

UNLV

University of Nevada, Las Vegas
Office of the Senior Vice Provost for
Academic Affairs

Program Review Self-Study

Program(s) Under Review: Electrical Engineering

Degree(s): M.S., Ph.D.

Program Chair or Director: Dr. Biswajit Das

Dean: Dr. Rama Venkat

Date of Report: Nov. 28, 2022

GENERAL INSTRUCTIONS

- Please complete the program review self-study using this template.
- If this review is covering several degree levels, be sure to address each level in the responses to the questions.
- This is a formal document that will be read by Senior Vice Provost for Academic Affairs, the Nevada System of Higher Education (NSHE), and the Board of Regents, and will become a public document when submitted to NSHE. Please use professional language throughout the document.
- Writing style:
 - Write the self-study in third person (i.e., do not use “I, we or our”).
 - When referring to the program or faculty, use “the faculty” or “the program’s faculty”.
 - Use plain language when explaining parts of the program, i.e. don’t use discipline specific jargon or slang that will not be easy for others outside the program to understand.
 - Define abbreviations before using.
- Answer every question; do not refer to different sections as an answer. Information can be restated or summarized for subsequent sections.
- Please do not alter the format of this document.
- Ensure that the document has been edited (check for grammar, punctuation, notes to self, etc.) **prior to submission.**
- Send completed self-study electronically to: programreview@unlv.edu
- Questions can be addressed to the Academic Programs Analyst in the Office of the Senior Vice Provost for Academic Affairs or to programreview@unlv.edu

The Provost Office is committed to engaging programs in a clear and useful program review process. To facilitate continuous improvement, we welcome feedback from programs and departments, external or internal reviewers, and any other constituents of the process.

I. Program Description

a. College/Program

- **College or School:** College of Engineering
- **Unit:** Department of Electrical and Computer Engineering (ECE)
- **Web address:** <https://www.unlv.edu/ece>,
<https://catalog.unlv.edu/content.php?catoid=44&navoid=12863>
- **Program(s) being reviewed:**
 - **Degrees and their abbreviations:**
Master of Science in Electrical Engineering (abbreviated as MSEE)
Ph. D. in Electrical Engineering (abbreviated as PhDEE)

b. Primary Individual Completing This Worksheet

- **Name:** Mei Yang
- **Title:** Professor, Graduate Coordinator
- **Campus phone number:** (702)-895-2364
- **Mail stop:** 4026
- **E-mail:** Mei.Yang@unlv.edu
- **Date of self-study:** Nov. 28, 2022

c. Other Faculty Involved in Writing This Report

- **Names and e-mails:** Biswajit Das, Biswajit.Das@unlv.edu

d. Catalog Description

- i. Insert the most recent catalog description(s) of the programs(s)

[Department of Electrical and Computer Engineering Description:](#)

Electrical engineering is the basic and applied research of scientific and mathematical principles to investigate, invent, develop, design, manufacture, and control machines, processes, phenomena, and/or systems. The work of electrical engineers has had and continues to have a direct and vital impact on people's lives in the fields of environment, energy, defense, homeland security, data security, medicine, space exploration, safety, communication, biology and extending to all types of industrial and manufacturing issues. For example, electrical engineers have been responsible for the creation of electric power and signals at all frequencies and pulse repetition rates, modern electronics, computers, electronic communication systems, modern flight controllers, automated manufacturing, and medical diagnostic tools. An electrical engineering education continues to provide opportunities for solving problems of great social significance and for augmenting the quality of life. The Department of Electrical and Computer Engineering at UNLV has excellent facilities for graduate education and research in electrical engineering. In addition, the Electrical and Computer Engineering faculty is experienced and knowledgeable in many of the electrical engineering disciplines, including communications, computer engineering, control system theory, electromagnetics and optics, electronics, power systems, signal processing, and solid state devices. At UNLV, students have the

opportunity to interact effectively with faculty and personnel so that programs and research theses and dissertations can be tailored to their interests.

[Master of Science in Engineering - Electrical Engineering](#)

Plan Description

The Department of Electrical and Computer Engineering at UNLV offers a number of program degree options leading to the Master of Science in Engineering (M.S.E.) - Electrical Engineering. Specific areas of study that are currently available include Communications, Computer Engineering, Control System Theory, Electromagnetics and Optics, Electronics, Power Systems, Signal Processing, and Solid State Electronics and Photonics.

The following degree options are available:

- M.S.E. - Electrical Engineering with thesis option,
- M.S.E. – Electrical Engineering with course only option,
- M.S.E. – Electrical Engineering Integrated BS-MS subplan option, and
- M.S.E. – Electrical Engineering dual degree option.

The M.S.E. – Electrical Engineering thesis option culminates with a thesis which prepares the student for a Ph.D. experience if higher education is desired. The course only option is a final advanced professional degree option culminating with a comprehensive exam that must be passed in the student’s specialty area.

The Integrated BS-MS subplan option is for UNLV graduates who excel in their ECE UNLV undergraduate programs wanting to attain a M.S.E. or Ph.D. degree at UNLV in ECE with the thesis option.

The dual degree program allows the student to complete a M.S.E. – Electrical Engineering degree and a Masters of Science in Mathematics degree jointly [Refer to Dual Degree: Master of Science in Engineering – Electrical Engineering and Master of Science – Mathematical Sciences].

For more information about your program including your graduate program handbook and learning outcomes please visit the [Degree Directory](https://www.unlv.edu/degree/ms-electrical-engineering), <https://www.unlv.edu/degree/ms-electrical-engineering>.

Plan Admission Requirements

[Application deadlines](#)

Applications available on the [UNLV Graduate College website](#).

Applications are considered on an individual basis. Candidates can be admitted on a regular (full graduate standing) or provisional status. Qualified applicants who are not admitted on either status can take graduate courses as a non-degree seeking graduate student. Up to 15 UNLV credits taken as a non-degree seeking graduate student at UNLV can be applied towards an M.S.E. degree. Potentially, six graduate credits taken at another regionally accredited university [Graduate College Policy] may be transferred into the M.S.E. degree program at UNLV. At most, only 15 credits of a combination of non-UNLV course credits and ECE UNLV course credits taken as a non-seeking graduate student may be applied to the M.S.E. program. Courses with a grade less than B (3.0) cannot be applied to the M.S.E. program. Further, the courses must not have been or will be applied to different degree program. Note that informal course credits will not be transferred into a M.S.E. degree program. Informal courses such as Graduate Independent Study and seminar taken as a non-

degree seeking student cannot be applied towards an M.S.E. degree. Non-degree seeking students can count Electrical & Computer Engineering Graduate Special Topics towards the program degree as long as they adhere to the conditions of the particular program option regarding informal course credits.

To be considered for admission to the M.S.E. program, an applicant must:

1. Have a regionally accredited or equivalent Bachelor of Science (B.S.) degree in electrical engineering, computer engineering or a closely related discipline.
 - a. Applicants who possess a bachelor's degree in a closely related discipline, such as physics or mathematics, may be admitted on conditional and/or provisional status. These students will be required to complete certain undergraduate and/or graduate courses before they can attain regular status. The graduate committee determines these courses on an individual basis.
 - b. Graduates with degrees in engineering technology ordinarily have an inadequate background to be admitted to the graduate program.
2. Have a minimum grade point average (GPA) of 3.00 (A=4.00) for their bachelor's degree. Applicants who have an overall GPA below 3.00 must submit Graduate Record Examination (GRE) scores {scaled score and percentile score in quantitative, verbal reasoning, and analytical writing} to the Electrical and Computer Engineering Department. These applicants may be admitted subject to the discretion and possible further requirements of the Electrical and Computer Engineering Graduate Committee. Applicants who want to be considered for an assistantship, or who feel that their GRE scores will enhance their chances for admission, are strongly encouraged to submit GRE scores.
3. Submit GRE scaled and percentile scores in quantitative, verbal reasoning, and analytical writing to the Department of Electrical and Computer Engineering if the applicant did not obtain their bachelor's degree from an ABET accredited institution, if the applicant is interested in a teaching assistantship, or if the applicant received a Bachelor's Degree in Electrical and Computer Engineering more than five years prior to the first day of the first semester of the degree program applied for. Interpretation of the scores is at the discretion of the Electrical and Computer Engineering Graduate Committee. (An applicant possessing a bachelor's degree from an ABET accredited institution within the past five years is not required to submit GRE scores.)
4. Submit a completed application prior to the department's admission deadline.
 - a. Completed online application.
 - b. Submit official transcripts of all college-level work to the Graduate College.
 - c. Submit a one-page curriculum vitae listing the applicant's project, publication, and award records.
 - d. Submit a one page written statement of purpose indicating the applicant's research interests, motivations, and objectives.
 - i. In the statement of purpose, the applicant must explicitly identify their areas of interest from the following list of areas offered at UNLV in the ECE Department: Communications, Computer Engineering, Control Systems, Electromagnetics and Optics, Electronics, Power Systems, Signal Processing, and Solid State Materials and Devices (which includes Nanotechnology).
 - ii. Applicants are required to account for all time beyond the Bachelor degree indicating how they have developed professionally.
 - iii. Applicants transferring from other graduate programs must justify why they are leaving that program to join our program.
 - iv. Applicants receiving grades less than B in a graduate course elsewhere may not be admitted to the graduate program without a well-justified explanation. Poor performance in course work in the program that the student is transferring from may be

a cause for denial of admission. It will be the graduate committee's discretion whether to allow or deny admission.

- e. Submit three dated letters of recommendation concerning the applicant's potential for succeeding in the graduate program. If the applicant has attended a university or is currently enrolled in a program beyond the bachelor degree, then the letters of recommendation should be solicited from that university or program. If the applicant has been out of school for an extended period of time, then letters should be solicited from the professional community that can comment on the applicant's technical background and/or from the applicant's most recent academic institution. Letters of recommendation written beyond a six-month period prior to applying for admission to our graduate program will not be accepted. Strong letters of recommendation illustrate technical talent and professional accomplishments beyond the grade point average or course grade. The graduate committee is interested in the applicant's technical, conceptual, verbal, ethical, and social skills. The graduate committee is interested in the applicant's ability to perform research with evidence to substantiate claims made. Note that letters from professors that casually know the applicant will not help in the admission process.
 - f. Application deadlines are February 1st for admission in the fall of the same year and October 1st for admission in the spring of the subsequent year.
5. International applicants must provide proof of English proficiency, as stated in the Graduate College English proficiency requirements website.
 6. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

The Integrated BS-MS subplan program allows select UNLV undergraduates to pursue the Electrical Engineering M.S.E. degree at UNLV. The program provides an opportunity for those undergraduates who have taken either 9, 6, or 3 graduate-level electrical and computer engineering course credits applied toward their undergraduate electrical/computer engineering degrees, to complete the respectively corresponding M.S. in Engineering with a total of either 21, 24, or 27 as opposed to the 30 credits required for Thesis subplan. Students admitted to the Integrated BS-MS subplan program are required to write a thesis.

To be considered for admission to the Integrated BS-MS subplan, an applicant must:

1. Have a minimum overall grade point average (GPA) of 3.5 (A = 4.00) for their B.S. degree in electrical engineering or computer engineering at UNLV.
2. Have completed up to a maximum of 9 credits of formal Graduate College curriculum approved 600/700 level courses (which excludes informal courses such as Graduate Independent Study, Graduate Seminar, and Special Topics) which were applied towards the student's B.S. degree. Each graduate level course must have been completed with a minimum grade of B (3.0).

Students are accepted into a degree program as described in the Graduate Catalog. The faculty and corresponding sub-disciplines and sub-plans within the described programs are subject to change at any time.

Plan Requirements

See Subplan Requirements below.

- Subplan 1: Comprehensive Exam
- Subplan 2: Thesis
- Subplan 3: Integrated BS-MS

Subplan 1 Requirements: Comprehensive Exam

Total Credits Required: 30

Course Requirements

Core Courses – Credits: 9

Complete a minimum of 3 credits in at least three of the following areas:

Communications

ECG 704 - Coding with Applications in Computers and Communication Media

ECG 706 - Analysis of Telecommunication and Data Networks

ECG 760 - Random Processes in Engineering Problems

ECG 762 - Detection and Estimation of Signals in Noise

ECG 763 - Advanced Digital Communication Systems

Computer Engineering

ECG 618 - Cloud Computing in Engineering

ECG 700 - Advanced Computer System Architecture

ECG 701 - Reliable Design of Digital Systems

ECG 702 - Interconnection Networks for Parallel Processing Applications

ECG 703 - Machine Learning and Applications

ECG 704 - Coding with Applications in Computers and Communication Media

ECG 706 - Analysis of Telecommunication and Data Networks

ECG 707 - Logic Synthesis Engineering

ECG 709 - Synthesis and Optimization of Digital Systems

Control Systems Theory

ECG 770 - Linear Systems

ECG 771 - Optimal and Modern Control

ECG 772 - Nonlinear Systems

ECG 774 - Stochastic Control

ECG 776 - Adaptive Control

Electromagnetics and Optics

ECG 730 - Advanced Engineering Electromagnetics I

ECG 731 - Theoretical Techniques in Electromagnetics

ECG 732 - Advanced Engineering Electromagnetics II

ECG 733 - Plasma I

Electronics

ECG 720 - Advanced Analog IC Design

ECG 721 - Memory Circuit Design

ECG 722 - Mixed-Signal Circuit Design

Power Engineering

ECG 740 - Computer Analysis Methods for Power Systems

ECG 741 - Electric Power Distribution System Engineering

ECG 742 - Power System Stability and Control

ECG 743 - Smart Electrical Power Grid

Signal Processing

- ECG 682 - Digital Signal Processing Applications
- ECG 703 - Machine Learning and Applications
- ECG 760 - Random Processes in Engineering Problems
- ECG 762 - Detection and Estimation of Signals in Noise
- ECG 781 - Digital Filters
- ECG 782 - Multidimensional Digital Signal Processing
- ECG 783 - Adaptive Signal Processing with Neural Networks

Solid State Electronics and Photonics

- ECG 614 - Quantum Communication
- ECG 712 - Optical Materials and Devices
- ECG 715 - Biomedical Photonics
- ECG 716 - Space Systems
- ECG 750 - Photonics
- ECG 752 - Physical Electronics
- ECG 753 - Advanced Topics in Semiconductor Devices I
- ECG 755 - Monolithic Integrated Circuit Fabrication
- ECG 756 - Advanced Topics in Semiconductor Devices II
- ECG 757 - Electron Transport Phenomena in Solid State Devices
- ECG 758 - Numerical Methods in Engineering

Additional Core Courses – Credits: 12

Complete 12 credits of 700-level additional core courses from the core courses in any of the areas listed above.

Elective Courses – Credits 9

Complete a minimum of 9 credits of 600- or 700-level MAT, PHY, AST, CEE, CEM, ECG, EGG, CS, ME, or other advisor-approved courses.

Degree Requirements

1. Students must satisfy the M.S.E. - Electrical Engineering degree program admission requirements and be admitted to the M.S.E. - Electrical Engineering program with regular full graduate standing status, having met all conditions and provisions.
2. Students must complete a minimum of 30 credits of graduate level courses with an overall minimum GPA of 3.00 (B), a minimum GPA of 3.00 (B) each semester, and a minimum GPA of 2.70 (B-) in each class applied towards the 30 credits. Grades below B- are not counted towards the M.S.E. degree and must be repeated or replaced.
3. Students who do not maintain an overall GPA of 3.00 (B), a GPA of 3.00 (B) each semester, or who earn more than one grade below B- will either be placed on probation or expelled from the program. The Electrical and Computer Engineering Graduate Committee and/or the Graduate College will determine the terms of the student's probation in accordance with the rules of the Graduate College.
4. At the time of admission or no later than the first semester, the candidate must formally petition BOTH the graduate college and the ECE graduate committee to accept transfer credits and credits taken as a non-degree seeking graduate student to be applied to the M.S.E. program.
5. Students must select a faculty advisor in their first semester.

6. A minimum of 21 credits must be in core electrical engineering 700-level courses excluding informal courses (such as Independent Study, Graduate Seminar, and Special Topics).
7. No more than 3 credits may be from Independent Study (which cumulatively includes Graduate Seminar) and no more than a total of 6 credits of the combination of Independent Study, Graduate Seminar, and Graduate Special Topics may be applied towards the M.S.E. degree program.
8. Pass a comprehensive exam on graduate level coursework in the student's specialty area.
 1. The exam may be taken in the last two semesters of the student's M.S.E. program.
 2. The student may not take the exam until all course work pertaining to the exam is completed. For clarity, students enrolled in courses pertaining to the comprehensive exam cannot take the comprehensive exam. Within the six year limit, the exam may be repeated until passed but cannot be taken more than once per semester. Prior to the end of the first week of classes in the student's last two semesters, the student must announce to the ECE Graduate Coordinator their intention of taking the exam, the major field to be examined, and at least two courses taken in that field.
9. The Comprehensive Exam subplan is a final advanced professional degree option in that students who complete this subplan will not be considered for admission into any of the department's Ph.D. program options.

Graduation Requirements

- The student must pass a final comprehensive exam.
- Students may apply for graduation up to two semesters prior to completing their degree requirements. All required forms must be submitted to the graduate college via the [Grad Rebel Gateway](#).

Subplan 2 Requirements: Thesis

Total Credits Required: 30

Course Requirements

Core Courses – Credits: 9

Complete a minimum of 3 credits in at least three of the following areas:

Communications

ECG 662 - Digital Communication Systems

ECG 666 - Wireless and Mobile Communication Systems

ECG 704 - Coding with Applications in Computers and Communication Media

ECG 706 - Analysis of Telecommunication and Data Networks

ECG 760 - Random Processes in Engineering Problems

ECG 762 - Detection and Estimation of Signals in Noise

ECG 763 - Advanced Digital Communication Systems

Computer Engineering

ECG 600 - Computer Communication Networks

ECG 604 - Modern Processor Architecture

ECG 605 - Data Compression Systems

ECG 607 - Biometrics

ECG 608 - Digital Design Verification and Testing

ECG 609 - Embedded Digital Signal Processing

ECG 617 - Internet of Things Systems

ECG 618 - Cloud Computing in Engineering
ECG 700 - Advanced Computer System Architecture
ECG 701 - Reliable Design of Digital Systems
ECG 702 - Interconnection Networks for Parallel Processing Applications
ECG 703 - Machine Learning and Applications
ECG 704 - Coding with Applications in Computers and Communication Media
ECG 706 - Analysis of Telecommunication and Data Networks
ECG 707 - Logic Synthesis Engineering
ECG 709 - Synthesis and Optimization of Digital Systems

Control Systems Theory

ECG 672 - Digital Control Systems
ECG 770 - Linear Systems
ECG 771 - Optimal and Modern Control
ECG 772 - Nonlinear Systems
ECG 774 - Stochastic Control
ECG 776 - Adaptive Control

Electromagnetics and Optics

ECG 630 - Transmission Lines
ECG 631 - Engineering Optics
ECG 632 - Antenna Engineering
ECG 633 - Active and Passive Microwave Engineering
ECG 730 - Advanced Engineering Electromagnetics I
ECG 731 - Theoretical Techniques in Electromagnetics
ECG 732 - Advanced Engineering Electromagnetics II
ECG 733 - Plasma I

Electronics

ECG 620 - Analog Integrated Circuit Design
ECG 621 - Digital Integrated Circuit Design
ECG 720 - Advanced Analog IC Design
ECG 721 - Memory Circuit Design
ECG 722 - Mixed-Signal Circuit Design

Power Engineering

ECG 642 - Power Electronics
ECG 646 - Photovoltaic Devices and Systems
ECG 740 - Computer Analysis Methods for Power Systems
ECG 741 - Electric Power Distribution System Engineering
ECG 742 - Power System Stability and Control
ECG 743 - Smart Electrical Power Grid

Signal Processing

ECG 680 - Discrete-Time Signal Processing
ECG 682 - Digital Signal Processing Applications
ECG 703 - Machine Learning and Applications
ECG 760 - Random Processes in Engineering Problems

ECG 762 - Detection and Estimation of Signals in Noise
ECG 781 - Digital Filters
ECG 782 - Multidimensional Digital Signal Processing
ECG 783 - Adaptive Signal Processing with Neural Networks

Solid State Electronics and Photonics
ECG 614 - Quantum Communication
ECG 651 - Electronic and Magnetic Materials and Devices
ECG 652 - Optoelectronics
ECG 653 - Introduction to Nanotechnology
ECG 712 - Optical Materials and Devices
ECG 715 - Biomedical Photonics
ECG 716 - Space Systems
ECG 750 - Photonics
ECG 752 - Physical Electronics
ECG 753 - Advanced Topics in Semiconductor Devices I
ECG 755 - Monolithic Integrated Circuit Fabrication
ECG 756 - Advanced Topics in Semiconductor Devices II
ECG 757 - Electron Transport Phenomena in Solid State Devices
ECG 758 - Numerical Methods in Engineering

Additional Core Courses – Credits: 9

Complete 9 credits of additional core courses from the core courses in any of the areas listed above.

Elective Courses – Credits: 6

Complete a minimum of 6 credits of 600- or 700-level MAT, PHY, AST, CEE, CEM, ECG, EGG, CS, ME, or other advisor-approved courses.

