisory Committee must approve the research proposal before you can continue to the oral examination.

The Oral Examination will be scheduled to take place after submission of the research proposal. The Oral Examination will be basically a defense of the research proposal, but questions may be asked on the written examination or in any area the Supervisory Committee feels is appropriate. If the Oral Examination is passed, the Ph.D. Qualifying Examination is complete and you advance to Ph.D. candidate status.

If the Qualifying Examination is failed, the Supervisory Committee may advise the termination with a M.S. degree, or may recommend that the Examination be retaken. If the Oral Examination is failed, only the Oral Examination need to be rescheduled.

Degree Time Limits

Requirements for the MS degree can be completed within four semesters. Four years is the maximum time allowable for completion of a M.S.

The time necessary to complete the Ph.D. requirements depends largely on how soon a student initiates research and the degree to which he/she devotes his/her efforts to its pursuit. However, the candidate shall finish his/her dissertation within three years after his/her qualifying examination. Six years is the maximum time allowable for completion of a Ph.D.

Applying for Graduation

All graduate students should meet with the Program graduate academic advisor prior to applying for graduation. Students are required to apply for graduation through the Registrar's Office, Graduation Division. The graduation application deadline is the same as the M.S. Candidacy or Ph.D. Program of Study forms: November 1 for Spring; April 1 for Summer; July 1 for Fall. The application can be found on the Program website. *Ph.D. students may only apply for graduation after publishing two peer reviewed journal articles.*