Thesis – Credits: 6

ECG 797 - Electrical Engineering Thesis

Degree Requirements

1. Students must satisfy the M.S.E. - Electrical Engineering degree program admission requirements and be admitted to the M.S.E. - Electrical Engineering program with regular full graduate standing status, having met all conditions and provisions.
2. Students must complete a minimum of 30 credits of graduate level courses with an overall minimum GPA of 3.00 (B), a minimum GPA of 3.00 (B) each semester, and a minimum GPA of 2.70 (B-) in each class applied towards the 30 credits. Grades below B- are not counted towards the M.S.E. degree and must be repeated or replaced.
3. Students who do not maintain an overall GPA of 3.00 (B), a GPA of 3.00 (B) each semester, or who earn more than one grade below B- will either be placed on probation or expelled from the program. The Electrical and Computer Engineering Graduate Committee and/or the Graduate College will determine the terms of the student's probation in accordance with the rules of the Graduate College.
4. At the time of admission or no later than the first semester, the MS candidate must formally petition BOTH the graduate college and the ECE graduate committee to accept transfer credits and credits taken as a non-degree seeking graduate student to be applied to the M.S.E. program.
5. Students must select a faculty advisor in their first semester.
6. A minimum of 18 credits must be in core (formal) electrical engineering courses, of which 15 credits

- must be 700-level. This excludes Thesis credits, and informal courses (such as Special Topics, Graduate Seminar, and Independent Study).
7. No more than 3 credits may be from Independent Study (which cumulatively includes Graduate Seminar) and no more than a total of 6 credits of the combination of Independent Study, Graduate Seminar, and Graduate Special Topics may be applied towards the M.S.E. degree program.
 8. In consultation with their advisor, a student will organize a thesis committee of at least three departmental members. In addition, a fourth member from outside the department, known as the Graduate College Representative, must be appointed. An additional committee member may be added at the student and department's discretion. Please see Graduate College policy for committee appointment guidelines.
 9. Students must complete a thesis.
 1. Students must complete at least 6 credits of Thesis which culminates in the successful completion of a thesis oral exam and the submission of an approved thesis. Although Electrical Engineering Thesis can be taken repeatedly, no more than 6 credits can be applied towards the 30 credits required for the M.S.E. degree.
 2. Before beginning a thesis, students must have their thesis topic approved by their advisor, and the necessary paper work must be filed with the Graduate College. The thesis prospectus describes the thesis topic and must include an introductory set of sentences, a well formed hypothesis or hypotheses (specifically italicized in the prospectus) accompanied by a motivation, objectives with major and alternative approaches to the studies, and conjectures of possible outcomes. Students are NOT allowed to take thesis credits until their thesis prospectus is approved. Credits taken before the approval date will NOT count towards the degree program.
 3. The student must complete a thesis containing original research and publically defend it before their advisory committee at the Thesis Exam.
 4. Prior to the student's defense of the thesis before their advisory committee, the student must submit a complete copy of the thesis to each member of their advisory committee. This submission must occur at least two weeks prior to the date of the oral defense. The student must also notify each member of their advisory committee of the date, time and location of the oral defense of the thesis or project at least two weeks in advance.
 5. Students who plan to continue their studies beyond the M.S.E. degree program are strongly encouraged to select this option.
 10. A full graduate standing master's degree candidate who is interested in pursuing a doctoral degree may be allowed to take the Ph.D. qualifying exam without penalty during their period as an M.S.E. student. The exam may be taken as many times as desired but no more than once a semester at the time the exam is typically offered. The M.S.E. candidate must pass four areas of choice in a single sitting to satisfy the Qualifying Exam requirement. If the student successfully completes the Qualifying Exam requirement while pursuing the M.S.E. degree in Electrical Engineering with a thesis option in the Electrical and Computer Engineering department at UNLV, the student will have automatically fulfilled the Qualifying Exam requirement upon admission to the Ph.D. program in the Electrical and Computer Engineering program at UNLV. Once the student receives an M.S. degree in the field of Electrical Engineering, the student must abide by the requirements outlined in the Ph.D. program. This option is not available to non-degree students.

Graduation Requirements

- The student must submit and successfully defend their thesis by the posted deadline. The defense must be advertised and is open to the public.

- After the thesis defense, the student must electronically submit a properly formatted pdf copy of their thesis to the Graduate College for format check. Once the thesis format has been approved by the Graduate College, the student will submit the approved electronic version to ProQuest. Deadlines for thesis defenses, format check submissions, and the final ProQuest submission can be found here.
- Students may apply for graduation up to two semesters prior to completing their degree requirements. All required forms must be submitted to the graduate college via the Grad Rebel Gateway.

Subplan 3 Requirements: Integrated BS-MS

Total Credits Required: 21-27

Course Requirements

Core Courses – Credits: 0-9

Complete a minimum of 0-3 credits in at least three of the following areas:

Communications

ECG 662 - Digital Communication Systems
 ECG 666 - Wireless and Mobile Communication Systems
 ECG 704 - Coding with Applications in Computers and Communication Media
 ECG 706 - Analysis of Telecommunication and Data Networks
 ECG 760 - Random Processes in Engineering Problems
 ECG 762 - Detection and Estimation of Signals in Noise
 ECG 763 - Advanced Digital Communication Systems

Computer Engineering

ECG 600 - Computer Communication Networks
 ECG 604 - Modern Processor Architecture
 ECG 605 - Data Compression Systems
 ECG 607 - Biometrics
 ECG 608 - Digital Design Verification and Testing
 ECG 609 - Embedded Digital Signal Processing
 ECG 617 - Internet of Things Systems
 ECG 618 - Cloud Computing in Engineering
 ECG 700 - Advanced Computer System Architecture
 ECG 701 - Reliable Design of Digital Systems
 ECG 702 - Interconnection Networks for Parallel Processing Applications
 ECG 703 - Machine Learning and Applications
 ECG 704 - Coding with Applications in Computers and Communication Media
 ECG 706 - Analysis of Telecommunication and Data Networks
 ECG 707 - Logic Synthesis Engineering
 ECG 709 - Synthesis and Optimization of Digital Systems

Control Systems Theory

ECG 672 - Digital Control Systems
 ECG 770 - Linear Systems
 ECG 771 - Optimal and Modern Control

ECG 772 - Nonlinear Systems
ECG 774 - Stochastic Control
ECG 776 - Adaptive Control

Electromagnetics and Optics

ECG 630 - Transmission Lines
ECG 631 - Engineering Optics
ECG 632 - Antenna Engineering
ECG 633 - Active and Passive Microwave Engineering
ECG 730 - Advanced Engineering Electromagnetics I
ECG 731 - Theoretical Techniques in Electromagnetics
ECG 732 - Advanced Engineering Electromagnetics II
ECG 733 - Plasma I

Electronics

ECG 620 - Analog Integrated Circuit Design
ECG 621 - Digital Integrated Circuit Design
ECG 720 - Advanced Analog IC Design
ECG 721 - Memory Circuit Design
ECG 722 - Mixed-Signal Circuit Design

Power Engineering

ECG 642 - Power Electronics
ECG 646 - Photovoltaic Devices and Systems
ECG 740 - Computer Analysis Methods for Power Systems
ECG 741 - Electric Power Distribution System Engineering
ECG 742 - Power System Stability and Control
ECG 743 - Smart Electrical Power Grid

Signal Processing

ECG 680 - Discrete-Time Signal Processing
ECG 682 - Digital Signal Processing Applications
ECG 703 - Machine Learning and Applications
ECG 760 - Random Processes in Engineering Problems
ECG 762 - Detection and Estimation of Signals in Noise
ECG 781 - Digital Filters
ECG 782 - Multidimensional Digital Signal Processing
ECG 783 - Adaptive Signal Processing with Neural Networks

Solid State Electronics and Photonics

ECG 614 - Quantum Communication
ECG 651 - Electronic and Magnetic Materials and Devices
ECG 652 - Optoelectronics
ECG 653 - Introduction to Nanotechnology
ECG 712 - Optical Materials and Devices
ECG 715 - Biomedical Photonics
ECG 716 - Space Systems
ECG 750 - Photonics

ECG 752 - Physical Electronics
ECG 753 - Advanced Topics in Semiconductor Devices I
ECG 755 - Monolithic Integrated Circuit Fabrication
ECG 756 - Advanced Topics in Semiconductor Devices II
ECG 757 - Electron Transport Phenomena in Solid State Devices
ECG 758 - Numerical Methods in Engineering

Additional Core Courses – Credits: 0-9

Complete 0-9 credits of additional core courses from the core courses in any of the areas listed above.

Elective Courses – Credits: 0-6

Complete 0-6 credits of 600- or 700-level MAT, PHY, AST, CEE, CEM, ECG, EGG, CS, ME, or other advisor-approved courses.

Thesis – Credits: 6

ECG 797 - Electrical Engineering Thesis

Degree Requirements

1. Students must satisfy the M.S.E. - Electrical Engineering degree program admission requirements and be admitted to the M.S.E. - Electrical Engineering program with regular full graduate standing status, having met all conditions and provisions.
2. Total credits required depends on the total number of approved graduate-level course work taken as technical electives (with a grade of B or better) during the senior year.
3. Complete a minimum of 21, 24, or 27 credits (including thesis credits) in the Integrated BS-MS subplan program respectively corresponding to 9, 6, or 3 credits of formally approved graduate level courses applied toward the B.S. degree yielding a total of 30 course credits. The final division of major, minor, and elective credits will be determined in consultation with the student's advisor.
4. Students must complete all courses with an overall minimum GPA of 3.00 (B), a minimum GPA of 3.00 (B) each semester, and a minimum GPA of 2.70 (B-) in each class applied towards the 30 credits. Grades below B- are not counted towards the M.S.E. degree and must be repeated or replaced.
5. Students who do not maintain an overall GPA of 3.00 (B), a GPA of 3.00 (B) each semester, or who earn more than one grade below B- will either be placed on probation or expelled from the program. The Electrical and Computer Engineering Graduate Committee and/or the Graduate College will determine the terms of the student's probation in accordance with the rules of the Graduate College.
6. At the time of admission or no later than the first semester, the MS candidate must formally petition BOTH the graduate college and the ECE graduate committee to accept transfer credits and credits taken as a non-degree seeking graduate student to be applied to the M.S.E. program.
7. Students must select a faculty advisor in their first semester.
8. A minimum of 18 credits must be in core (formal) electrical engineering courses, of which 15 credits must be 700-level. This excludes Thesis credits, and informal courses (such as Special Topics, Graduate Seminar, and Independent Study).
9. No more than 3 credits may be from Independent Study (which cumulatively includes Graduate Seminar) and no more than a total of 6 credits of the combination of Independent Study, Graduate Seminar, and Graduate Special Topics may be applied towards the M.S.E. degree program.
10. In consultation with their advisor, a student will organize a thesis committee of at least three departmental members. In addition, a fourth member from outside the department, known as the Graduate College Representative, must be appointed. An additional committee member may be added at the student and department's discretion. Please see Graduate College policy for committee

appointment guidelines.

11. Students must complete a thesis.

1. Students must complete at least 6 credits of Thesis which culminates in the successful completion of a thesis oral exam and the submission of an approved thesis. Although Electrical Engineering Thesis can be taken repeatedly, no more than 6 credits can be applied towards the 30 credits required for the M.S.E. degree.
2. Before beginning a thesis, students must have their thesis topic approved by their advisor, and the necessary paper work must be filed with the Graduate College. The thesis prospectus describes the thesis topic and must include an introductory set of sentences, a well formed hypothesis or hypotheses (specifically italicized in the prospectus) accompanied by a motivation, objectives with major and alternative approaches to the studies, and conjectures of possible outcomes. Students are NOT allowed to take thesis credits until their thesis prospectus is approved. Credits taken before the approval date will NOT count towards the degree program.
3. The student must complete a thesis containing original research and publically defend it before their advisory committee at the Thesis Exam.
4. Prior to the student's defense of the thesis before their advisory committee, the student must submit a complete copy of the thesis to each member of their advisory committee. This submission must occur at least two weeks prior to the date of the oral defense. The student must also notify each member of their advisory committee of the date, time and location of the oral defense of the thesis or project at least two weeks in advance.
5. Students who plan to continue their studies beyond the M.S.E. degree program are strongly encouraged to select this option.

12. A full graduate standing master's degree candidate who is interested in pursuing a doctoral degree may be allowed to take the Ph.D. qualifying exam without penalty during their period as an M.S.E. student. The exam may be taken as many times as desired but no more than once a semester at the time the exam is typically offered. The M.S.E. candidate must pass four areas of choice in a single sitting to satisfy the Qualifying Exam requirement. If the student successfully completes the Qualifying Exam requirement while pursuing the M.S.E. degree in Electrical Engineering with a thesis option in the Electrical and Computer Engineering department at UNLV, the student will have automatically fulfilled the Qualifying Exam requirement upon admission to the Ph.D. program in the Electrical and Computer Engineering program at UNLV. Once the student receives an M.S. degree in the field of Electrical Engineering, the student must abide by the requirements outlined in the Ph.D. program. This option is not available to non-degree students.

Graduation Requirements

- The student must submit and successfully defend their thesis by the posted deadline. The defense must be advertised and is open to the public.
- After the thesis defense, the student must electronically submit a properly formatted pdf copy of their thesis to the Graduate College for format check. Once the thesis format has been approved by the Graduate College, the student will submit the approved electronic version to ProQuest. Deadlines for thesis defenses, format check submissions, and the final ProQuest submission can be found here.
- Students may apply for graduation up to two semesters prior to completing their degree requirements. All required forms must be submitted to the graduate college via the Grad Rebel Gateway.

[Doctor of Philosophy - Electrical Engineering](#)

Plan Description

The culminating experience in the Ph.D. program in the Department of Electrical and Computer Engineering is centered about developing new knowledge focused around a specific theme embodied in the form a well-written and orally defended dissertation. The Department of Electrical and Computer Engineering at UNLV offers a number of program options leading to the Ph.D. degree in the Field of Electrical Engineering. Specific major areas of study currently available include: Communications, Computer Engineering, Control System Theory, Electromagnetics and Optics, Electronics, Power Systems, Signal Processing, and Solid State Materials and Devices.

Applicants may be admitted to the Electrical Engineering Ph.D Program through one of the following three options:

- the Post-Master's subplan,
- the Post-Bachelor's subplan,
- or the Post-Bachelor's Integrated BS-PHD subplan.

The Post-Master's subplan requires the student to have completed a M.S. Degree in Electrical Engineering, Computer Engineering, or a closely related field with thesis before entering the program.

The Post-Bachelor's subplan allows undergraduates with outstanding undergraduate backgrounds to enter the Ph.D. program without having to complete a M.S. Degree in Electrical or Computer Engineering.

The Post-Bachelor's Integrated BS-PHD subplan allows students who applied up to 9 credits of graduate courses towards their B.S. degrees to complete their Ph.D. in engineering with up to 9 fewer credits than students in the Post-Bachelor's subplan. All requirements leading to a Ph.D. are still required beyond the B.S. Degree in Electrical and Computer Engineering excluding the completion of a Master's thesis. In conjunction with these options, a dual degree option does exist for candidates simultaneously working towards a Ph.D. degree in Electrical Engineering and a Master of Science degree in Mathematics.

This program prepares graduate students with complementing educational components covering electrical engineering and mathematics, which is the basis of all engineering. [Refer to the Dual Degree Doctor of Philosophy – Electrical Engineering and Master of Science – Mathematical Sciences program description.

For more information about your program, including your graduate program handbook and learning outcomes, please visit the [Degree Directory](https://www.unlv.edu/degree/phd-electrical-engineering), <https://www.unlv.edu/degree/phd-electrical-engineering>.

Plan Admission Requirements

[Application deadlines](#)

Applications available on the [UNLV Graduate College website](#).

Applicants are considered on an individual basis. Applicants may be admitted as a regular or provisional status student. Qualified applicants who are not admitted can take graduate courses as a non-degree seeking graduate student. Up to 15 UNLV credits taken as a non-degree seeking graduate student at UNLV can be applied towards a PhD degree program in electrical and computer engineering. Potentially, nine graduate credits taken at another regionally accredited university may be transferred in the PhD degree program at

UNLV. At most, only 15 credits of a combination of UNLV and non-UNLV course credits, within the constraints above, may be applied to the PhD program. Courses with a grade less than B (3.0) will not be applied to the PhD program. Further, the courses must not have been or will be applied to different degree program. Note that informal course credits will not be transferred into a PhD degree program. Informal courses such as Graduate Independent Study and Seminar taken as a non-degree seeking student cannot be applied towards a program degree in ECE. Non-degree seeking students can count Electrical & Computer Engineering Graduate Special Topics towards the program degree as long as they adhere to the conditions of the particular program option regarding informal course credits.

To be considered for admission an applicant must:

1. Submit GRE scaled and percentile scores in quantitative, verbal reasoning, and analytical writing to the Department of Electrical and Computer Engineering and have obtained the following minimum relative percentile comparison rank of 75 in the Quantitative section, 20 in the Verbal Reasoning section, and 20 in Analytical Writing. Please note that GRE scores will only be considered valid if taken within five years prior to the time of admission and are recognized by the GRE examination board. Official scores must be obtained from an official GRE provider. The GRE requirement can be waived under the circumstances listed in the GRE Waiver section.
2. Submit a completed application form and official transcripts of all college level work to the Graduate College.
3. Submit a one-page written statement of purpose indicating the applicant's interests, motivations, and objectives. In the statement of purpose, the applicant must explicitly identify their areas of interest from the following list of areas offered at UNLV in the ECE Department: Communications, Computer Engineering, Control Systems, Electromagnetics and Optics, Electronics, Power Systems, Signal Processing, and Solid-State Electronics and Photonics (which includes Nanotechnology). Applicants are required to account for all time beyond the B.S. degree indicating how they have developed professionally. Applicants transferring from other graduate programs without obtaining an M.S. degree must justify why they are leaving that program to join our graduate program. Applicants receiving grades less than B in a graduate course elsewhere may not be admitted to the graduate program without a well-justified explanation. Poor performance in course work in the program that the student is transferring from can be a cause for denial of admission. It will be the graduate committee's discretion whether to allow or deny admission.
4. Submit a one-page curriculum vitae listing the applicant's project, publication, and award records.
5. Submit three letters of recommendation (signed and dated) concerning the applicant's potential for succeeding in the graduate program directly to the Department of Electrical and Computer Engineering. Letters of reference may be electronically uploaded in the online admissions application process. If the student received a M.S. degree in electrical or computer engineering at UNLV, then only one letter of recommendation is required, and it must come from the candidate's faculty advisor who should be the student's thesis committee chair. If the applicant has attended a university or is currently enrolled in a program beyond the M.S. degree, then at least one letter of recommendation should be solicited from that university or program and two from the university in which the M.S. degree was received. One of the three letters should be written by your thesis advisor commenting on your background and your thesis research. If the applicant has been out of school for an extended period of time, then letters should be solicited from the professional community who can comment on the applicant's technical background and/or from the applicant's most recent academic institution. Letters of recommendation written beyond a six-month period prior to applying for admission to our graduate program will not be accepted. Strong letters of recommendation illustrate technical talent and professional accomplishments beyond the grade point average or course grade. The graduate

committee is interested in the applicant's technical, conceptual, verbal, ethical and social skills. The graduate committee is interested in the applicant's ability to perform research with evidence to substantiate claims made. Note that letters from professors that casually know you will not help you in the admission process.

6. International applicants must provide proof of English proficiency, as stated in the Graduate College English proficiency requirements website.
7. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.
8. Application deadlines are February 1st for admission in the fall of the same year and October 1st for admission in the spring of the subsequent year.

Post-Master's subplan:

1. Have a Master of Science (M.S.) degree in electrical engineering or computer engineering or a closely related field with an M.S. thesis component. The M.S. thesis must be completed prior to admission. Potential candidates applying to the program based on a course only option or a project option will not be admitted. (Applicants who possess a bachelor's degree in a closely related discipline, such as physics or mathematics, may be admitted on conditional and/or provisional status. These students will be required to complete certain undergraduate and/or graduate courses before they can attain regular full graduate standing status. The graduate committee determines these courses on an individual basis.)
2. Have a minimum overall grade point average (GPA) of 3.20 (A = 4.00) for their M.S. degree and a 3.00 for their B.S. degree.

Post-Bachelor's subplan:

1. Have a Bachelor of Science (B.S.) degree in electrical engineering or computer engineering or a closely related field. (Applicants who possess a bachelor degree in a closely related discipline, such as physics or mathematics, may be admitted on conditional and/or provisional status. These students will be required to complete certain undergraduate and/or graduate courses before they can attain regular full graduate standing status. The graduate committee determines these courses on an individual basis.)
2. Have a minimum overall grade point average (GPA) of 3.50 (A = 4.00) for their B.S. degree in Electrical or Computer Engineering a closely related field.

Post-Bachelor's Integrated BS-PHD subplan:

The Integrated BS-PHD subplan program allows UNLV undergraduate students who applied up to 9 credits of UNLV electrical engineering or computer engineering graduate courses towards their UNLV B.S. in Electrical Engineering or Computer Engineering degree to complete their Ph.D. in engineering with up to 9 fewer credits than students in the Post-Bachelor's subplan. All requirements leading to a Ph.D. are still required beyond the B.S. Degree in Electrical and Computer Engineering excluding the completion of a Master's thesis.

1. Have a minimum overall grade point average (GPA) of 3.5 (A = 4.00) for their B.S. degree in electrical engineering or computer engineering at UNLV.
2. Have completed up to a maximum of 9 credits of formal Graduate College curriculum approved 600/700 level courses (which excludes informal courses such as Graduate Independent Study, Graduate Seminar, and Special Topics) which were applied towards the student's B.S. degree. Each

graduate level course must have been completed with a minimum grade of B (GPA) of 3.2 (A = 4.00).

GRE Waiver:

The GRE entrance requirement will be waived for students entering the Ph.D. program if ALL of the following are satisfied. The final decision is up to the graduate committee.

1. The candidate received a bachelor or master's degree (thesis option) in electrical and/or computer engineering from an ABET-accredited electrical and/or computer engineering program.
2. The candidate's BS GPA equals or exceeds 3.0 and MS GPA equals or exceeds 3.6 for conventional Ph.D. applicants. The candidate's BS GPA equals or exceeds 3.5 for direct Ph.D. applicants.
3. The conventional Ph.D. applicant must show evidence that a paper pertaining to his/her research has been accepted/published in a refereed conference (minimum requirement) or a journal. Reviewers' comments along with a letter of acceptance may be used as minimum evidence that a paper will be published. The direct Ph.D. applicant must show evidence of research experience. Examples of such evidence include but not limited to 1) a research publication; 2) a research poster/presentation; 3) participation in a sponsored research project; 4) participation in a research internship, etc.
4. Letters of recommendation should clearly indicate the student's potential and ability to succeed in research and higher education.

Students are accepted into a degree program as described in the Graduate Catalog. The faculty and corresponding sub-disciplines and sub-plans within the described programs are subject to change at any time.

Plan Requirements

See Subplan Requirements below.

- Subplan 1: Post-Master's
- Subplan 2: Post-Bachelor's
- Subplan 3: Post-Bachelor's Integrated BS-PHD

Subplan 1 Requirements: Post-Master's

Total Credits Required: 45

Course Requirements

Major Field Courses – Credits: 6-15

Complete 6-15 credits of advisor approved coursework in an single major area in Electrical and Computer Engineering (suggested courses below), with a minimum overall average GPA of 3.33.

Communications

ECG 662 - Digital Communication Systems

ECG 666 - Wireless and Mobile Communication Systems

ECG 704 - Coding with Applications in Computers and Communication Media

ECG 706 - Analysis of Telecommunication and Data Networks

ECG 760 - Random Processes in Engineering Problems
ECG 762 - Detection and Estimation of Signals in Noise
ECG 763 - Advanced Digital Communication Systems

Computer Engineering

ECG 600 - Computer Communication Networks
ECG 603 - Embedded Systems Design
ECG 604 - Modern Processor Architecture
ECG 605 - Data Compression Systems
ECG 607 - Biometrics
ECG 608 - Digital Design Verification and Testing
ECG 609 - Embedded Digital Signal Processing
ECG 617 - Internet of Things Systems
ECG 618 - Cloud Computing in Engineering
ECG 700 - Advanced Computer System Architecture
ECG 701 - Reliable Design of Digital Systems
ECG 702 - Interconnection Networks for Parallel Processing Applications
ECG 703 - Machine Learning and Applications
ECG 704 - Coding with Applications in Computers and Communication Media
ECG 706 - Analysis of Telecommunication and Data Networks
ECG 707 - Logic Synthesis Engineering
ECG 709 - Synthesis and Optimization of Digital Systems

Control Systems Theory

ECG 672 - Digital Control Systems
ECG 770 - Linear Systems
ECG 771 - Optimal and Modern Control
ECG 772 - Nonlinear Systems
ECG 774 - Stochastic Control
ECG 776 - Adaptive Control

Electromagnetics and Optics

ECG 630 - Transmission Lines
ECG 631 - Engineering Optics
ECG 632 - Antenna Engineering
ECG 633 - Active and Passive Microwave Engineering
ECG 730 - Advanced Engineering Electromagnetics I
ECG 731 - Theoretical Techniques in Electromagnetics
ECG 732 - Advanced Engineering Electromagnetics II
ECG 733 - Plasma I

Electronics

ECG 620 - Analog Integrated Circuit Design
ECG 621 - Digital Integrated Circuit Design
ECG 720 - Advanced Analog IC Design
ECG 721 - Memory Circuit Design
ECG 722 - Mixed-Signal Circuit Design

Power Engineering

- ECG 642 - Power Electronics
- ECG 646 - Photovoltaic Devices and Systems
- ECG 740 - Computer Analysis Methods for Power Systems
- ECG 741 - Electric Power Distribution System Engineering
- ECG 742 - Power System Stability and Control
- ECG 743 - Smart Electrical Power Grid

Signal Processing

- ECG 680 - Discrete-Time Signal Processing
- ECG 682 - Digital Signal Processing Applications
- ECG 703 - Machine Learning and Applications
- ECG 760 - Random Processes in Engineering Problems
- ECG 762 - Detection and Estimation of Signals in Noise
- ECG 781 - Digital Filters
- ECG 782 - Multidimensional Digital Signal Processing
- ECG 783 - Adaptive Signal Processing with Neural Networks

Solid State Electronics and Photonics

- ECG 614 - Quantum Communication
- ECG 651 - Electronic and Magnetic Materials and Devices
- ECG 652 - Optoelectronics
- ECG 653 - Introduction to Nanotechnology
- ECG 712 - Optical Materials and Devices
- ECG 715 - Biomedical Photonics
- ECG 716 - Space Systems
- ECG 750 - Photonics
- ECG 752 - Physical Electronics
- ECG 753 - Advanced Topics in Semiconductor Devices I
- ECG 755 - Monolithic Integrated Circuit Fabrication
- ECG 756 - Advanced Topics in Semiconductor Devices II
- ECG 757 - Electron Transport Phenomena in Solid State Devices
- ECG 758 - Numerical Methods in Engineering

Minor Fields Courses – Credits: 6-18

Select two advisor-approved minor fields and complete coursework (suggested courses below) in each single area totaling 6-18 credits, with a minimum overall average GPA of 3.33. The secondary minor can be from a field outside Electrical Engineering.

Communications

- ECG 662 - Digital Communication Systems
- ECG 666 - Wireless and Mobile Communication Systems
- ECG 760 - Random Processes in Engineering Problems
- ECG 762 - Detection and Estimation of Signals in Noise

Computer Engineering

- ECG 600 - Computer Communication Networks
- ECG 603 - Embedded Systems Design

ECG 604 - Modern Processor Architecture
ECG 605 - Data Compression Systems
ECG 607 - Biometrics
ECG 608 - Digital Design Verification and Testing
ECG 609 - Embedded Digital Signal Processing
ECG 617 - Internet of Things Systems
ECG 618 - Cloud Computing in Engineering
ECG 700 - Advanced Computer System Architecture
ECG 701 - Reliable Design of Digital Systems
ECG 702 - Interconnection Networks for Parallel Processing Applications
ECG 703 - Machine Learning and Applications
ECG 704 - Coding with Applications in Computers and Communication Media
ECG 706 - Analysis of Telecommunication and Data Networks
ECG 707 - Logic Synthesis Engineering
ECG 709 - Synthesis and Optimization of Digital Systems

Control Systems Theory

ECG 770 - Linear Systems
ECG 771 - Optimal and Modern Control
ECG 772 - Nonlinear Systems
ECG 774 - Stochastic Control
ECG 776 - Adaptive Control

Electromagnetics and Optics

ECG 630 - Transmission Lines
ECG 631 - Engineering Optics
ECG 632 - Antenna Engineering
ECG 633 - Active and Passive Microwave Engineering
ECG 730 - Advanced Engineering Electromagnetics I
ECG 731 - Theoretical Techniques in Electromagnetics
ECG 732 - Advanced Engineering Electromagnetics II
ECG 733 - Plasma I

Electronics

ECG 620 - Analog Integrated Circuit Design
ECG 621 - Digital Integrated Circuit Design
ECG 720 - Advanced Analog IC Design
ECG 721 - Memory Circuit Design
ECG 722 - Mixed-Signal Circuit Design

Power Engineering

ECG 642 - Power Electronics
ECG 646 - Photovoltaic Devices and Systems
ECG 740 - Computer Analysis Methods for Power Systems
ECG 741 - Electric Power Distribution System Engineering
ECG 742 - Power System Stability and Control
ECG 743 - Smart Electrical Power Grid

Signal Processing

ECG 680 - Discrete-Time Signal Processing
ECG 682 - Digital Signal Processing Applications
ECG 703 - Machine Learning and Applications
ECG 760 - Random Processes in Engineering Problems
ECG 762 - Detection and Estimation of Signals in Noise
ECG 781 - Digital Filters
ECG 782 - Multidimensional Digital Signal Processing
ECG 783 - Adaptive Signal Processing with Neural Networks

Solid State Electronics and Photonics

ECG 614 - Quantum Communication
ECG 651 - Electronic and Magnetic Materials and Devices
ECG 652 - Optoelectronics
ECG 653 - Introduction to Nanotechnology
ECG 712 - Optical Materials and Devices
ECG 715 - Biomedical Photonics
ECG 716 - Space Systems
ECG 750 - Photonics
ECG 752 - Physical Electronics
ECG 753 - Advanced Topics in Semiconductor Devices I
ECG 755 - Monolithic Integrated Circuit Fabrication
ECG 756 - Advanced Topics in Semiconductor Devices II
ECG 757 - Electron Transport Phenomena in Solid State Devices
ECG 758 - Numerical Methods in Engineering

Elective Courses – Credits: 0-15

Complete 0-15 credits of 600- or 700-level MAT, PHY, AST, CEE, CEM, ECG, EGG, CS, ME, or other advisor-approved courses.

Dissertation – Credits: 18

ECG 799 – Dissertation

Degree Requirements

1. All Ph.D. students must satisfy the Ph.D. degree program admission requirements and be admitted to the Ph.D. program on a regular status.
2. Complete a minimum of 27 credits of graduate level courses (excluding dissertation credits) with an overall minimum GPA of 3.20 and a minimum GPA of 2.70 (B-) in each class applied towards the 27 credits. The final division of major, minor, and elective credits will be determined in consultation with the student's advisor.
3. Of the 27 required credits, a minimum of 18 credits must be in 700-level courses. Of these 18 credits, a minimum of 15 must be from formal courses. The student's doctoral advisory committee may add more requirements in accordance with the individual's background and field of study.
4. No more than 3 credits may be from Graduate Independent Study together with Graduate Seminar. No more than 6 credits of a combination of informal courses such as Graduate Independent Study, Special Topics, and Seminar may be applied to the degree program.
5. Beyond the Bachelor degree, a Ph.D. student must complete a minimum of 15 credits in an

approved ECE major field, 9 credits an approved ECE minor (primary minor) field, and 9 credits in a second approved open minor (secondary minor) field. Of the 15 credits required in the ECE major field, a minimum of 9 credits must be completed in 700-level courses. A minimum GPA of 3.33 (B+=3.30) must be obtained in the major field. Of the 9 required credits in each minor field, a minimum of 6 credits must be in 700-level courses. A minimum GPA of 3.33 (B+=3.30) must be obtained in each of the minor fields.

6. Informal courses (Graduate Independent Study, Graduate Seminar, and Special Topics) cannot be applied to the ECE major, ECE minor (primary minor) and the open minor (secondary minor) fields.
7. At the time of admission or no later than the first semester, the Ph.D. candidate must formally petition BOTH the graduate college and the ECE graduate committee to accept transfer credits and credits taken as a non-degree seeking graduate student to be applied to the Ph.D. program.
8. All regular (full graduate standing) status graduate students must select a faculty advisor in their first semester.
9. Maintain a minimum overall grade point average (GPA) of 3.20, must maintain a minimum GPA of 3.20 each semester, and must complete all graduate level courses that apply towards their degree with a minimum GPA of 2.70 (B-) in each course. Grades below B- cannot be applied towards the Ph.D. degree and must be repeated or replaced. A class grade below C (2.0) is grounds for initiating a program separation recommendation to the Graduate College. Ph.D. candidates who do not maintain an overall minimum GPA of 3.2, who do not maintain a minimum GPA of 3.2 each semester, or who earn more than one grade below B- may be placed on academic probation or expelled from the program. The Electrical and Computer Engineering Graduate Committee in conjunction with the Graduate College will determine the terms of the student's probation based upon the student's academic record and in accordance with the rules of the Graduate College.
10. All regular (full graduate standing) status graduate students must file an approved Plan of Study form before the completion of their third semester. This program must be approved by the student's advisor and the graduate coordinator. All regular and provisional status graduate students must show satisfactory progress towards completion of their degree by completing at least six credits of their approved program per calendar year. If their progress towards their degree program is not satisfactory, students may either be put on probation or expelled from the program.
11. Before beginning a dissertation, students must have their dissertation topic approved by their advisor, and the necessary paper work including a dissertation prospectus must be filed with the Graduate College by the end of the third semester. The dissertation prospectus describes the dissertation topic and must include an introductory set of sentences, a well formed hypothesis or hypotheses (specifically italicized in the prospectus) accompanied by a motivation, objectives with major and alternative approaches to the studies, and conjectures of possible outcomes. Students are NOT allowed to take dissertation credits until their prospectus is approved. Credits taken before the approval date will NOT count towards the degree program.

Graduation Requirements

See Plan Graduation Requirements below.

Subplan 2 Requirements: Post-Bachelor's
Total Credits Required: 69

Course Requirements

MAJOR FIELD COURSES – CREDITS: 15

Complete 15 credits of advisor approved coursework in an single major area in Electrical and Computer Engineering (suggested courses below), with a minimum overall GPA of 3.33. A minimum of 9 credits must be in 700-level courses.

Communications

- ECG 662 - Digital Communication Systems
- ECG 666 - Wireless and Mobile Communication Systems
- ECG 704 - Coding with Applications in Computers and Communication Media
- ECG 706 - Analysis of Telecommunication and Data Networks
- ECG 760 - Random Processes in Engineering Problems
- ECG 762 - Detection and Estimation of Signals in Noise
- ECG 763 - Advanced Digital Communication Systems

Computer Engineering

- ECG 600 - Computer Communication Networks
- ECG 603 - Embedded Systems Design
- ECG 604 - Modern Processor Architecture
- ECG 605 - Data Compression Systems
- ECG 607 - Biometrics
- ECG 608 - Digital Design Verification and Testing
- ECG 609 - Embedded Digital Signal Processing
- ECG 617 - Internet of Things Systems
- ECG 618 - Cloud Computing in Engineering
- ECG 700 - Advanced Computer System Architecture
- ECG 701 - Reliable Design of Digital Systems
- ECG 702 - Interconnection Networks for Parallel Processing Applications
- ECG 703 - Machine Learning and Applications
- ECG 704 - Coding with Applications in Computers and Communication Media
- ECG 706 - Analysis of Telecommunication and Data Networks
- ECG 707 - Logic Synthesis Engineering
- ECG 709 - Synthesis and Optimization of Digital Systems

Control Systems Theory

- ECG 672 - Digital Control Systems
 - ECG 770 - Linear Systems
 - ECG 771 - Optimal and Modern Control
 - ECG 772 - Nonlinear Systems
 - ECG 774 - Stochastic Control
 - ECG 776 - Adaptive Control
- Electromagnetics and Optics
- ECG 630 - Transmission Lines
 - ECG 631 - Engineering Optics

ECG 632 - Antenna Engineering
ECG 633 - Active and Passive Microwave Engineering
ECG 730 - Advanced Engineering Electromagnetics I
ECG 731 - Theoretical Techniques in Electromagnetics
ECG 732 - Advanced Engineering Electromagnetics II
ECG 733 - Plasma I

Electronics

ECG 620 - Analog Integrated Circuit Design
ECG 621 - Digital Integrated Circuit Design
ECG 720 - Advanced Analog IC Design
ECG 721 - Memory Circuit Design
ECG 722 - Mixed-Signal Circuit Design

Power Engineering

ECG 642 - Power Electronics
ECG 646 - Photovoltaic Devices and Systems
ECG 740 - Computer Analysis Methods for Power Systems
ECG 741 - Electric Power Distribution System Engineering
ECG 742 - Power System Stability and Control
ECG 743 - Smart Electrical Power Grid

Signal Processing

ECG 680 - Discrete-Time Signal Processing
ECG 682 - Digital Signal Processing Applications
ECG 703 - Machine Learning and Applications
ECG 760 - Random Processes in Engineering Problems
ECG 762 - Detection and Estimation of Signals in Noise
ECG 781 - Digital Filters
ECG 782 - Multidimensional Digital Signal Processing
ECG 783 - Adaptive Signal Processing with Neural Networks

Solid State Electronics and Photonics

ECG 614 - Quantum Communication
ECG 651 - Electronic and Magnetic Materials and Devices
ECG 652 - Optoelectronics
ECG 653 - Introduction to Nanotechnology
ECG 712 - Optical Materials and Devices
ECG 715 - Biomedical Photonics
ECG 716 - Space Systems
ECG 750 - Photonics
ECG 752 - Physical Electronics
ECG 753 - Advanced Topics in Semiconductor Devices I
ECG 755 - Monolithic Integrated Circuit Fabrication
ECG 756 - Advanced Topics in Semiconductor Devices II
ECG 757 - Electron Transport Phenomena in Solid State Devices
ECG 758 - Numerical Methods in Engineering

MINOR FIELDS COURSES – CREDITS: 18

Select two advisor-approved minor fields and complete 9 credits of coursework (suggested courses below) in each single area with a minimum overall average GPA of 3.33. A minimum of 6 credits in each area must be in 700-level courses. The secondary minor can be from a field outside Electrical Engineering.

Communications

ECG 662 - Digital Communication Systems
ECG 666 - Wireless and Mobile Communication Systems
ECG 760 - Random Processes in Engineering Problems
ECG 762 - Detection and Estimation of Signals in Noise

Computer Engineering

ECG 600 - Computer Communication Networks
ECG 603 - Embedded Systems Design
ECG 604 - Modern Processor Architecture
ECG 605 - Data Compression Systems
ECG 607 - Biometrics
ECG 608 - Digital Design Verification and Testing
ECG 609 - Embedded Digital Signal Processing
ECG 617 - Internet of Things Systems
ECG 618 - Cloud Computing in Engineering
ECG 700 - Advanced Computer System Architecture
ECG 701 - Reliable Design of Digital Systems
ECG 702 - Interconnection Networks for Parallel Processing Applications
ECG 703 - Machine Learning and Applications
ECG 704 - Coding with Applications in Computers and Communication Media
ECG 706 - Analysis of Telecommunication and Data Networks
ECG 707 - Logic Synthesis Engineering
ECG 709 - Synthesis and Optimization of Digital Systems

Control Systems Theory

ECG 770 - Linear Systems
ECG 771 - Optimal and Modern Control
ECG 772 - Nonlinear Systems
ECG 774 - Stochastic Control
ECG 776 - Adaptive Control

Electromagnetics and Optics

ECG 630 - Transmission Lines
ECG 631 - Engineering Optics
ECG 632 - Antenna Engineering
ECG 633 - Active and Passive Microwave Engineering
ECG 730 - Advanced Engineering Electromagnetics I
ECG 731 - Theoretical Techniques in Electromagnetics
ECG 732 - Advanced Engineering Electromagnetics II
ECG 733 - Plasma I

Electronics

ECG 620 - Analog Integrated Circuit Design

ECG 621 - Digital Integrated Circuit Design

ECG 720 - Advanced Analog IC Design

ECG 721 - Memory Circuit Design

ECG 722 - Mixed-Signal Circuit Design

Power Engineering

ECG 642 - Power Electronics

ECG 646 - Photovoltaic Devices and Systems

ECG 740 - Computer Analysis Methods for Power Systems

ECG 741 - Electric Power Distribution System Engineering

ECG 742 - Power System Stability and Control

ECG 743 - Smart Electrical Power Grid

Signal Processing

ECG 680 - Discrete-Time Signal Processing

ECG 682 - Digital Signal Processing Applications

ECG 703 - Machine Learning and Applications

ECG 760 - Random Processes in Engineering Problems

ECG 762 - Detection and Estimation of Signals in Noise

ECG 781 - Digital Filters

ECG 782 - Multidimensional Digital Signal Processing

ECG 783 - Adaptive Signal Processing with Neural Networks

Solid State Electronics and Photonics

ECG 614 - Quantum Communication

ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

ECG 712 - Optical Materials and Devices

ECG 715 - Biomedical Photonics

ECG 716 - Space Systems

ECG 750 - Photonics

ECG 752 - Physical Electronics

ECG 753 - Advanced Topics in Semiconductor Devices I

ECG 755 - Monolithic Integrated Circuit Fabrication

ECG 756 - Advanced Topics in Semiconductor Devices II

ECG 757 - Electron Transport Phenomena in Solid State Devices

ECG 758 - Numerical Methods in Engineering

700-LEVEL ELECTIVE COURSES – CREDITS: 12

Complete 12 credits of 700-level MAT, PHY, AST, CEE, CEM, ECG, EGG, CS, ME, or other advisor-approved courses.

ELECTIVE COURSES – CREDITS: 6

Complete 6 credits of 600- or 700-level MAT, PHY, AST, CEE, CEM, ECG, EGG, CS, ME, or other advisor-approved courses.

DISSERTATION – CREDITS: 18
ECG 799 – Dissertation

Degree Requirements

1. All Ph.D. students must satisfy the Ph.D. degree program admission requirements and be admitted to the Ph.D. program on a regular status.
2. Complete a minimum of 51 credits (24 M.S.E. credits + 27 Post-Master's subplan credits) of graduate level courses (excluding dissertation credits) with an overall minimum GPA of 3.20 and a minimum GPA of 2.70 (B-) in each class applied towards the 27 credits.
3. Of the 51 required credits, a minimum of 33 credits must be in 700-level courses. Of these 33 credits, a minimum of 30 must be from formal courses. The student's doctoral advisory committee may add more requirements in accordance with the individual's background and field of study.
4. No more than 6 credits may be from Graduate Independent Study together with Graduate Seminar. No more than 12 credits of a combination of informal courses such as Graduate Independent Study, Special Topics, and Seminar may be applied to the degree program.
5. Complete a minimum of 15 credits in an approved ECE major field, 9 credits an approved ECE minor (primary minor) field, and 9 credits in a second approved open minor (secondary minor) field. Of the 15 credits required in the ECE major field, a minimum of 9 credits must be completed in 700-level courses. A minimum GPA of 3.33 (B+=3.30) must be obtained in the major field. Of the 9 required credits in each minor field, a minimum of 6 credits must be in 700-level courses. A minimum GPA of 3.33 (B+=3.30) must be obtained in each of the minor fields.
6. Informal courses (Graduate Independent Study, Graduate Seminar, and Special Topics) cannot be applied to the ECE major, ECE minor (primary minor) and the open minor (secondary minor) fields.
7. At the time of admission or no later than the first semester, the Ph.D. candidate must formally petition BOTH the graduate college and the ECE graduate committee to accept transfer credits and credits taken as a non-degree seeking graduate student to be applied to the Ph.D. program.
8. All regular (full graduate standing) status graduate students must select a faculty advisor in their first semester.
9. Students on academic probation may be transferred to the M.S.E. Program depending on the student's academic record. In such a case, the M.S.E. Program requirements must be satisfied. For example, only 6 credits of the informal courses may be applied to the M.S.E. degree program with the further constraint that up to 3 credits total of Independent Study in combination with Graduate Seminar may be in the 6 credits.
10. Maintain a minimum overall grade point average (GPA) of 3.20, must maintain a minimum GPA of 3.20 each semester, and must complete all graduate level courses that apply towards their degree with a minimum GPA of 2.70 (B-) in each course. Grades below B- cannot be applied towards the Ph.D. degree and must be repeated or replaced. A class grade below C (2.0) is grounds for initiating a program separation recommendation to the Graduate College. Ph.D. candidates who do not maintain an overall minimum GPA of 3.2, who do not maintain a minimum GPA of 3.2 each semester, or who earn more than one grade below B- may be placed on academic probation or expelled from the program. The Electrical and Computer Engineering Graduate Committee and/or the Graduate College will determine the terms of the student's probation in accordance with the rules of the Graduate College.

11. All regular status graduate students must file an approved Plan of Study form before the completion of their third semester. This program must be approved by the student's advisor and the graduate coordinator. All regular and provisional status graduate students must show satisfactory progress towards completion of their degree by completing at least six credits of their approved program per calendar year. If their progress towards their degree program is not satisfactory, students may either be put on probation or expelled from the program.
12. Before beginning a dissertation, students must have their dissertation topic approved by their advisor, and the necessary paper work including a dissertation prospectus must be filed with the Graduate College by the end of the third semester. The dissertation prospectus describes the dissertation topic and must include an introductory set of sentences, a well formed hypothesis or hypotheses (specifically italicized in the prospectus) accompanied by a motivation, objectives with major and alternative approaches to the studies, and conjectures of possible outcomes. Students are NOT allowed to take dissertation credits until their prospectus is approved. Credits taken before the approval date will NOT count towards the degree program.

Graduation Requirements

See Plan Graduation Requirements below.

Subplan 3 Requirements: Post-Bachelor's Integrated BS-PHD

Total Credits Required: 60-66

Course Requirements

MAJOR FIELD COURSES – CREDITS: 6-15

Complete 6-15 credits of advisor approved coursework in an single major area in Electrical and Computer Engineering (suggested courses below), with a minimum overall GPA of 3.33.

Communications

ECG 662 - Digital Communication Systems

ECG 666 - Wireless and Mobile Communication Systems

ECG 704 - Coding with Applications in Computers and Communication Media

ECG 706 - Analysis of Telecommunication and Data Networks

ECG 760 - Random Processes in Engineering Problems

ECG 762 - Detection and Estimation of Signals in Noise

ECG 763 - Advanced Digital Communication Systems

Computer Engineering

ECG 600 - Computer Communication Networks

ECG 603 - Embedded Systems Design

ECG 604 - Modern Processor Architecture

ECG 605 - Data Compression Systems

ECG 607 - Biometrics

ECG 608 - Digital Design Verification and Testing

ECG 609 - Embedded Digital Signal Processing

ECG 617 - Internet of Things Systems

ECG 618 - Cloud Computing in Engineering

ECG 700 - Advanced Computer System Architecture
ECG 701 - Reliable Design of Digital Systems
ECG 702 - Interconnection Networks for Parallel Processing Applications
ECG 703 - Machine Learning and Applications
ECG 704 - Coding with Applications in Computers and Communication Media
ECG 706 - Analysis of Telecommunication and Data Networks
ECG 707 - Logic Synthesis Engineering
ECG 709 - Synthesis and Optimization of Digital Systems

Control Systems Theory

ECG 672 - Digital Control Systems
ECG 770 - Linear Systems
ECG 771 - Optimal and Modern Control
ECG 772 - Nonlinear Systems
ECG 774 - Stochastic Control
ECG 776 - Adaptive Control

Electromagnetics and Optics

ECG 630 - Transmission Lines
ECG 631 - Engineering Optics
ECG 632 - Antenna Engineering
ECG 633 - Active and Passive Microwave Engineering
ECG 730 - Advanced Engineering Electromagnetics I
ECG 731 - Theoretical Techniques in Electromagnetics
ECG 732 - Advanced Engineering Electromagnetics II
ECG 733 - Plasma I

Electronics

ECG 620 - Analog Integrated Circuit Design
ECG 621 - Digital Integrated Circuit Design
ECG 720 - Advanced Analog IC Design
ECG 721 - Memory Circuit Design
ECG 722 - Mixed-Signal Circuit Design

Power Engineering

ECG 642 - Power Electronics
ECG 646 - Photovoltaic Devices and Systems
ECG 740 - Computer Analysis Methods for Power Systems
ECG 741 - Electric Power Distribution System Engineering
ECG 742 - Power System Stability and Control
ECG 743 - Smart Electrical Power Grid

Signal Processing

ECG 680 - Discrete-Time Signal Processing
ECG 682 - Digital Signal Processing Applications
ECG 703 - Machine Learning and Applications
ECG 760 - Random Processes in Engineering Problems
ECG 762 - Detection and Estimation of Signals in Noise

ECG 781 - Digital Filters
ECG 782 - Multidimensional Digital Signal Processing
ECG 783 - Adaptive Signal Processing with Neural Networks

Solid State Electronics and Photonics
ECG 614 - Quantum Communication
ECG 651 - Electronic and Magnetic Materials and Devices
ECG 652 - Optoelectronics
ECG 653 - Introduction to Nanotechnology
ECG 712 - Optical Materials and Devices
ECG 715 - Biomedical Photonics
ECG 716 - Space Systems
ECG 750 - Photonics
ECG 752 - Physical Electronics
ECG 753 - Advanced Topics in Semiconductor Devices I
ECG 755 - Monolithic Integrated Circuit Fabrication
ECG 756 - Advanced Topics in Semiconductor Devices II
ECG 757 - Electron Transport Phenomena in Solid State Devices
ECG 758 - Numerical Methods in Engineering

MINOR FIELDS COURSES – CREDITS: 9-18

Select two advisor-approved minor fields and complete coursework (suggested courses below) in each single area totaling 9-18 credits, with a minimum overall average GPA of 3.33. The secondary minor can be from a field outside Electrical Engineering.

Communications

ECG 662 - Digital Communication Systems
ECG 666 - Wireless and Mobile Communication Systems
ECG 760 - Random Processes in Engineering Problems
ECG 762 - Detection and Estimation of Signals in Noise

Computer Engineering

ECG 600 - Computer Communication Networks
ECG 603 - Embedded Systems Design
ECG 604 - Modern Processor Architecture
ECG 605 - Data Compression Systems
ECG 607 - Biometrics
ECG 608 - Digital Design Verification and Testing
ECG 609 - Embedded Digital Signal Processing
ECG 617 - Internet of Things Systems
ECG 618 - Cloud Computing in Engineering
ECG 700 - Advanced Computer System Architecture
ECG 701 - Reliable Design of Digital Systems
ECG 702 - Interconnection Networks for Parallel Processing Applications
ECG 703 - Machine Learning and Applications
ECG 704 - Coding with Applications in Computers and Communication Media
ECG 706 - Analysis of Telecommunication and Data Networks
ECG 707 - Logic Synthesis Engineering

ECG 709 - Synthesis and Optimization of Digital Systems

Control Systems Theory

- ECG 770 - Linear Systems
- ECG 771 - Optimal and Modern Control
- ECG 772 - Nonlinear Systems
- ECG 774 - Stochastic Control
- ECG 776 - Adaptive Control

Electromagnetics and Optics

- ECG 630 - Transmission Lines
- ECG 631 - Engineering Optics
- ECG 632 - Antenna Engineering
- ECG 633 - Active and Passive Microwave Engineering
- ECG 730 - Advanced Engineering Electromagnetics I
- ECG 731 - Theoretical Techniques in Electromagnetics
- ECG 732 - Advanced Engineering Electromagnetics II
- ECG 733 - Plasma I

Electronics

- ECG 620 - Analog Integrated Circuit Design
- ECG 621 - Digital Integrated Circuit Design
- ECG 720 - Advanced Analog IC Design
- ECG 721 - Memory Circuit Design
- ECG 722 - Mixed-Signal Circuit Design

Power Engineering

- ECG 642 - Power Electronics
- ECG 646 - Photovoltaic Devices and Systems
- ECG 740 - Computer Analysis Methods for Power Systems
- ECG 741 - Electric Power Distribution System Engineering
- ECG 742 - Power System Stability and Control
- ECG 743 - Smart Electrical Power Grid

Signal Processing

- ECG 680 - Discrete-Time Signal Processing
- ECG 682 - Digital Signal Processing Applications
- ECG 703 - Machine Learning and Applications
- ECG 760 - Random Processes in Engineering Problems
- ECG 762 - Detection and Estimation of Signals in Noise
- ECG 781 - Digital Filters
- ECG 782 - Multidimensional Digital Signal Processing
- ECG 783 - Adaptive Signal Processing with Neural Networks

Solid State Electronics and Photonics

- ECG 614 - Quantum Communication
- ECG 651 - Electronic and Magnetic Materials and Devices
- ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology
ECG 712 - Optical Materials and Devices
ECG 715 - Biomedical Photonics
ECG 716 - Space Systems
ECG 750 - Photonics
ECG 752 - Physical Electronics
ECG 753 - Advanced Topics in Semiconductor Devices I
ECG 755 - Monolithic Integrated Circuit Fabrication
ECG 756 - Advanced Topics in Semiconductor Devices II
ECG 757 - Electron Transport Phenomena in Solid State Devices
ECG 758 - Numerical Methods in Engineering

ELECTIVE COURSES – CREDITS: 9-18

Complete 9-18 credits of 600- or 700-level MAT, PHY, AST, CEE, CEM, ECG, EGG, CS, ME, or other advisor-approved courses.

DISSERTATION – CREDITS: 18

ECG 799 - Dissertation

Degree Requirements

1. All Ph.D. students must satisfy the Ph.D. degree program admission requirements and be admitted to the Ph.D. program on a regular status.
2. Total credits required depends on the total number of approved graduate-level course work taken as technical electives (with a grade of B or better) during the senior year.
3. Complete a minimum of 60, 63, or 66 credits (including dissertation credits) respectively corresponding to 9, 6, or 3 credits of formally approved graduate level courses applied toward the B.S. degree yielding a total of 69 course credits. The final division of major, minor, and elective credits will be determined in consultation with the student's advisor.
4. Of the 51 required credits, a minimum of 33 credits must be in 700-level courses. Of these 33 credits, a minimum of 30 must be from formal courses. The student's doctoral advisory committee may add more requirements in accordance with the individual's background and field of study.
5. No more than 6 credits may be from Graduate Independent Study together with Graduate Seminar. No more than 12 credits of a combination of informal courses such as Graduate Independent Study, Special Topics, and Seminar may be applied to the degree program.
6. Complete a minimum of 15 credits in an approved ECE major field, 9 credits an approved ECE minor (primary minor) field, and 9 credits in a second approved open minor (secondary minor) field. Of the 15 credits required in the ECE major field, a minimum of 9 credits must be completed in 700-level courses. A minimum GPA of 3.33 (B+=3.30) must be obtained in the major field. Of the 9 required credits in each minor field, a minimum of 6 credits must be in 700-level courses. A minimum GPA of 3.33 (B+=3.30) must be obtained in each of the minor fields.
7. Informal courses (Graduate Independent Study, Graduate Seminar, and Special Topics) cannot be applied to the ECE major, ECE minor (primary minor) and the open minor (secondary minor) fields.
8. All regular (full graduate standing) status graduate students must select a faculty advisor in their first semester.
9. Students on academic probation may be transferred to the M.S.E. Program depending on the

student's academic record. In such a case, the M.S.E. Program requirements must be satisfied. For example, only 6 credits of the informal courses may be applied to the M.S.E. degree program with the further constraint that up to 3 credits total of Independent Study in combination with Graduate Seminar may be in the 6 credits.

10. Maintain a minimum overall grade point average (GPA) of 3.20, must maintain a minimum GPA of 3.20 each semester, and must complete all graduate level courses that apply towards their degree with a minimum GPA of 2.70 (B-) in each course. Grades below B- cannot be applied towards the Ph.D. degree and must be repeated or replaced. A class grade below C (2.0) is grounds for initiating a program separation recommendation to the Graduate College. Ph.D. candidates who do not maintain an overall minimum GPA of 3.20, who do not maintain a GPA of 3.20 each semester, or who earn more than one grade below B- may either be placed on probation or expelled from the program. The Electrical and Computer Engineering Graduate Committee and/or the Graduate College will determine the terms of the student's probation in accordance with the rules of the Graduate College.
11. All regular status graduate students must file an approved Plan of Study form before the completion of their third semester. This program must be approved by the student's advisor and the graduate coordinator. All regular and provisional status graduate students must show satisfactory progress towards completion of their degree by completing at least six credits of their approved program per calendar year. If their progress towards their degree program is not satisfactory, students may either be put on probation or expelled from the program.
12. Before beginning a dissertation, students must have their dissertation topic approved by their advisor, and the necessary paper work including a dissertation prospectus must be filed with the Graduate College by the end of the third semester. The dissertation prospectus describes the dissertation topic and must include an introductory set of sentences, a well formed hypothesis or hypotheses (specifically italicized in the prospectus) accompanied by a motivation, objectives with major and alternative approaches to the studies, and conjectures of possible outcomes. Students are NOT allowed to take dissertation credits until their prospectus is approved. Credits taken before the approval date will NOT count towards the degree program.

Graduation Requirements

See Plan Graduation Requirements below.

Plan Graduation Requirements

1. During the first semester, a Ph.D. student must select a faculty advisor. The faculty advisor does not have to be the one to whom the student was assigned upon entering the Ph.D. program. In coordination with the faculty advisor, the student must also form a doctoral advisory committee. A doctoral advisory committee is composed of at least four members of the UNLV Graduate Faculty. Three of the faculty must be from the Department of Electrical and Computer Engineering. The fourth from a relevant supporting field having Full Graduate Faculty Status as recognized by the Graduate College.
2. Students admitted on provisional and/or conditional status are not allowed to take the qualifying exam until their provisions and/or conditions have been met. Students taking the exam while on provisional or conditional status will be required to retake the exam regardless if one or all areas of the exam have been passed. Provisional status students must complete all required supplementary work within one calendar year from the time of admission into the program with a grade of B (3.0) or better in each course.
3. Pass the Qualifying Exam within 2 semesters of being admitted to the Ph.D. program on a regular

(full graduate standing) status. The Qualifying Exam is offered once every fall semester and once every spring semester. This exam cannot be taken more than twice. The Qualifying Exam tests the student's general undergraduate knowledge of electrical engineering and computer engineering. To register for the Qualifying Exam, eligible students must notify the graduate coordinator no later than one month prior to the examination date.

- All students must pass the Qualifying Exam within the first two semesters (excluding the summer semester) upon being admitted to the Ph.D. program on a regular status. If a student is required to take the qualifying exam and is not present to sit the exam, an automatic FAIL is assigned. Students who have not passed the Qualifying Exam within this time frame will be terminated from the Ph.D. program. Students who have not passed the Qualifying Exam by their second attempt will be terminated from the Ph.D. program. Students in the Direct Ph.D. program who fail the Qualifying Exam on their second attempt within the two semester time frame may elect to pursue a M.S. Degree by completing all of the requirements listed for that degree.
 - The Qualifying Exam is a four and one-half hour exam covering questions in the following undergraduate electrical and computer engineering fields:
 - Communications
 - Control System Theory
 - Electromagnetics and Optics
 - Electronics
 - Power
 - Signal Processing
 - Solid State
 - Digital Logic Design
 - Computer Architectures
 - Embedded Systems
 - Computer Communication Networks
 - To pass the qualifying exam requirement, the student must successfully complete any four of the eleven areas with a grade of PASS to complete the qualifying exam requirement within two sittings. If the student passes less than four areas on the first attempt, the student will receive a PASS for those individual areas successfully completed and will not be required to retake these areas on the second attempt. The exam is a closed note, closed book exam.
 - For more details on course specifics, exam logistics, appeal rights and procedure, and protocols regarding the qualifying exam, refer to the ECE department's Electrical Engineering Graduate Program Document.
4. In all Post-Bachelor's subplans, a Ph.D. student must complete a minimum of 15 credits in an approved ECE major field in a single area of Electrical and Computer Engineering, 9 credits in an approved ECE minor field (primary minor) in a single but different area of Electrical and Computer Engineering, and another 9 credits in a second approved minor (secondary minor) field. Currently, the Department of Electrical and Computer Engineering at UNLV offers Communications, Computer Engineering, Control System Theory, Electromagnetics and Optics, Electronics, Power Systems, Signal Processing, and Solid State Electronics and Photonics as major fields. Specific courses that can be applied to specific fields are listed in detail in the Electrical Engineering Graduate Program Document.
- Of the 15 credits required in the ECE major field, a minimum of 9 credits must be completed in 700-level courses. To complete the ECE major field requirement, the applied 15 credits of ECE major course work must attain a minimum overall GPA of 3.33 (B+=3.30).
 - Each student must complete two minor fields. To complete a minor field, a student must complete a minimum of 9 credits in a minor field and have an overall minimum GPA of 3.33

(B+=3.30) for the 9 minor field credits. Of the 9 required credits in each minor field, a minimum of 6 credits must be in 700-level courses. Courses that can be applied to specific minor fields are listed in detail in the Electrical Engineering Graduate Program Document. These courses may be applied to any designated field but may only be counted once. With the written approval of the major advisor and the student's advisory committee, the secondary minor may be a mixed minor field. A mixed minor field may be formed with courses inside and/or outside of the Electrical Engineering Department's approved fields (e.g., mathematics and physics, computer engineering and computer science, physics, mechanical engineering, solid state and electromagnetics) A mixed minor may not be composed of courses in the Electrical Engineering Department that satisfy course work in the major and the other minor field. The only exception is when a course may be used in more than one field. In this case, the course may not be counted twice but may be used for either minor area. However, the student must complete at least one minor field (primary minor field) in Electrical Engineering in a single area.

5. After successfully completing all required course work, the candidate must pass the Preliminary Exam. The Preliminary Exam cannot be taken more than once per semester but may be repeated until passed. The Preliminary Exam evaluates the caliber of a student's dissertation topic. The Preliminary Exam cannot be taken more than once per semester but may be repeated until passed.
 - To be eligible for the Preliminary Exam, a student must have successfully completed all required course work except for the 18 credits of Dissertation.
 - Before the Preliminary Exam, a student must prepare a 10 to 20-page prospectus of their research. A copy of this prospectus must be submitted to the Graduate Committee and each member of the Ph.D. candidate's advisory committee at least two weeks prior to the Preliminary Exam.
 - The student must also notify the Graduate Committee and each member of their advisory committee of the date, time and location of their Preliminary Exam. This must be done at least two weeks prior to the Preliminary Exam.
 - During the Preliminary Exam, the student presents their prospectus to their advisory committee. To pass the Preliminary Exam, the student's advisory committee must unanimously approve the student's prospectus. Students who pass the Preliminary Exam are advanced to candidacy for the Ph.D.
6. Complete a minimum of 18 credits of Dissertation and complete a dissertation containing original research. Upon completion, the student must pass the Final Exam in which the student defends their dissertation. The Final Exam is the culminating experience of the PhD program.
 - The Final Exam evaluates the Ph.D. candidate's dissertation. The Final Exam cannot be taken more than once per every three months but may be repeated until passed. To be eligible for the Final Exam, a Ph.D. candidate must have passed the Preliminary Exam, and have successfully completed all required course work including a minimum of 18 credits of Dissertation. A minimum of 12 credits of Dissertation must be taken after the successful completion of the Preliminary Exam. A copy of the Ph.D. candidate's dissertation must be submitted to the Graduate Committee and each member of the Ph.D. candidate's advisory committee at least two weeks prior to the Final Exam. The Ph.D. candidate must also notify the Graduate Committee and each member of their advisory committee of the date, time, and location of their Final Exam at least two weeks prior to the Final Exam. During the Final Exam, the Ph.D. candidate will present their dissertation to their advisory committee. To pass the Final Exam, the Ph.D. candidate's advisory committee must unanimously approve the Ph.D. candidate's dissertation.
7. The Department of Electrical and Computer Engineering requires that the Ph.D. degree be completed within a period of six years from the time the candidate is fully admitted to the Ph.D. program. Further, courses taken more than six years prior to graduation cannot be applied toward the

PhD degree without permission from the Graduate College. Students exceeding this time limit must formally write a letter requesting permission from both the Graduate Committee and the Graduate College to stay in the Ph.D. program and apply coursework towards the degree program. The formal letter must explain the circumstances of why the degree was not completed within the allotted time frame and indicate the extended period of time needed to complete the degree.

8. The student must submit and successfully defend their dissertation by the posted deadline. The defense must be advertised and is open to the public.
 - After the dissertation defense, the student must electronically submit a properly formatted pdf copy of their dissertation to the Graduate College for format check. Once the dissertation format has been approved by the Graduate College, the student will submit the approved electronic version to ProQuest. Deadlines for dissertation defenses, format check submissions, and the final ProQuest submission can be found [here](https://www.unlv.edu/graduatecollege/current), <https://www.unlv.edu/graduatecollege/current>.

Students may apply for graduation up to two semesters prior to completing their degree requirements. All required forms must be submitted to the graduate college via the [Grad Rebel Gateway](#).

ii. *Is the description for the program(s) correct? If not, what needs to be changed? Have changes been initiated in Curriculog?*

The department has initiated and proposed the following changes to the MSEE and PhDEE for the 2024-25 catalog:

In the past several years, there has been an increasing demand for a new concentration in intelligent systems and robotics, especially for students coming from Computer Engineering or Computer Science background. Additionally, the current Computer Engineering is too broad for a concentration. Students from Computer Engineering or Computer Science background had difficulty in selecting courses out of two concentration as their major and minor areas. There is an urgent need to split the Computer Engineering concentration into two concentrations. The department decided to change the Computer Engineering concentration to Digital Design and Computer Systems, and add a new concentration in Intelligent Systems and Robotics

The resulting course options for the concentrations are proposed as follows:

Digital Design and Computer Systems

ECG 600 Computer Communication Networks
ECG 603 Embedded Systems Design
ECG 604 Modern Processor Architecture
ECG 605 Data Compression Systems
ECG 608 Digital Design Verification and Testing
ECG 609 Embedded Digital Signal Processing
ECG 617 Internet of Things Systems
ECG 618 Cloud Computing in Engineering

ECG 700 Advanced Computer System Architecture
ECG 701 Reliable Design of Digital Systems
ECG 702 Interconnection Networks for Parallel Processing Applications
ECG 704 Coding with Applications in Computers and Communication Media
ECG 706 Analysis of Telecommunication and Data Networks
ECG 707 Logic Synthesis Engineering
ECG 709 Synthesis and Optimization of Digital Systems
ECG 710 - Real-Time Embedded Systems

Intelligent Systems and Robotics

ECG 607 Biometrics
ECG 617 Internet of Things Systems
ECG 676 - Mobile Robotics
ECG 677 - Embedded Security and Machine Learning
ECG 682 Digital Signal Processing Applications
ECG 703 Machine Learning and Applications
ECG 710 - Real-Time Embedded Systems
ECG 711 - Embedded Systems for Automation
ECG 782 Multidimensional Digital Signal Processing
ECG 783 Adaptive Signal Processing with Neural Networks
CS - 682 - Artificial Intelligence
CS - 688 - Big Data Analytics
CS 722 - Advanced Machine Learning

e. Relationship to Other Programs

- i. What relationship does this program have to other programs, e.g. articulation, transfers, collaborations, partnerships, in the NSHE system?
All undergraduate programs have transfer agreements.
None
- ii. What relationship does this program have to other programs at UNLV, e.g. collaborations, partnerships, affiliated faculty, general education requirements?
Two dual degree programs that are related to M.S. Math program:
Dual degree: Ph. D. – EE & M. S. – Mathematical Sciences
Dual degree: M. S. – EE & M. S. – Mathematical Sciences

II. Mission Alignment, Excellence, and Productivity

- i. What is the program's mission statement?
If the program does not have a mission statement, please use the department or college mission statement.
The Department of Electrical and Computer Engineering offers graduate

programs which culminate in M.S. and Ph.D. degrees in Electrical Engineering. Throughout this document, the Master of Science in Electrical Engineering and Doctor of Philosophy in Electrical Engineering are abbreviated as MSEE (M.S.E.E.) and PhD (Ph.D.) respectively. These programs strive to provide a learning centered environment where accomplished faculty share their experience and knowledge with students so that graduates of the program can

- Demonstrate strong technical knowledge in their field of study with the potential to lead and direct engineering and scientific teams.

- Demonstrate the ability to learn independently and generate new knowledge in their chosen field of study.
- Reach the highest academic level with the potential to become a leader and an authority in Electrical and Computer Engineering.

ii. Briefly describe how this program is aligned to and supports achievement of the university's [Mission](#) and [Top Tier 2.0 Strategic Plan](#).

UNLV Top Tier 2.0 Mission

“As a minority-serving institution rich with diversity and committed to equity, UNLV:

- provides access to world-class educational experiences that are responsive to the needs of our students and stakeholder;
- engages in groundbreaking research, scholarship, professional, and creative activities that have impact and cross boundaries; and
- offers high-value, cutting-edge interdisciplinary physical and mental health care to support our community.

We create value for the individuals and communities we serve by fostering a climate of innovation, stimulating economic diversification and workforce development, promoting social justice and inclusion of all voices and enriching cultural vitality.”

The PhD and MSEE programs in ECE department supports UNLV’s Top Tier 2.0 mission by maintaining a dynamic and productive research environment driven by high-quality faculty publications and a student-centered learning experience. A significant portion of program faculty are leaders in cutting-edge interdisciplinary research, collaborating with College of Education, College of Sciences, School of Dental Medicine, Kirk Kerkorian School of Medicine, School of Public Health, Nevada Institute of Personalized Medicine, etc. The majority of program faculty have been awarded external research funds that are used to assist the program’s graduate students as they engage in research and scholarly activities.

The program has a strong record of employment outcomes and exceptional postgraduate educational opportunities. Several program alumni are faculty members at four-year universities across the US and internationally. Graduates who pursue employment at the conclusion of their program, found opportunities in research and innovation within highly ranked companies in industries. Program graduates who remain in the Las Vegas area occupy top management and engineering positions or work within state or local governments. This network of local alumni creates community engagement and reinforces bonds between UNLV and the surrounding region.

- iii. Provide at least three examples of the integration of teaching, research and service at the program level (e.g. faculty mentoring which lead to student presentations at conferences, service learning classes, community service activities involving students, or other noteworthy student activities and achievements).

In each year, mentored by their faculty advisor, a number of ECE graduate students submit and present their work in international technical conferences. Students also actively participate in peer mentoring and professional development workshops organized by student chapters of professional societies, such as Tau beta pi, Institute of Electrical and Electronics Engineers (IEEE) student chapter, and American Institute of Aeronautics and Astronautics (AIAA) Camp. Students are also involved in community service activities such as working as the instructors for Science, Technology, Engineering, and Mathematics (STEM) camps hosted by College of Engineering.

- iv. List and briefly describe five highlights or areas of excellence of the program.
 1. The department's faculty have produced a large number of publications with the highest publication citation number in the College of Engineering. Majority of these publications have been published with program graduate students. In 2022, two ECE faculty members were rated among the top 2% of scientists in multiple fields/subfields in the world (also known as Stanford top 2% list, which can be found at <https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/5>).
 2. Graduates have been successful in securing academic positions in higher education institutions (7 in the past six years) and research & innovation positions in highly ranked companies (10 in the past six years).
 3. The department have partnered with international universities including, Shanghai Maritime University and Beijing Jiaotong to create new pathways to program completion through the 1+1 program and 3+1+1 program. These programs produced two graduates with Master's degrees. After the end of COVID-19 pandemic, we expect to have more students join these programs.
 4. In the past three years, the department recruited 19 students (including 7 Ph. D. students) into the ECE graduate program. Compared with five years ago, more UNLV graduates joined the Ph.D. program. Recruitment has been particularly robust through the integrated BS+MS and BS+PhD programs, revealing that the program is congruent with student interests helping continuing students extend their specialized knowledge in the field.
 5. The department's faculty and graduate students received recognition in the College, University, and professional society through best dissertation award, scholarships, and best paper awards. In the past five years, one Ph. D. student won the College Best Dissertation award in Spring 2022. Two Ph. D. students were awarded the Howe Foundation Scholarships. One Ph. D. student was awarded the Wolzinger Family Engineering Research Scholarship twice and the Roy & Helen Kelsall engineering Scholarship.

- v. Provide an indication of faculty productivity appropriate for your unit (lists of publications and other creative activities, grant proposals submitted and funded, installations designed, etc.) organized by category.

ECE faculty members have been very productive in publications on and before 2018. In 2019, the program graduated five Ph. D. students, most of their journal publications were published on or after 2020. After 2019, the number of journal publications dropped significantly partially due to the reduction of number of active Ph. D. students impacted by the COVID-19 pandemic.

The research expenditure of ECE faculty has undergone fluctuations in the past ten years. The significant drop of expenditure in 2020 was attributed to the impact of the COVID-19 pandemic. Starting from 2021, there is an increasing trend as more research funding has been secured by faculty. The number of proposals submitted by our faculty has been stable since 2016. Noticeably, in the past six years, our faculty have collaborated more with faculty within and outside College of Engineering in collaborative proposals. For example, the NSF EPSCoR RII-BEC aiming to enhance the transition of COVID-19-affected students from undergraduate to graduate careers in STEM through multi-year undergraduate research experiences (Dr. Harris served as Co-PI), the NSF Noyce Grant aiming to support STEM teachers holistic supporting programs and scholarship (Dr. Yang served as Co-PI), etc.

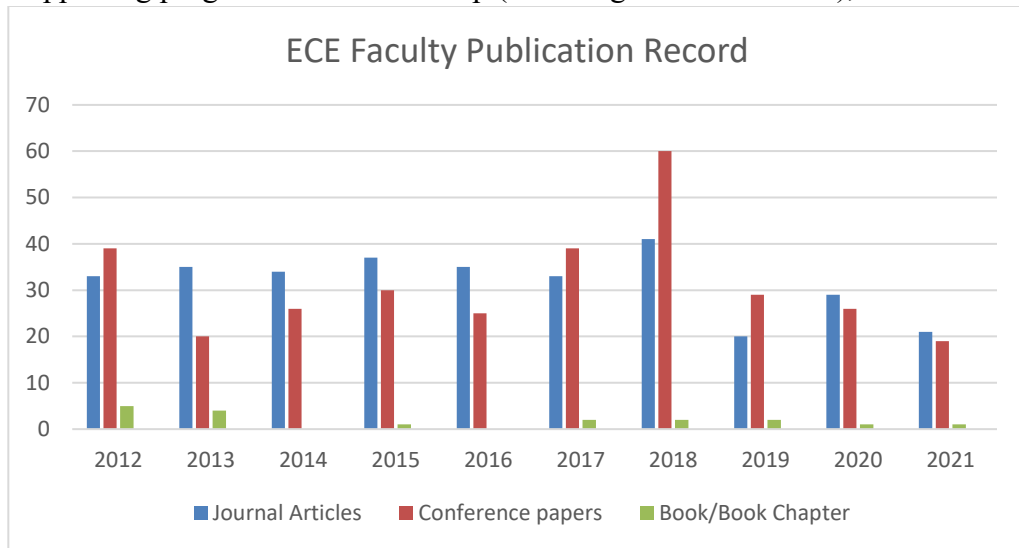


Figure 1 Publication record of ECE faculty.

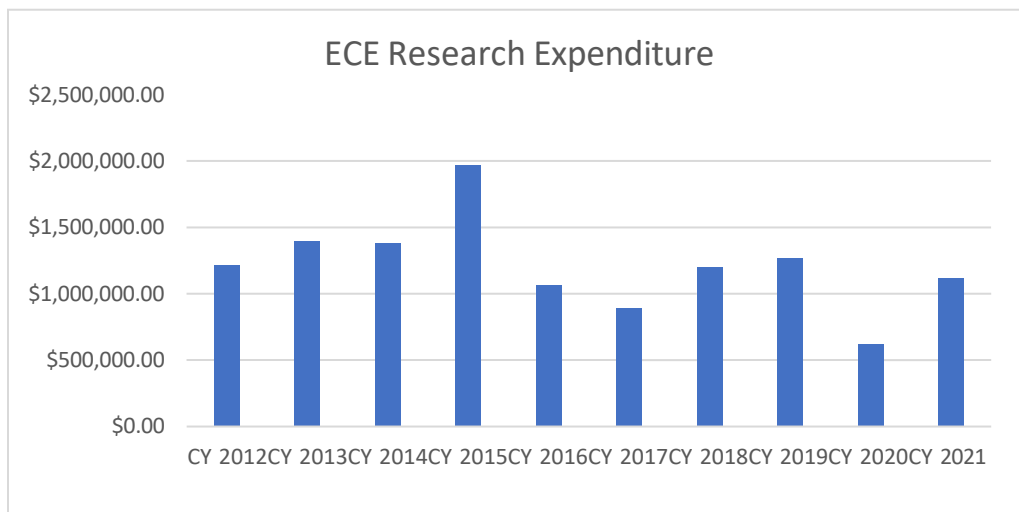


Figure 2 Research expenditure of ECE faculty.

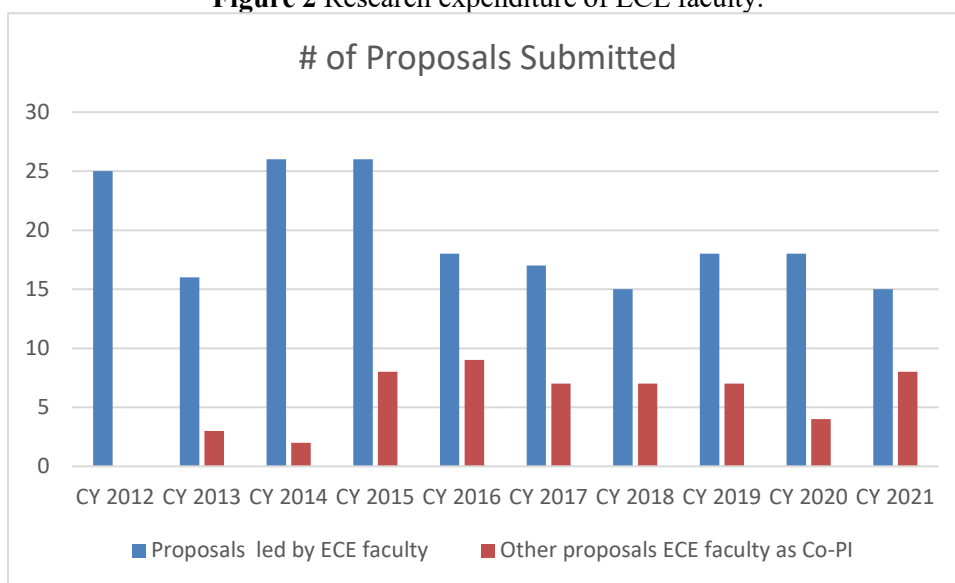


Figure 3 Proposals submitted by ECE faculty.

- vi. Provide an indication of student productivity appropriate for your unit (lists of publications and other creative activities, grant proposals submitted and funded, installations designed, etc.) organized by category.

Figure 4 shows the number of publications generated by ECE graduate students between 2016 to 2022. The number of journal papers dropped significantly in 2019 was due to most of the journal publications generated by the five Ph. D. graduates in that year occurred in 2020. The overall low publication numbers in 2021 and 2022 are partially due to the impact of the COVID-19 pandemic. The partial data of 2023 showed it started to resume.

In the past five years, several of our graduate students received travel grant provided by UNLV Graduate and Professional Students at UNLV. One Ph. D. student received the internal research grant.

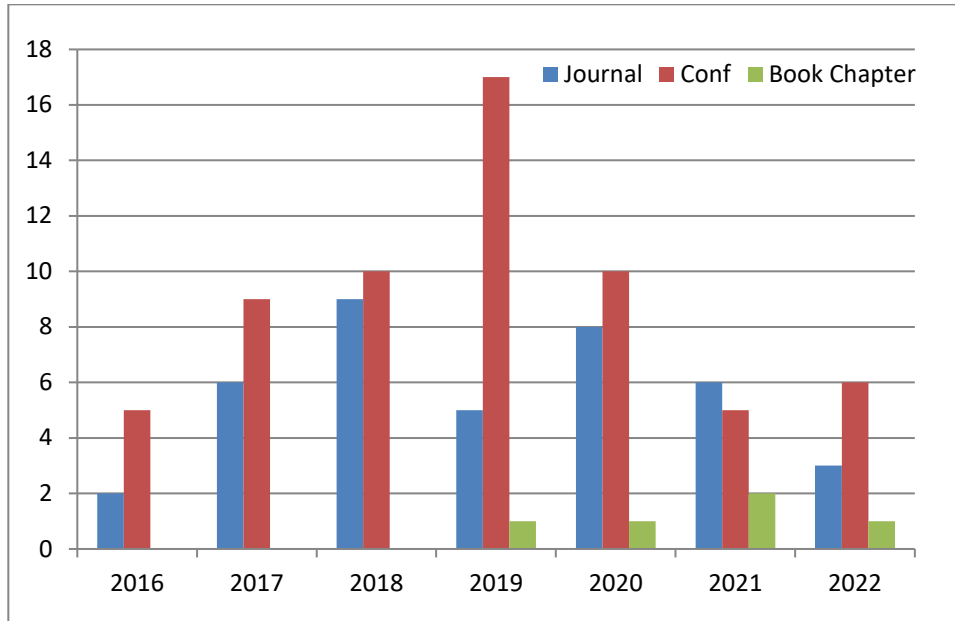


Figure 4 Publications generated by ECE graduate students.

III. External Demand for the Program

- i. Who are the main (local and regional) stakeholders of your educational programs? In other words, which employers and entities benefit from these programs, by hiring the graduates or admitting them to graduate and/or professional programs?

A significant portion of graduate students joined industry after graduation. The main local and regional stakeholders include JT4, NV Energy, ALDEC, Nevada National Security Site (NNSS), Gaming Laboratories, and Alphacore. About one third of the ECE Ph.D. graduates joined the academy as faculty or post-doc fellows. While the department's graduates are employed across the US and internationally, a substantial group of graduates are affiliated with local/regional entities, such as government agencies (state, municipal, county) or private industry.

- ii. Describe the needs of these stakeholders for graduates of this program.
There are needs of graduate students working in radar, pulse power, automated vehicles, cybersecurity, and information technology from these stakeholders.
- iii. What are the anticipated placement needs for program graduates over the next 3-5 years? Please cite your sources (e.g. Occupational Outlook Handbook, Nevada Workforce Research Data System, etc.).

Due to COVID-19 the pandemic, the pool of foreign workers has been shrinking, while the market demand for electrical engineering personnel continues to grow. This shift in supply demonstrates the need to reinforce this pipeline producing ECE graduates trained in U.S. universities. Demand is

particularly acute in fast developing fields including semiconductor (at least 70,000 new jobs by 2025), bioengineering (10% increase between 2021-2031), aerospace engineering (6% increase), and computer engineering (5% increase) based on projection from <https://www.theforage.com/>, [Architecture and Engineering Occupations : Occupational Outlook Handbook: : U.S. Bureau of Labor Statistics \(bls.gov\)](https://www.bls.gov/). The local demand reflects these national trends, which suggests that program graduates can pursue a variety of employment opportunities along with flexible locations as they complete their training at UNLV.

iv. **What changes to the program, if any, will the anticipated placement needs for the program graduates require?**

The current enrollment in the Ph.D. and MSEE program is impacted by COVID-19 pandemic significantly. The placement of our graduates is close to 100%, and the demand from local industry is strong. To meet the demand from employers, the department needs to recruit and graduate more students in timely manner. We have made changes in the graduate program by adding more courses in demanding subjects and releasing the GRE requirements for applicants from ABET accredited universities.

There are more applicants from Computer Science and Engineering background applying to EE Ph. D. program. To accommodate these students, the ECE Graduate Committee is planning to break Computer Engineering into two subareas (Digital Design Computer Systems, Intelligent Systems and Robotics) so that they can fulfill the course requirement in one major and two minor subareas. In addition, the committee is planning to reduce the number of course credits needed for direct Ph. D. students to attract more research-ready undergraduate students.

v. **Describe the placements of recent graduates.**

The table below lists the placement of recent Ph.D. graduates between Fall 2016 to Spring 2022. Out of the 18 Ph. D. graduates, seven (39%) are working in academia and the remainder are working in public or private industry.

Table 1 Ph.D. graduates' placement data (Fall 2016 to Spring 2022)

Graduation Date	Name of student	Degree	Placement
Summer 2017	Ali Pouryazdanpanah Kermani	Ph.D.	Harvard University
Fall 2017	Ming Zhu	Ph.D.	UNLV
Spring 2018	Vahid Vahidi	Ph.D.	USPTO
Summer 2018	Sanjana Das	Ph.D.	Intel Corp.
Summer 2018	Shahab Taregh Tayeb	Ph.D.	Fresno State University
Fall 2019	Wenlan Wu	Ph.D.	Alphacore Inc.
Fall 2019	Konstantinos Moutafis	Ph.D.	Alphacore Inc.
Fall 2019	Jiong Si	Ph.D.	Silergy Technology

Fall 2019	Paritosh Parmar	Ph.D.	The University of British Columbia
Fall 2019	Xiangrong Ma	Ph.D.	UNLV
Summer 2020	Kaushik Raj	Ph.D.	Refevi
Summer 2020	Zhao Fu	Ph.D.	UNLV
Fall 2020	Sachin Purushothaman Namboodiri	Ph.D.	Alphacore Inc.
Spring 2021	Brandon Blackstone	Ph.D.	DCS Corp.
Summer 2021	Arsal Huda Syed	Ph.D.	Maven Wave, an Atos Company
Spring 2022	Lina Chato	Ph.D.	UNLV
Spring 2022	Yang Jiao	Ph.D.	Amazon Inc.
Spring 2022	Binayak Tiwari	Ph.D.	SiFive

Table 2 lists the placement of recent MSEE graduates between Fall 2016 to Spring 2022. Out of the 46 MSEE graduates, eight of them are pursuing Ph.D. degrees (17.4%) and rest of them are working in public or private industry.

Table 2 MSEE graduates' placement data (Fall 2016 to Spring 2022)

Graduation Date	Name of student	Degree	Placement
Fall 2016	Ahmed Chowdhury	MSEE	
Fall 2016	Farhad Fallahlalezari	MSEE	Intel, AZ
Fall 2016	Richard Ryan	MSEE	JT4
Fall 2016	Carlo Lopez-Tello	MSEE	KLA
Spring 2017	Nima Mohseni	MSEE	Wyze Labs
Spring 2017	Charikleia Tsagkari	MSEE	Alphacore Inc.
Spring 2017	Nikita Wanjale	MSEE	Microsoft
Spring 2017	Louis Rotea	MSEE	NV Energy
Spring 2017	Asmelash Beshah	MSEE	Phillips Gradick Engineering
Spring 2017	Min Lan	MSEE	Full Spectrum Laser
Summer 2017	Farideh Foroozandeh Shahraki	MSEE	Ph. D. at University of Houston
Summer 2017	Yang Jiao	MSEE	Ph. D. at UNLV
Summer 2017	Reed Stout	MSEE	Helix Electric
Summer 2017	Ali Pouryazdanpanah Kermani	MSEE	Ph. D. at UNLV
Fall 2017	Benju Koirala	MSEE	TransPerfect
Fall 2017	Ruixing Li	MSEE	Signify
Fall 2017	Vincent Dipuccio	MSEE	Power Assemblies LLC
Fall 2017	Michael Misch	MSEE	

Spring 2018	Christopher Hicks	MSEE	NV Energy
Spring 2018	Narayan Bhusal	MSEE	Quanta Technology
Spring 2018	Nicholas Moya	MSEE	Corning Incorporated
Spring 2018	Justin Le	MSEE	Ph. D. at UCSB
Fall 2018	Shada Sharif	MSEE	Alpha Omega
Fall 2018	Jonathan Deboy	MSEE	HRL Laboratories, LLC.
Fall 2018	Dane Gentry	MSEE	Ambiq
Fall 2018	Vikas Vinayaka	MSEE	Cadence Design Systems
Fall 2018	Eric Monahan	MSEE	Hill Air Force Base
Fall 2018	Michael Gacusan	MSEE	Freelancer
Fall 2018	James Mellott	MSEE	Mission Support and Test Services, LLC
Spring 2019	Jadin Tredup	MSEE	Liveperson
Spring 2019	Suman Ghimire	MSEE	Charter Communications
Spring 2020	Mario Valles	MSEE	Millennium Space Systems, part-time PhD at UNLV
Spring 2020	Angel Solis	MSEE	Microsoft
Fall 2020	Gonzalo Arteaga	MSEE	Analog Devices
Fall 2020	Carlos Lemus	MSEE	JT4
Fall 2020	Jason Silic	MSEE	Thermo Fisher Scientific
Fall 2020	Brandon Wade	MSEE	Microsoft
Spring 2021	Umme Fatema	MSEE	Ph. D. at Virginia Tech
Summer 2021	Yuan Dao	MSEE	Chinese company
Fall 2021	Priyanka Rajendra	MSEE	Agilysys
Fall 2021	James Skelly	MSEE	Ph. D. at Standard

			University
Fall 2021	Daniel Senda	MSEE	JT4
Spring 2022	Stryder Loveday	MSEE	NV Energy
Spring 2022	Francisco Mata Carlos	MSEE	Vorpall Research Systems, LLC
Spring 2022	Lihao Qiu	MSEE	Ph. D. at UNLV
Spring 2022	Anh Bui	MSEE	Gaming Laboratories International, LLC

- vi. [If the program does not have placement information on graduates, what is the plan to gather that information?](#)
Prior to graduation, graduate students are required to complete the department's exit survey. This process provides the program with post-graduation plans for each student, while also providing information about the student learning experience.
- vii. [As required by NSHE, discuss how the program assesses whether the graduates are meeting employers' needs.](#)

The department is planning to run employer survey to assess where the graduates are meeting employer's needs in Fall 2023.

IV. Program Resources

a. Faculty Time and GA Resources

Please fill in the table below in order to answer the questions below.

Table 3 Faculty time and GA resources

Staff Type		Fall 2019	Spring 2020	Fall 2020	Spring 2021	Fall 2021	Spring 2022
Tenured & Tenure-Track Faculty	Total Number:	17	17	17	17	17	17
	Percent of Courses Taught:	70.3	71.1	73.5	73	74	71.3
	Student Credit Hours Taught:	157-230	143-211	194-260	149-225	166-235	136-219
Faculty in Residence (FIRs), Lecturers, & Visiting Faculty	Total Number:	0	0	0	0	0	0
	Percent of Courses Taught:	0	0	0	0	0	0
	Student Credit Hours Taught:	0	0	0	0	0	0
Part-time Instructors (PTI)	Total Number:	6	2	5	3	3	4
	Percent of Courses Taught:	11.0	3.6	9.8	5	8	8
	Student Credit Hours Taught:	28	7	26-28	8-11	19	17-23

State-supported Graduate Assistants (GAs) Provided by the Graduate College	Total Number:	15	16	16.5	13	18	12
	Percent of Courses Taught:	18.7	25.3	16.7	22	18	20.7
	Student Credit Hours Taught:	15	21	27	16	22	17

b. Budget

- i. Fill in the three tables below and use this information to answer the questions below.

Table 4 Revenue of ECE department.

Revenues	Fiscal Year (FY) FY 19-20	FY 20-21	FY 21-22
State Operating Account	\$3,208,590.00	\$3,217,103.00	\$3,230,385.00
Student Fees	\$101,302.30	\$91,268.12	\$116,524.28
Other	\$49,379.66	\$46,574.08	\$67,637.97
Total Revenue	\$3,359,271.96	\$3,354,945.20	\$3,414,547.25

Table 5 Expenses of ECE department.

Expenses	FY 19-20	FY 20-21	FY 21-22
Salaries (faculty, staff, GAs, work-study student, etc.)	\$3,461,712.06	\$3,416,181.63	\$2,548,285.31
Operating Expenses (operational and instructional supplies, equipment maintenance, software licensing, online electronic subscriptions, etc.)	\$91,140.60	\$155,721.77	\$139,727.11
Student Activities (recruitment, career services, general activities, etc.)	\$75.00	\$0	\$0
Other	\$5,876.15	\$2,218.94	\$1,405.63
Total Expenditures	\$3,558,803.81	\$3,574,122.34	\$2,689,418.05

Table 6 Number of graduate assistants supported in ECE department.

Graduate Assistantships	FY 19-20	FY 20-21	FY 21-22
Number of Graduate Assistantships provided by the Graduate College	25.5	19	25
Number of Graduate Assistantships funded by grants	12.5	30	19
Total number of Graduate Assistantships	38	49	44

- ii. Are these resources sufficient to meet the degree programs instructional and scholarship needs? If not, approximately how much additional funding is needed for what specific activities? What funding sources could be reasonably increased to help the program attain its goals?

These resources are not sufficient to meet the degree programs' instructional and scholarship needs. The program needs more faculty in

residence and Part Time Instructors (PTIs) to teach lower-level courses so that graduate faculty can offer more advanced courses to keep up with new developments in this dynamic field (~ \$100K/yr). Furthermore, the department needs two additional teaching assistants to facilitate labs and grade homework (~\$50K/yr). These positions are necessary to reduce faculty workload allowing them to redirect their efforts to research and mentorship of advanced graduate students. One senior faculty in electromagnetics will retire next year, and the department has recruited one tenure-track faculty member to replace this position. With the establishment of the medical school at UNLV and a significant increase in funding nationally in biomedical and health related research, it will be greatly beneficial to the department if one or more faculty members can be recruited in this exploding area. (~\$120K/yr, \$300K one-time)

c. Program Funding

- i. *Is funding from other sources sufficient to assist the program in achieving its outcomes? (Other sources include: differential tuition, grants and contracts, endowment income, and one-time gifts for student scholarships.)*

In the past five years, the ECE department research grants showed an increasing trend but had some fluctuations. In 2021/2022, 19 students were supported by research grants. The reliance on such funding is risky as extramural funding depends on circumstances beyond the control of ECE faculty members. The department received funding from differential tuition to acquire the GPU server and robots for EE462 course. The differential tuition cannot be used for scholarships for Graduate students. The department does not receive endowment funds to support graduate programs. The funding from these resources is not enough to assist Ph.D. and MSEE programs in achieving their desired outcomes. An increase in graduate student funding internally can alleviate some of these problems.

- ii. *If not, which funding streams could be increased to help the program attain its outcomes?*

The Graduate Coordinator submitted proposals in graduate students training to NSF which will support up to two new doctoral trainees for each department. Department faculty is also collaborating with researchers in NNSS to prepare proposals for graduate fellowships through the Department of Energy. The department is also exploring other funding options through scholarships and structured internships, such as GRFP from NSF, GAANN from Department of Education, and STP from Department of Energy.

- iii. What, if any, new donor revenue has been generated since the last program review?

The department will reach out to industry and professional society partners to seek their support in internships and one-time gifts for student scholarships. Such activities will be carried out through the College of Engineering.

- iv. Discuss the unit's engagement in fundraising activities during the last five years to garner support for the program. Alternatively, explain the constraints that have prevented such actions.

The ECE department engages in external fundraising activities through the College of Engineering, and have been successful in obtaining multiple named scholarships for graduate and undergraduate students as well as a gift fund as listed below.

Roy & Helen Kelsall Engineering Scholarship : \$18K

Gilman & Bartlett Engineering Scholarship : \$10K

Wolzinger Family Engineering Scholarship : \$4K

Dr. William Wells Scholarship : \$3K

Suresh and Subansiri Vishnubhatla Eng. Scholarship : \$1K

Program Resources

- i. Is the quality and quantity of available consumable materials and supplies (e.g. office supplies or laboratory supplies) adequate? If not, please explain why.

Yes, the quality and quantity of available consumable materials and supplies (e.g., office supplies or lab supplies) are adequate. However, the budget to buy key resources required for laboratory equipment for instructional and research purpose, is not sufficient. The investments needed for such items are substantially higher than the revenues generated from the (relatively low) lab/course fees for the undergraduate and graduate courses.

- ii. Is the quality and quantity of available technological resources (e.g. computers, large format displays, software) adequate? If not, please explain why.

The ECE department has limited lab capacity for graduate and undergraduate students. The spaces, which include one dedicated computer laboratory (TBE-B348), one dedicated circuit laboratory (TBE-B350), and one power laboratory (TBE- B309), have approximately 40 computers across the two labs. These labs are vital for senior design courses, student projects, and new graduate course offerings, but the spaces are in demand, which can make scheduling difficult. Therefore, more lab space and lab equipment are necessary to improve the capacity of the graduate program.

- iii. Is the quality and quantity of other types of necessary equipment

adequate? If not, please explain why.

Graduate students perform research in faculty-maintained research labs funded through external grants. The quality and quantity of equipment necessary for such research is adequate. However, it would be beneficial if UNLV could provide each graduate student with a new PC or a laptop alleviate some of the equipment funding loads on the research grants.

- iv. Is the quality and quantity of available library and information resources adequate? If not, please explain why.

Yes, the quality and quantity of available library and information resources are adequate.

- v. Are available program staff resources sufficient to attain the programs outcomes? If not, please explain why and state what additional staff resources are needed and how they would be funded.

The ECE department has two administrative assistants, which are not enough to meet the current administrative burden. Administrative personnel are vital for processing graduate applications and GA appointments, tracking enrollment, retention, and graduation. Administering grant activities and processes is time and labor intensive, so increasing grant acquisition and implementation requires at least one more administrative assistant who is dedicated to managing these processes.

d. General Education

- i. If your program or unit offers General Education course, estimate what portion of the unit's teaching resources are allocated to those courses.

N/A

- ii. Are there any factors that affect the unit's ability to offer courses for its major students? If so, please explain why.

N/A

V. Size, Retention, Progression and Completion

a. Size of the Program

- i. Headcount, course enrollment and degree conferred data provided by the Office of Decision Support. Use the tables to answer questions below.

Note:

Program review data does not include transfer students or part-time students in the retention rate calculations or in the 6-year degree completion rate calculations.

Headcounts of student majors and enrollments in courses do include all student enrollments (both transfer and part-time student enrollments are included). Counts of degrees conferred for a program would also include any student earning the degree (both transfer and part-time students earning degrees are included in the degree counts).

The program may track graduation rates differently from the official data provided by the

Office of Decision Support and that can be described in the document in the data section. Please be sure to explain how and why these data differ from the official data. Do not delete the Decision Support information.

- i. Discuss the headcount figures from the last five years. Are the trends in line with projections in your unit’s strategic plan?

Table 7 shows the headcount of MSEE and Ph.D. students in the department since Fall 2010. The data shows that the department has about 20 PhD students every semester on average. This is equivalent to the student-to-faculty ratio of 1.25, which should be increased. In the past five years, there has been no significant decrease in Ph.D. headcounts. The MSEE headcount over the last five years shows a decrease of 18%, which is approximately 22 students per semester. Ideally, the ratio of MSEE to Ph.D. students should be at least 1.5, which requires a minimum MSEE enrollment of 28 students. The department is preparing a strategic plan to recruit more Ph.D. and MSEE students into the program.

Table 7 Headcount declared majors in Electrical Engineering graduate program.

Term	MSEE	Ph.D.
Fall 2010	31	16
Spring 2011	31	14
Fall 2011	24	17
Spring 2012	27	19
Fall 2012	30	22
Spring 2013	24	21
Fall 2013	25	16
Spring 2014	26	22
Fall 2014	24	22
Spring 2015	30	24
Fall 2015	30	22
Spring 2016	25	22
Fall 2016	29	19
Spring 2017	27	21
Fall 2017	21	20
Spring 2018	23	22
Fall 2018	23	16
Spring 2019	18	20
Fall 2019	17	22
Spring 2020	21	20
Fall 2020	23	20
Spring 2021	23	18
Fall 2021	25	19
Spring 2022	23	20

Source: PeopleSoft Table
 PS_LV_CNR_STDNT_CR
 PS_LV_CNR_STDNT_CP
 Office of Decision Support, July 2022

- ii. Does your program enrollment trend differ from national trends? If so, please explain why.

Two metrics are used to compare degree enrollments with the national trend: first, the enrollment of Ph.D. and MSEE students in the department

is compared with corresponding enrollments in other departments within the College of Engineering; second, program enrollment in is compared with corresponding enrollments at peer institutions..

Table 8 shows the PhD and MSE enrollments in the other three departments in the College of Engineering. The data indicate that Overall, the ECE graduate program enrollment is lower than the enrollment for other departments in the College of Engineering. Part of the reason is the funding support and lack of new faculty. In the past 10 years, the department did not add any new tenure-track faculty who can help support more graduate students with startup support.

Next, the ECE’s Ph.D. and MSEE program enrollments are compared with those in corresponding programs at peer universities (Table 9). The peer universities considered are New Mexico State University (NMSU), Utah State University (USU), and Louisianan State University (LSU). The ASEE data for 2020 shows that the ECE’s Ph.D. enrollment is same as NMSU but lower than the other two peers. In terms of MSEE enrollment, UNLV’s department has higher enrollment than LSU but lower enrollment than the other two peers. Compared with USU which has about the same number of faculty as our department but with more than 60% assistant professors, our Ph.D. enrollment is comparable but MS enrollment is much lower.

Table 8 Ph.D. and MSEE headcount in departments at College of Engineering for Fall 2020 (data collected from Decision Support)

Department	PhD	Student/Faculty	MSEE	Student/Faculty
Electrical and Computer Engineering	20	1.25	23	1.44
Civil and Environmental Engineering	35	1.06	41	1.36
Computer Science	32	1.48	38	1.81
Mechanical Engineering	41	2.41	29	1.71

Table 9 PhD and MSEE headcount in EE departments at peer universities for Fall 2020 (data collected from American Society of Engineering Education, 2020).

Department	PhD	% difference	MSEE	% difference
UNLV	20	-	23	-
New Mexico State University	20	0%	36	-56%
Utah State University	23	-15%	28	-22%
Louisiana State University	52	-160%	8	188%

b. Major Course Offerings

- i. Does the program offer enough course to meet enrollment demands? If so, please explain why.

Yes, the program’s curriculum is aligned with current developments in the

discipline. These courses are offered in eight different areas of expertise: control system theory, electromagnetics and optics, electronics, power systems, signal processing, and solid state electronics and photonics. To meet the new developments in these fields, the department recently added five new courses: CpE418/618 Cloud Computing in Engineering, EE 414/614 Quantum Communication, ECG712 Optical Materials and Devices, ECG 715 Biomedical Photonics, and ECG 716 Space Systems. Every year, the faculty members revise the existing course contents to meet the demands of the industry. The department also recently updated the catalog.

Table 10 lists the total enrollment in these graduate courses over the last ten years, with average enrollments of 21 and 70 in 600-level and 700-level courses, respectively. Enrollments dropped in 600- and 700-level courses over the last five years partly due to the impact of the COVID-19 pandemic. The department generally offers 8 or 9 600-level and 6 or 7 700-level courses in fall semester and 4 or 5 600-level and 3 or 4 700-level courses in spring semester. These data indicate that the department offers an adequate number of courses to meet enrollment demands.

Table 10 ECE enrollments by course level

Term	Level - 600	Level - 700
Fall 2010	22	77
Spring 2011	29	56
Fall 2011	25	56
Spring 2012	22	72
Fall 2012	35	62
Spring 2013	19	72
Fall 2013	26	62
Spring 2014	24	60
Fall 2014	30	75
Spring 2015	31	80
Fall 2015	21	94
Spring 2016	18	82
Fall 2016	13	84
Spring 2017	11	81
Fall 2017	16	75
Spring 2018	14	77
Fall 2018	24	61
Spring 2019	21	55
Fall 2019	19	59
Spring 2020	18	78
Fall 2020	17	67
Spring 2021	3	63
Fall 2021	19	60
Spring 2022	16	69

Source: PeopleSoft Table PS_LV_CNR_ENRL
Office of Decision Support, July 2022

ii. How many major courses have been added or eliminated in the last five years?

a. Two 600-level courses and three 700-level courses Added

b. 0 Eliminated

iii. Why were these actions taken?

These actions were taken to stay current within this dynamic and evolving field. Thus, cloud computing and photonics are emerging areas of study, and it is vital that students receive training in these areas. These classes are adapted to meet demands of this rapidly growing field. Furthermore, faculty work diligently to ensure that students get the most up-to-date training in this fields.

iv. What additional actions should be taken to improve retention, progression and graduation of students in the program?

The number of Ph.D. graduates over the last five years are about 3 per fiscal year (Table 11). The number has been increased slightly compared to previous five years. About 45% of Ph. D. students were able to complete the degree in 5 years (Figure 5) with an average time to degree of about 5.1 years. Several Ph. D. students took more than 5 years to graduate partly due to switching advisors. Three students requested leave for absence for half to one year due to family or health issues. Some students were not aware of the requirement of 12 dissertation credits must be completed after the preliminary exam. The ECE Graduate Committee is trying to emphasize the policy on the faculty meeting and encourage advisors to advise the students regularly, and track the students' progress every semester. The department is also trying to obtain more scholarships for graduate students, in the forms of state funded GAs and grant funded GAs, so that the students can complete their dissertations or theses on time. The faculty are actively recruiting more Ph. D. students, especially students graduated from UNLV and other domestic universities.

The number of MSEE graduates fluctuates over the most recent five years (Table 11), but on average, the program graduates 8 students per year. More than 77% of MSEE students finished their degree in less than five years. Several students who stayed in the program for an excessive period of time are part-time students with full-time jobs. To create better alignment with Top Tier 2.0 goals, the department is shifting focus to Ph.D. completions with the goal of helping more Ph.D. students complete their program requirements within a shorter period of time.

Table 11 Degrees conferred by academic year.

Academic Year	M.S. Degree Count	Ph.D. Degree Count
2009-10	16	3
2010-11	12	3
2011-12	10	2
2012-13	8	1
2013-14	12	4
2014-15	7	4
2015-16	9	6
2016-17	12	2
2017-18	11	2
2018-19	9	3
2019-20	2	5
2020-21	5	4

Source: PeopleSoft Table
 PS_LV_CNR_DEGREES
 Office of Decision Support, July 2022

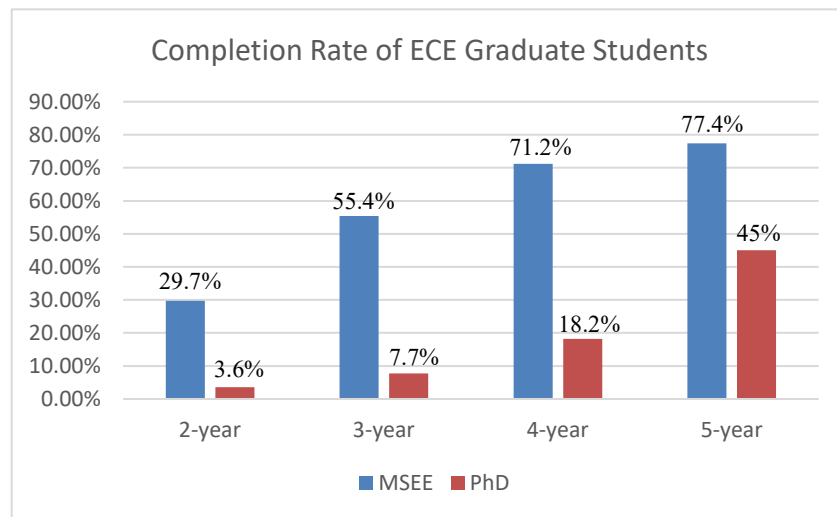


Figure 5 Completion rate of ECE graduate students in the past 10 years

- v. Are there courses that represent barriers for progression and/or graduation, because students routinely have difficulty enrolling in, and/or completing those courses? If so, please explain why.

There are no barriers for progression or graduation due to difficulty in enrolling in the courses. Every year, about ten 700-level courses are offered with the assistance of web-based option. Every 700-level course can be scheduled in every one to one and half years.

- vi. If there are course that represent barriers for progression and/or graduation, please describe financially-based and non-financially-based solutions to reduce “bottle-necks” in these courses.

The ECE Graduate Committee has already investigated related to “bottle-neck” courses in the graduate programs. None of the courses are found to be “bottle-necks” in the program.

- vii. Can any changes in sequencing of courses be made to facilitate student retention, progression and graduation?

The Department Chair, with the help of the Graduate Coordinator, changes the sequence of courses every semester to facilitate student retention, progression, and graduation. In this process, the department reviews graduate courses every semester and decides which courses to offer and explores which new courses should be developed to help students maintain current skills in the field and promote on-time graduation.

- viii. Please discuss whether the unit has any plans to provide any or more online courses within the next 2-3 years. If the unit does not have such plans please explain why.

The department has offered several graduate courses online in the past five years. Based on the feedback from students and faculty, more online courses are planned over the next 2-3 years.

c. Curriculum

- i. Is the programs curriculum aligned with current developments in the discipline? If so, please explain how.

Yes, the program curriculum is aligned with current developments in the discipline. To meet the new developments in the field, the sub-area of solid state electronics was updated to solid state electronics and photonics. The department also added five new graduate courses. Every year, the faculty members revise the existing course content to meet demands of the industry.

The newly revised catalog can be found at this link:

PhD in Electrical Engineering Catalog (<https://www.unlv.edu/degree/phd-electrical-engineering>)

Master in Electrical Engineering Catalog

(<https://www.unlv.edu/degree/ms-electrical-engineering>)

- ii. If the program curriculum is not aligned with current developments in the discipline, please explain what steps faculty are taking to modernize the curriculum.

Not applicable

d. Advising

- i. How many full-time academic advisors are available at the Colleges Advising Center? Is this number sufficient?

There are no academic advisors available at the College’s Advising Center for graduate students. However, in the ECE department, the Graduate Coordinator serves as an academic advisor for newly admitted students.. Every fall the graduate coordinator hosts a new student orientation incoming students to review the degree requirements and timeline. Each student needs to select their faculty advisor within the first semester. This advisor helps them plan their degree path in order to ensure progression to degree and timely graduation. Faculty advisor assignments are based on area of expertise within eight sub-areas. The rules of academic advising can be found in “Graduate Student Handbook” at this link <https://www.unlv.edu/sites/default/files/media/document/2022-08/ElectricalEngineering-Handbook-2022-23.pdf>

- ii. Describe any changes to advising practices in the last five years based on the findings of assessment reports.

1. The timeline provided in the Graduate Student Handbook should be followed.
2. The major milestones for Ph.D. students are the appointment of Advisory Committee, submission of Plan of Study, Ph.D. Qualifying Exam, Prospectus and Preliminary Exam, and Final Dissertation Defense. These milestones must be completed within the timeframe provided in the Graduate Student Handbook.
3. Major milestones for MSE students include their appointment of advisory committee, submission of Plan of Study, Prospectus, and Final Thesis Defense, for MSEE Thesis option students. For MSEE course-only students, the main milestones are appointment of Faculty Advisor, submission of Plan of Study, Comprehensive Exam, and submission of Final Culminating Experience Form. These milestones need to be completed on time, as listed in the Graduate Student Handbook.
4. A graduate student’s thesis or dissertation defense is evaluated by their committee members, and the evaluation scores must be submitted to the Graduate Coordinator for assessment purposes.

e. Graduation Rates

- i. Program graduation numbers and rates are summarized below (insert here tables with graduation data). Use the tables to answer the below questions.

Table 12 Graduation rates for fall cohorts Ph.D. students

Fall	Size	Yr 2 rate (%)	Yr 3 rate (%)	Yr 4 rate (%)	Yr 5 rate (%)
2010	3	0.0	0.0	0.0	66.7
2011	5	0.0	20.0	20.0	40.0
2012	5	0.0	0.0	60.0	60.0
2013	1	0.0	0.0	0.0	0.0
2014	3	0.0	0.0	0.0	33.3
2015	1	0.0	0.0	0.0	0.0
2016	2	0.0	0.0	0.0	50.0
2017	2	0.0	0.0	0.0	NA
2019	4	25.0	25.0	NA	NA
2020	2	0.0	NA	NA	NA
2021	3	NA	NA	NA	NA

Source: PeopleSoft Table PS_LV_CNR_DEGREES
PS_LV_CNR_CP
PS_LV_CNR_CR
Office of Decision Support, July 2022

Table 13 Graduation rates for Fall Cohorts MSEE students

Fall	Size	Yr 2 rate (%)	Yr 3 rate (%)	Yr 4 rate (%)	Yr 5 rate (%)
2010	8	12.5	37.5	87.5	100.0
2011	7	14.3	57.1	57.1	57.1
2012	11	9.1	27.3	36.4	45.5
2013	6	33.3	66.7	83.3	83.3
2014	5	40.0	60.0	80.0	100.0
2015	5	60.0	80.0	80.0	80.0
2016	7	57.1	71.4	85.7	85.7
2017	4	100.0	100.0	100.0	100.0
2018	6	16.7	66.7	66.7	NA
2019	6	33.3	33.3	NA	NA
2020	9	11.1	NA	NA	NA
2021	7	NA	NA	NA	NA

Source: PeopleSoft Table PS_LV_CNR_DEGREES
PS_LV_CNR_CP
PS_LV_CNR_CR
Office of Decision Support, July 2022

ii. Are the trends in 6-year cohort graduation close to the University’s goal of 50% graduation rate?

Table 12 shows the cohort graduation rate of the Ph.D. program. It shows that ECE Ph.D. 4-year and 5-year cohort average graduation rates are 18.2% and 45%, respectively. With the exception of two cohort years that had a single Ph.D. student, less than half cohorts have a 5-year graduation rate that meets or exceeds 50%. The average and median time to degree for recent graduates 5 years. The program goal is to achieve an average time to degree of 5 years for meeting 50% of each Ph.D. cohort.

The cohort graduation data of MSEE students is shown in Table 13. The MSEE students should be completing their degree in between 2 to 3 years. Comparing this number with the department’s 2-year and 3-year cohort average graduation rates from 2010 to 2017, which are about 40% and 62%, respectively, the cohort graduation rate of MSEE program is not

satisfactory. During a ten year period (2010 to 2020), only the 2013 MSEE cohort, only in 2013, three cohorts 2-year cohort graduation exceeded 50%. The department is focused on improving this 2-year cohort graduation rate meeting 50% for every MSEE cohort.

- iii. [If not, what is being done to reach the 50% graduation rate?](#)
Students' survey data reflected that the barriers for students' completion: 1) lack of training in research skills and research methods, 2) lack of 700-level courses offered, 3) lack of funding support. To accomplish these goals, faculty members are advising students in a timely manner, and the department is seeking extra funds to provide more financial help to graduate students. More support for new tenure-track faculty and PTIs will definitely be helpful for achieving these goals.

VI. Quality

a. Admission and Graduation Requirements

- i. [List program admission and graduation requirements as they appear in the current UNLV academic catalog.](#)

• [Admission requirement for PhD in Electrical Engineering](#)

There are three tracks in the PhD in Electrical Engineering: post-master's track, post-bachelor's track, and post-bachelor's integrated BS-PhD track. The general admission requirements for these tracks are as follows:

To be considered for admission an applicant must:

1. Submit GRE scaled and percentile scores in quantitative, verbal reasoning, and analytical writing to the Department of Electrical and Computer Engineering and have obtained the following minimum relative percentile comparison rank of 75 in the Quantitative section, 20 in the Verbal Reasoning section, and 20 in Analytical Writing. Please note that GRE scores will only be considered valid if taken within five years prior to the time of admission and are recognized by the GRE examination board. Official scores must be obtained from an official GRE provider. The GRE requirement can be waived under the circumstances listed in the GRE Waiver section.
2. Submit a completed application form and official transcripts of all college level work to the Graduate College. Submit an additional set of transcripts of all college-level work directly to the Department of Electrical and Computer Engineering.
3. Submit a one-page written statement of purpose indicating the applicant's interests, motivations, and objectives. In the statement of purpose, the applicant must explicitly identify their areas of interest from the following list of areas offered at UNLV in the ECE

Department: Communications, Computer Engineering, Control Systems, Electromagnetics and Optics, Electronics, Power Systems, Signal Processing, and Solid-State Electronics and Photonics (which includes Nanotechnology). Applicants are required to account for all

time beyond the B.S. degree indicating how they have developed professionally. Applicants transferring from other graduate programs without obtaining an M.S. degree must justify why they are leaving that program to join our graduate program. Applicants receiving grades less than B in a graduate course elsewhere may not be admitted to the graduate program without a well-justified explanation. Poor performance in course work in the program that the student is transferring from can be a cause for denial of admission. It will be the graduate committee's discretion whether to allow or deny admission.

4. Submit a one-page curriculum vitae listing the applicant's project, publication, and award records.
5. Submit three letters of recommendation (signed and dated) concerning the applicant's potential for succeeding in the graduate program directly to the Department of Electrical and Computer Engineering. Letters of reference may be electronically uploaded in the online admissions application process. If the student received a M.S. degree in electrical or computer engineering at UNLV, then only one letter of recommendation is required, and it must come from the candidate's faculty advisor who should be the student's thesis committee chair. If the applicant has attended a university or is currently enrolled in a program beyond the M.S. degree, then at least one letter of recommendation should be solicited from that university or program and two from the university in which the M.S. degree was received. One of the three letters should be written by your thesis advisor commenting on your background and your thesis research. If the applicant has been out of school for an extended period of time, then letters should be solicited from the professional community who can comment on the applicant's technical background and/or from the applicant's most recent academic institution. Letters of recommendation written beyond a six-month period prior to applying for admission to our graduate program will not be accepted. Strong letters of recommendation illustrate technical talent and professional accomplishments beyond the grade point average or course grade. The graduate committee is interested in the applicant's technical, conceptual, verbal, ethical and social skills. The graduate committee is interested in the applicant's ability to perform research with evidence to substantiate claims made. Note that letters from professors that casually know you will not help you in the admission process.
6. International applicants must provide proof of English proficiency, as stated in the Graduate College English proficiency requirements website.
7. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

8. Application deadlines are February 1st for admission in the fall of the same year and October 1st for admission in the spring of the subsequent year.

Post-Master's subplan

Have a Master of Science (M.S.) degree in electrical engineering or computer engineering or a closely related field with an M.S. thesis component. The M.S. thesis must be completed prior to admission. Potential candidates applying to the program based on a course only option or a project option will not be admitted. (Applicants who possess a bachelor's degree in a closely related discipline, such as physics or mathematics, may be admitted on conditional and/or provisional status. These students will be required to complete certain undergraduate and/or graduate courses before they can attain regular full graduate standing status. The graduate committee determines these courses on an individual basis.)

Have a minimum overall grade point average (GPA) of 3.20 (A = 4.00) for their M.S. degree and a 3.00 for their B.S. degree.

Post-Bachelor's subplan:

Have a Bachelor of Science (B.S.) degree in electrical engineering or computer engineering or a closely related field. (Applicants who possess a bachelor degree in a closely related discipline, such as physics or mathematics, may be admitted on conditional and/or provisional status. These students will be required to complete certain undergraduate and/or graduate courses before they can attain regular full graduate standing status. The graduate committee determines these courses on an individual basis.)

Have a minimum overall grade point average (GPA) of 3.50 (A = 4.00) for their B.S. degree in Electrical or Computer Engineering a closely related field.

Post-Bachelor's Integrated BS-PHD subplan:

The Integrated BS-PHD subplan program allows UNLV undergraduate students who applied up to 9 credits of UNLV electrical engineering or computer engineering graduate courses towards their UNLV B.S. in Electrical Engineering or Computer Engineering degree to complete their Ph.D. in engineering with up to 9 fewer credits than students in the Post-Bachelor's subplan. All requirements leading to a Ph.D. are still required beyond the B.S. Degree in Electrical and Computer Engineering excluding the completion of a Master's thesis.

Have a minimum overall grade point average (GPA) of 3.5 (A = 4.00) for their B.S. degree in electrical engineering or computer engineering at UNLV.

Have completed up to a maximum of 9 credits of formal Graduate College curriculum approved 600/700 level courses (which excludes informal courses such as Graduate Independent Study, Graduate Seminar, and Special Topics) which were applied towards the student's B.S. degree. Each graduate level course must have been completed with a minimum grade of B (GPA) of 3.2 (A = 4.00).

GRE Waiver:

The GRE entrance requirement will be waived for students entering the Ph.D. program if *ALL* of the following are satisfied. The final decision is up to the graduate committee.

1. The candidate received a bachelor or master's degree (thesis option) in electrical and/or computer engineering from an ABET-accredited electrical and/or computer engineering program.
2. The candidate's BS GPA equals or exceeds 3.0 and MS GPA equals or exceeds 3.6 for conventional Ph.D. applicants. The candidate's BS GPA equals or exceeds 3.5 for direct Ph.D. applicants.
3. The conventional Ph.D. applicant must show evidence that a paper pertaining to his/her research has been accepted/published in a refereed conference (minimum requirement) or a journal. Reviewers' comments along with a letter of acceptance may be used as minimum evidence that a paper will be published. The direct Ph.D. applicant must show evidence of research experience. Examples of such evidence include but not limited to 1) a research publication; 2) a research poster/presentation; 3) participation in a sponsored research project; 4) participation in a research internship, etc.
4. Letters of recommendation should clearly indicate the student's potential and ability to succeed in research and higher education.

• Admission requirement for MSEE

To be considered for admission to the M.S.E. program, an applicant must:

1. Have a regionally accredited or equivalent Bachelor of Science (B.S.) degree in electrical engineering, computer engineering or a closely related discipline.
 - a. Applicants who possess a bachelor's degree in a closely related discipline, such as physics or mathematics, may be admitted on

conditional and/or provisional status. These students will be required to complete certain undergraduate and/or graduate courses before they can attain regular status. The graduate committee determines these courses on an individual basis.

- b. Graduates with degrees in engineering technology ordinarily have an inadequate background to be admitted to the graduate program.
2. Have a minimum grade point average (GPA) of 3.00 (A=4.00) for their bachelor's degree. Applicants who have an overall GPA below 3.00 must submit Graduate Record Examination (GRE) scores {scaled score and percentile score in quantitative, verbal reasoning, and analytical writing} to the Electrical and Computer Engineering Department. These applicants may be admitted subject to the discretion and possible further requirements of the Electrical and Computer Engineering Graduate Committee. Applicants who want to be considered for an assistantship, or who feel that their GRE scores will enhance their chances for admission, are strongly encouraged to submit GRE scores.
3. Submit GRE scaled and percentile scores in quantitative, verbal reasoning, and analytical writing to the Department of Electrical and Computer Engineering if the applicant did not obtain their bachelor's degree from an ABET accredited institution, if the applicant is interested in a teaching assistantship, or if the applicant received a Bachelor's Degree in Electrical and Computer Engineering more than five years prior to the first day of the first semester of the degree program applied for. Interpretation of the scores is at the discretion of the Electrical and Computer Engineering Graduate Committee. (An applicant possessing a bachelor's degree from an ABET accredited institution within the past five years is not required to submit GRE scores.)
4. Submit a completed application prior to the department's admission deadline.
 - a. Completed online application.
 - b. Submit official transcripts of all college-level work to the Graduate College.
 - c. Submit an additional set of transcripts of all college-level work directly to the Department of Electrical and Computer Engineering.
 - d. Submit a one-page curriculum vitae listing the applicant's project, publication, and award records.
 - e. Submit a one page written statement of purpose indicating the applicant's research interests, motivations, and objectives.
 - i. In the statement of purpose, the applicant must explicitly identify their areas of interest from the following list of areas offered at UNLV in the ECE Department: Communications, Computer Engineering, Control Systems, Electromagnetics and Optics,

Electronics, Power Systems, Signal Processing, and Solid State Materials and Devices (which includes Nanotechnology).

- ii. Applicants are required to account for all time beyond the Bachelor degree indicating how they have developed professionally.
 - iii. Applicants transferring from other graduate programs must justify why they are leaving that program to join our program.
 - iv. Applicants receiving grades less than B in a graduate course elsewhere may not be admitted to the graduate program without a well-justified explanation. Poor performance in course work in the program that the student is transferring from may be a cause for denial of admission. It will be the graduate committee's discretion whether to allow or deny admission.
- f. Submit three dated letters of recommendation concerning the applicant's potential for succeeding in the graduate program. If the applicant has attended a university or is currently enrolled in a program beyond the bachelor degree, then the letters of recommendation should be solicited from that university or program. If the applicant has been out of school for an extended period of time, then letters should be solicited from the professional community that can comment on the applicant's technical background and/or from the applicant's most recent academic institution. Letters of recommendation written beyond a six-month period prior to applying for admission to our graduate program will not be accepted. Strong letters of recommendation illustrate technical talent and professional accomplishments beyond the grade point average or course grade. The graduate committee is interested in the applicant's technical, conceptual, verbal, ethical, and social skills. The graduate committee is interested in the applicant's ability to perform research with evidence to substantiate claims made. Note that letters from professors that casually know the applicant will not help in the admission process.
- g. Application deadlines are February 1st for admission in the fall of the same year and October 1st for admission in the spring of the subsequent year.
5. International applicants must provide proof of English proficiency, as stated in the Graduate College English proficiency requirements website.
 6. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

The Integrated BS-MS subplan program allows select UNLV undergraduates to pursue the Electrical Engineering M.S.E. degree at

UNLV. The program provides an opportunity for those undergraduates who have taken either 9, 6, or 3 graduate-level electrical and computer engineering course credits applied toward their undergraduate electrical/computer engineering degrees, to complete the respectively corresponding M.S. in Engineering with a total of either 21, 24, or 27 as opposed to the 30 credits required for Thesis subplan. Students admitted to the Integrated BS-MS subplan program are required to write a thesis.

To be considered for admission to the Integrated BS-MS subplan, an applicant must:

1. Have a minimum overall grade point average (GPA) of 3.5 (A = 4.00) for their B.S. degree in electrical engineering or computer engineering at UNLV.
2. Have completed up to a maximum of 9 credits of formal Graduate College curriculum approved 600/700 level courses (which excludes informal courses such as Graduate Independent Study, Graduate Seminar, and Special Topics) which were applied towards the student's B.S. degree. Each graduate level course must have been completed with a minimum grade of B (3.0).

- Graduation Requirement for PhD for all subplans

1. During the first semester, a Ph.D. student must select a faculty advisor. The faculty advisor does not have to be the one to whom the student was assigned upon entering the Ph.D. program. In coordination with the faculty advisor, the student must also form a doctoral advisory committee. A doctoral advisory committee is composed of at least four members of the UNLV Graduate Faculty. Three of the faculty must be from the Department of Electrical and Computer Engineering. The fourth from a relevant supporting field having Full Graduate Faculty Status as recognized by the Graduate College.
2. Students admitted on provisional and/or conditional status are not allowed to take the qualifying exam until their provisions and/or conditions have been met. Students taking the exam while on provisional or conditional status will be required to retake the exam regardless if one or all areas of the exam have been passed. Provisional status students must complete all required supplementary work within one calendar year from the time of admission into the program with a grade of B (3.0) or better in each course.
3. Pass the Qualifying Exam within 2 semesters of being admitted to the Ph.D. program on a regular (full graduate standing) status. The Qualifying Exam is offered once every fall semester and once every spring semester. This exam cannot be taken more than twice. The

Qualifying Exam tests the student's general undergraduate knowledge of electrical engineering and computer engineering. To register for the Qualifying Exam, eligible students must notify the graduate coordinator no later than one month prior to the examination date.

- All students must pass the Qualifying Exam within the first two semesters (excluding the summer semester) upon being admitted to the Ph.D. program on a regular status. If a student is required to take the qualifying exam and is not present to sit the exam, an automatic FAIL is assigned. Students who have not passed the Qualifying Exam within this time frame will be terminated from the Ph.D. program. Students who have not passed the Qualifying Exam by their second attempt will be terminated from the Ph.D. program. Students in the Direct Ph.D. program who fail the Qualifying Exam on their second attempt within the two semester time frame may elect to pursue a M.S. Degree by completing all of the requirements listed for that degree.
 - The Qualifying Exam is a four and one-half hour exam covering questions in the following undergraduate electrical and computer engineering fields:
 - Communications
 - Control System Theory
 - Electromagnetics and Optics
 - Electronics
 - Power
 - Signal Processing
 - Solid State
 - Digital Logic Design
 - Computer Architectures
 - Embedded Systems
 - Computer Communication Networks
 - To pass the qualifying exam requirement, the student must successfully complete any four of the eleven areas with a grade of PASS to complete the qualifying exam requirement within two sittings. If the student passes less than four areas on the first attempt, the student will receive a PASS for those individual areas successfully completed and will not be required to retake these areas on the second attempt. The exam is a closed note, closed book exam.
 - For more details on course specifics, exam logistics, appeal rights and procedure, and protocols regarding the qualifying exam, refer to the ECE department's Electrical Engineering Graduate Program Document.
4. In all Post-Bachelor's subplans, a Ph.D. student must complete a minimum of 15 credits in an approved ECE major field in a single area

of Electrical and Computer Engineering, 9 credits in an approved ECE minor field (primary minor) in a single but different area of Electrical and Computer Engineering, and another 9 credits in a second approved minor (secondary minor) field. Currently, the Department of Electrical and Computer Engineering at UNLV offers Communications, Computer Engineering, Control System Theory, Electromagnetics and Optics, Electronics, Power Systems, Signal Processing, and Solid State Electronics and Photonics as major fields. Specific courses that can be applied to specific fields are listed in detail in the Electrical Engineering Graduate Program Document.

- Of the 15 credits required in the ECE major field, a minimum of 9 credits must be completed in 700-level courses. To complete the ECE major field requirement, the applied 15 credits of ECE major course work must attain a minimum overall GPA of 3.33 (B+=3.30).
 - Each student must complete two minor fields. To complete a minor field, a student must complete a minimum of 9 credits in a minor field and have an overall minimum GPA of 3.33 (B+=3.30) for the 9 minor field credits. Of the 9 required credits in each minor field, a minimum of 6 credits must be in 700-level courses. Courses that can be applied to specific minor fields are listed in detail in the Electrical Engineering Graduate Program Document. These courses may be applied to any designated field but may only be counted once. With the written approval of the major advisor and the student's advisory committee, the secondary minor may be a mixed minor field. A mixed minor field may be formed with courses inside and/or outside of the Electrical Engineering Department's approved fields (e.g., mathematics and physics, computer engineering and computer science, physics, mechanical engineering, solid state and electromagnetics) A mixed minor may not be composed of courses in the Electrical Engineering Department that satisfy course work in the major and the other minor field. The only exception is when a course may be used in more than one field. In this case, the course may not be counted twice but may be used for either minor area. However, the student must complete at least one minor field (primary minor field) in Electrical Engineering in a single area.
5. After successfully completing all required course work, the candidate must pass the Preliminary Exam. The Preliminary Exam cannot be taken more than once per semester but may be repeated until passed. The Preliminary Exam evaluates the caliber of a student's dissertation topic. The Preliminary Exam cannot be taken more than once per semester but may be repeated until passed.

- To be eligible for the Preliminary Exam, a student must have successfully completed all required course work except for the 18 credits of Dissertation.
 - Before the Preliminary Exam, a student must prepare a 10 to 20-page prospectus of their research. A copy of this prospectus must be submitted to the Graduate Committee and each member of the Ph.D. candidate's advisory committee at least two weeks prior to the Preliminary Exam.
 - The student must also notify the Graduate Committee and each member of their advisory committee of the date, time and location of their Preliminary Exam. This must be done at least two weeks prior to the Preliminary Exam.
 - During the Preliminary Exam, the student presents their prospectus to their advisory committee. To pass the Preliminary Exam, the student's advisory committee must unanimously approve the student's prospectus. Students who pass the Preliminary Exam are advanced to candidacy for the Ph.D.
6. Complete a minimum of 18 credits of Dissertation and complete a dissertation containing original research. Upon completion, the student must pass the Final Exam in which the student defends their dissertation. The Final Exam is the culminating experience of the PhD program.
- The Final Exam evaluates the Ph.D. candidate's dissertation. The Final Exam cannot be taken more than once per every three months but may be repeated until passed. To be eligible for the Final Exam, a Ph.D. candidate must have passed the Preliminary Exam, and have successfully completed all required course work including a minimum of 18 credits of Dissertation. A minimum of 12 credits of Dissertation must be taken after the successful completion of the Preliminary Exam. A copy of the Ph.D. candidate's dissertation must be submitted to the Graduate Committee and each member of the Ph.D. candidate's advisory committee at least two weeks prior to the Final Exam. The Ph.D. candidate must also notify the Graduate Committee and each member of their advisory committee of the date, time, and location of their Final Exam at least two weeks prior to the Final Exam. During the Final Exam, the Ph.D. candidate will present their dissertation to their advisory committee. To pass the Final Exam, the Ph.D. candidate's advisory committee must unanimously approve the Ph.D. candidate's dissertation.
7. The Department of Electrical and Computer Engineering requires that the Ph.D. degree be completed within a period of six years from the time the candidate is fully admitted to the Ph.D. program. Further,

courses taken more than six years prior to graduation cannot be applied toward the PhD degree without permission from the Graduate College. Students exceeding this time limit must formally write a letter requesting permission from both the Graduate Committee and the Graduate College to stay in the Ph.D. program and apply coursework towards the degree program. The formal letter must explain the circumstances of why the degree was not completed within the allotted time frame and indicate the extended period of time needed to complete the degree.

8. The student must submit and successfully defend their dissertation by the posted deadline. The defense must be advertised and is open to the public.
 - After the dissertation defense, the student must electronically submit a properly formatted pdf copy of their dissertation to the Graduate College for format check. Once the dissertation format has been approved by the Graduate College, the student will submit the approved electronic version to ProQuest. Deadlines for dissertation defenses, format check submissions, and the final ProQuest submission can be found here.

- Graduation Requirement for MSEE

Subplan 1: Course-only option

1. The student must pass a final comprehensive exam.
2. Students may apply for graduation up to two semesters prior to completing their degree requirements. All required forms must be submitted to the graduate college via the Grad Rebel Gateway.

Subplan 2: Thesis option

1. The student must submit and successfully defend their thesis by the posted deadline. The defense must be advertised and is open to the public.
2. After the thesis defense, the student must electronically submit a properly formatted pdf copy of their thesis to the Graduate College for format check. Once the thesis format has been approved by the Graduate College, the student will submit the approved electronic version to ProQuest. Deadlines for thesis defenses, format check submissions, and the final ProQuest submission can be found here.
3. Students may apply for graduation up to two semesters prior to completing their degree requirements. All required forms must be submitted to the graduate college via the Grad Rebel Gateway.

Subplan 2: Integrated BS-MS

1. The student must submit and successfully defend their thesis by the posted deadline. The defense must be advertised and is open to the public.
 2. After the thesis defense, the student must electronically submit a properly formatted pdf copy of their thesis to the Graduate College for format check. Once the thesis format has been approved by the Graduate College, the student will submit the approved electronic version to ProQuest. Deadlines for thesis defenses, format check submissions, and the final ProQuest submission can be found here.
 3. Students may apply for graduation up to two semesters prior to completing their degree requirements. All required forms must be submitted to the graduate college via the Grad Rebel Gateway.
- ii. [List any updates that need to be made to the undergraduate or graduate academic catalogs.](#)
 The use of GRE score in evaluating student's readiness for graduate program is less effective. Besides, due to the impact of COVID-19 pandemic, many international applicants were not be able to take GRE. We are temporarily waiving GRE for applicants till Fall 2023. We will evaluate the effect of this change and planning for removing GRE for all applicants.
- iii. [Have these changes been initiated in Curriculog?](#)
 Not yet

b. Outcomes and Assessment

- i. [Student Learning Outcomes and Program Assessment Plans and Reports by program concentration are available through the Office of Academic Assessment. Attach the most recent assessment report in the Appendix](#)
 The 2021 assessment report is attached in Appendix A.
- ii. [As a result of information gathered in your assessment reports, has the program revised its curriculum \(e.g. changing prerequisites, adding or eliminating required or elective courses, or co-curricular experiences for the degree\(s\)\) in the last five years? If so, what changes were made and why?](#)
 Five new courses were added in Spring 2022: CpE418/618 Cloud Computing in Engineering, EE 414/614 Quantum Communication, ECG712 Optical Materials and Devices, ECG 715 Biomedical Photonics, and ECG 716 Space Systems. These courses are added following the development of the fields and demand of graduate students.

- iii. Describe how the program has revised course content or pedagogical approaches based on findings in its assessment reports in the last five years?

Based on the courses assessed, the following changes are made:

- Complex critical thinking problems are being assigned in the form of projects, exam problems, or homework problems.
- Faculty have been asked to comment on how effective their class is in communicating their thoughts (written and/or verbal) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc.

- iv. Describe how you have used the findings in one assessment report to improve student learning.

ECE faculty members review the assessment report every year and use the assessment data to improve the student learning outcomes. One of the outcomes is “Student engagement in research, scholarship, creative expression and/or appropriate high-level professional practice.” The department requires each Ph.D. student to publish papers in a referred journal from their research work to assess this student’s learning outcome.

VII. Conclusion and Self-Assessment

a. Faculty Review of Self-Study

- i. On what date did the program and/or department faculty review this self-study?

Nov. 15-22, 2022

b. Conclusions

- i. What are the top three priorities and/or needs for the future development of the program?

1. Improve the 5-year completion rate of Ph.D. students through effective guidance and tracking of students’ progress.
2. Increase the enrollment of master and Ph.D. students especially students from underrepresented groups through proactive recruitment and early engagement of undergraduates in research.
3. Increase the external funding support through collaboration with other departments and colleges as well as partnership with local industry.

- ii. What are the strengths of the program?

1. The department’s faculty with graduate students have produced high profile research work with well-cited publication record.
2. Our graduates are well placed in academia and industry jobs with increasing local demands.

3. The department has established several joint programs with international universities.

iii. What are the challenges facing the program?

1. Lack of tenure-track assistant professors and faculty in-residence hinder the growth of the department.
2. Recruitment of international students is impacted severely by the COVID-19 pandemic.

iv. Provide any additional comments about the program.

Appendix A

ECE Graduate Program Annual Academic Assessment Report for Calendar Year 2021

Annual Academic Assessment Report Cover Sheet

Email to: assessment@unlv.edu

Program Information:

Program Assessed	MS and PhD programs
Department	Electrical and Computer Engineering
College	Engineering
Department Chair	Biswaji Das
Assessment Coordinator	Mei Yang
Date Submitted	
NEW: Semesters & Year Assessment Conducted	Spring 2022
Contact Person for This Report	
Name	Mei Yang
Phone	52364
Email	Mei.Yang@unlv.edu

Please attach a narrative (not to exceed 4 pages, excluding appendices) addressing the following:

- What are the student learning outcomes? Please provide a numbered list.
- Which learning outcomes were assessed?
- Undergraduate programs should assess at least one University Undergraduate Learning Outcome (UULO) each year, which may or may not overlap with a program learning outcome.
- Graduate programs should assess at least one outcome related to one of the following graduate level requirements each year:
 - student engagement in research, scholarship, creative expression and/or appropriate high-level professional practice.
 - activities requiring originality, critical analysis and expertise.
 - the development of extensive knowledge in the field under study.
- How were they assessed? (Programs must use at least one direct assessment of student learning.)
- What was learned from the assessment results?
- How did the program respond to what was learned?
- **OPTIONAL: How has your program responded to the challenges created by COVID-19?**

Please limit the narrative portion of your report to no more than four pages. You may attach appendices with data, tables, charts, or other materials as needed. Please explain the relevant conclusions from any appendices in your narrative. Please contact the Office of Academic Assessment if you have questions or need assistance.

Annual Graduate Assessment Report for Calendar Year 2021

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice

ECE Department Major Assessment: Communication and leadership

ECE Department Minor Assessment: Critical thinking

ECE Department Minor Assessment: Intellectual depth

Consistent with the Three-Year Plan, the Annual Assessment Report for Calendar Year 2021 will mainly focus on Communication and Leadership that complements the UNLV required outcome, “Student engagement in research, scholarship, creative expression and/or appropriate high-level professional practice.” The narrative below addresses the following Office of Academic Assessment questions regarding the ECE Graduate Program in the calendar year 2021

- What are the student learning outcomes? Provide a numbered list.
- Which learning outcomes were assessed?
- How were they assessed? Student learning must be backed up with at least one direct assessment.
- What was learned from the assessment results?
- How did the program respond to what has been learned?

1. What are the student learning outcomes?

The broad student learning outcomes of the ECE Graduate Program are

- 1) Demonstrate strong technical knowledge in their field of study with the potential to lead and direct engineering and scientific teams.
- 2) Demonstrate the ability to learn independently and generate new knowledge in their chosen field of study.
- 3) Reach the highest academic level with the potential to become a leader and an authority in Electrical and Computer Engineering.

Whereas the outcomes of the Office of Academic Assessment program for the ECE Graduate Program are

- Student engagement in research, scholarship, creative expression and/or appropriate high-level professional practice
- Activities requiring originality, critical analyses, and expertise
- The development of extensive knowledge in the field under study

2. Which learning outcomes were assessed?

The major learning outcomes being assessed in this report is Communication and Leadership as well as critical thinking and intellectual depth which are related to activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice, as well as graduate courses.

3. How were they assessed?

Graduate faculty completed an assessment form composed of part 1 students advised and part 2 graduate courses taught (form attached in Appendix A). In part 1, thesis/dissertation advisers assessed the graduate student(s) they advised regarding to the advancement of their student(s) towards the completion of their culminating experience (Appendix B; also contains a table of faculty that did participate in this assessment process). Faculty identified at least one critical

thinking problem associated with the experience and were asked how the student has advanced on that problem over the past year. Student activities associated with the culminating experience in terms of communication (written and verbal) and leadership were evaluated. Professional leadership extending outside of the culminating experience was addressed including leadership roles extended to teaching, mentoring, and research collaborations both on and off campus. Minor emphasis in the report accounted for the student's activities on critical thinking in the field under study and development of extensive knowledge in ECE subareas.

Communication and critical thinking in course work are addressed more on a class basis instead of a single student basis. Faculty have completed a form (Appendix C; also contains a table of faculty that did participate in this assessment process) which identifies one critical problem in their course that was assigned to students. Based on at least one direct learning assessment, faculty were asked to reflect on how the students as a whole or in subgroups addressed the problem with an emphasis on verbal and/or writing skills. Faculty have the opportunity to comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and orally) difficult conceptual topics especially those requiring critical thinking? Typically the problem assessed is assigned by way of an exam problem, project, or homework assignment.

It is anticipated that faculty reflection regarding student performance may be used as a tool to enhance student-professor interaction leading to an enhanced course experience in future classes or to an enhanced student research experience.

4. Brief Summary of Assessment Findings

Overall Faculty and Student Information

Pertaining to Culminating Experience (Thesis/Dissertation)

- 14 of 18 faculty/staff participated in the assessment.
- 16 Ph. D. students and 11 master students were assessed in 2021.

Pertaining to Graduate Courses

- 10 out of 18 faculty/staff responded in the assessment.
- 16 graduate courses were assessed: ten 700 level courses and six 600 level courses.
- Not all faculty taught graduate level courses.

Student Outcomes Thesis/Dissertation

- In 2021, no student attained an MS degree and no student attained a PhD degree
- Six PhD candidates progressed to advanced standing.
- Two students passed the MS Comprehensive Exam; three students passed the Ph. D. Qualifying Exam.
- All students that have advanced in degree have performed above average in both the oral and written part of their thesis/dissertation as evaluated by faculty on their advisory board.
- Communication and leadership activities were reported under a number of different avenues: presentations at conferences; writing papers, prospectus, thesis, and dissertation; mentoring undergraduate students, interns, and/or graduate students; working as a team member or leader in a research collaborations both on and off campus; regular meeting with students; and active leader in group discussions.

Graduate Course Outcomes (Based on the courses assessed)

- Complex critical thinking problems are being assigned in the form of projects, exam problems, or homework problems.

- Faculty have been asked to comment on how effective their class is in communicating their thoughts (written and/or verbal) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc.

What was learned from the assessment results?

- Some faculty that did address the students effectiveness to communicate their ideas stated that:
 - Students do have some writing issues but the writing center seems to help.
 - Students do not have a good handle in expressing their conceptual ideas in words; they have difficulty in providing a clear explanations or clear descriptions.
 - Some students haven't made significant progress in research due to health issues
- Other faculty indicated that students had adequate communication skills. These comments were directed mainly to graduate courses taught.
- Writing technical reports and formulating and structuring papers are important. It was suggested that graduate students need a technical paper writing component: both survey and report type.
- Graduate students, especially international students, need refined presentation skills.
- Though there was no student graduating in 2021, most PhD students had generated publications. Six students passed the preliminary exams. Overall, these students as judged by their thesis/dissertation advisory board have fairly well [above average] in both their written and oral experience. About half of MS students had made progress in their thesis work.

How did the program respond to what has been learned?

- Technical writing and presentation workshops offered in the College of Engineering for all graduate students have been suggested. Students need to learn how to formulate and structure their thoughts effectively and concisely in both the written and oral word. In some cases where the student has a good command on the English language, students need to refine and/or optimize their communication methods to be a more effective technical public speaker and/or technical writer.
- Students were notified with the R2PC workshops offered at the Graduate College.
- Dr. Yang worked with California State University, Los Angeles (CSULA) in hosting one virtual workshop for faculty job opportunities at CSULA in Nov. 2021. Four ECE graduate students attended the workshop. #

Appendix A

Faculty Assessment Form Part 1 and Part 2

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/<u>Adviser Name</u>: (BOTH names required) If no grad. students, type DNA for student name.	
Year Admitted:	
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	
Tentative Title of Thesis/Dissertation:	
Hypothesis:	
Motivation:	
Objectives:	
Oral Communication (Type)**/Date	
Written Presentation (Type)**/Date	
Professional Leadership (State type with brief details)***	
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	
Degree Awarded; (Type, date)	
Student efforts beyond the degree	

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
 Minor – Critical Thinking, Intellectual Depth
 After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	
Other:	
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	
No.# courses in ECE Minor Area (MS** or PhD***)	
No.# course in Second Minor (PhD only)	
Pass Qualifier Exam?	
Pass Comprehensive Exam?	
Pass Preliminary Exam?	

- * Number of courses in a major concentration field in ECE
- ** Number of all remaining courses in ECE
- *** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring originality, critical analyses, and expertise
ECE Department Major Assessment: Communication and Leadership
 ECE Department Minor Assessment: Critical Thinking
 ECE Department Minor Assessment: Intellectual Depth
Part 2

This section must be filled out for each graduate class taught in the academic year; 1/1/2021 – 12/31/2021.
 Independent study and special topics classes need to be treated as any regular course on this form.

Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	
Course Title:	
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	
Identify what makes the problem a critical thinking problem	
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	

Appendix B

Faculty Evaluations for 2021 Part 1 Student Assessment

Major Assessment: Communication and Leadership
Minor Assessment: Critical Thinking and Intellectual Depth

Faculty Participants (14/18)

Baker	Baghzouz	Das	Harris	Jiang
Latifi	Morris	Muthukumar	Regentova	Saberinia
Selvaraj	Schill	Yang	Zhu	

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2018 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Olufemi Olubode / Robert A. Schill Jr.
Year Admitted:	Spring 2018
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	PhD / Experimental, Theory, and some computation based on self-built models
Tentative Title of Thesis/Dissertation:	Electromagnetic Sensors and Applications
Hypothesis:	<i>It is hypothesized that the EM dots will be sensitive enough to monitor the magnetic field and detect small changes in the magnetic field generated by the current line in the test stand (locomotive's input power lines) based on pulsed-power technology using different physical conditions on the carbon strip to produce different resistance values R_z, thereby predicting the strip's end-of-life when the carbon strip has changed from its new state to its worst state (short state). It is further hypothesized that a theoretical approach will yield results that are reasonably in agreement with the experimental results.</i>
Motivation:	
Objectives:	<ul style="list-style-type: none"> • Design, build and test a pulsed-power carbon strip degradation test stand based on pulsed-power technology. This test stand is to emulate a typical pantograph-catenary of a locomotive (railroad) system. • Use the EM dot to monitor the current distribution from the test stand and hence, the magnetic field. • Exploit the EM dot sensitivity to monitor changes in the magnetic field generated by the current in the locomotive's input power lines. This will assist in distinguishing between various conditions of the carbon strip for degradation determination. • Develop an extensive circuit theory model using both Matlab and a computer-aided analysis and design (CAAD) tool based on a pulsed-power circuit. Simulated results from the CAAD tool and solutions from the theory using Matlab will be compared to experimental results for validation purposes. • Develop a mildly relativistic approximation that determines the initial conditions of the beam from a DPF with the final conditions known. The grazing condition will be used to determine the initial conditions of the charged particle beam in a finite drift tube. • Use an EBMD to determine the properties of the electron beam generated from the DPF experiment. Experimentally determine the captured charged particle energy.
Oral Communication (Type)**/Date	Two conferences and one seminar
Written Presentation (Type)**/Date	Two journal papers submitted
Professional Leadership (State type with brief details)***	Teaches an undergraduate laboratory class
Comment on any peer review of the	Olufemi can express in words difficult conceptual topics. He has

critical thinking problem. Comment on the quality of the student's communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	received good feedback at the seminar for his efforts. He is in the process of writing his thesis.
Degree Awarded; (Type, date)	DNA
Student efforts beyond the degree	Grader and lab assistant

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b

*Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Olufemi Olubode / Robert A. Schill, Jr.
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	Coursework complete, two papers submitted for publication
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	Dead ends addressed on railroad effort regarding noise issues. Working on the plasma effort
Other:	
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	Completed
No.# courses in ECE Minor Area (MS** or PhD***)	Completed
No.# course in Second Minor (PhD only)	Completed
Pass Qualifier Exam?	Completed
Pass Comprehensive Exam?	DNA
Pass Preliminary Exam?	Completed 2021

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Jingyuan Dai Advisor: Dr. Yingtao Jiang Co-Advisor: Dr. Ming Zhu
Year Admitted:	2019
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	Ph.D.
Tentative Title of Thesis/Dissertation:	Data fusion for 2D RGB images and 3D point cloud data for object recognition and geometry measurement
Hypothesis:	Combining 2D images and 3D PCD information can improve the accuracy in object geometry measurement for various engineering applications
Motivation:	Single modal image sensors may not suffice the accuracy requirement in object geometry measurement
Objectives:	Combining 2D images and 3D PCD information to improve the accuracy in object geometry measurement for various engineering applications
Oral Communication (Type)**/Date	NA
Written Presentation (Type)**/Date	NA
Professional Leadership (State type with brief details)***	NA
Comment on any peer review of the critical thinking problem. Comment on the quality of the student's communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Currently not much research study has been performed. Did minor study in 2D and 3D image fusion.
Degree Awarded; (Type, date)	NA
Student efforts beyond the degree	Below average

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
 Minor – Critical Thinking, Intellectual Depth
 After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Jingyuan Dai Advisor: Dr. Yingtao Jiang Co-Advisor: Dr. Ming Zhu
Critical Thinking-Culminating Exp. 1/1/2021 – 12/31/2021	Barely
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	Barely
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	Non-linear space mapping between 3D PCD and 2D images,
Other:	
Intellectual Depth (since beginning of program)	
No.# courses in ECE Major Area (MS* or PhD***)	4
No.# courses in ECE Minor Area (MS** or PhD***)	3
No.# course in Second Minor (PhD only)	3
Pass Qualifier Exam?	Yes
Pass Comprehensive Exam?	No yet
Pass Preliminary Exam?	No yet

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Jian Ni / Yingtao Jiang and Shengjie Zhai
Year Admitted:	2017 Spring
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	PhD
Tentative Title of Thesis/Dissertation:	On a fog-cloud-enabled Heart monitoring system for long-term, real-time detection of cardiac abnormalities
Hypothesis:	1. By properly partition tasks between the edge end and the cloud, IoT-based ECG monitoring systems will be rendered with the features of efficient utility of bandwidth, low latency, and enhanced scalability. 2. By identifying and preserving the useful morphological features on ECG waveforms, DNN-based models for processing and analyzing ECG signals can achieve high performances (measured by sensitivity, specificity, and F1 score).
Motivation:	Cardiovascular diseases (CVD) are the cause of death of about 17 million people annually – approximately 33% of all deaths worldwide (one every 60 seconds) [1]. A major tool for clinicians to evaluate irregular heart rhythm, and diagnose cardiac abnormalities are long-term continuous electrocardiography monitoring devices (ECG) . In traditional ECG monitoring systems, all ECG data are transmitted to the cloud, where automatic diagnostic algorithms provide interpretation of the data to assist clinicians in decision making of treatment. However, the reliance on the cloud will greatly delay the response time between patients and clinicians. Meanwhile, direct transmission of raw ECG data to the cloud can result in a big portion of noise and redundant data for diagnosis transmitted through the network, which greatly impact the bandwidth efficiency as well as the system scalability. Moreover, existing commercial automatic diagnostic algorithms for ECG interpretation still show substantial rates of misdiagnosis. All the above shortages of the cloud-based ECG monitoring system preclude the usage of the system as a standalone diagnostic tool and relegates them to an ancillary role.
Objectives:	1. The system features optimal or nearly optimal task partition between the cloud and the edge/fog devices in long term heart health/abnormality monitoring/detection. 2. We shall develop an automatic diagnostic model based on 12-lead ECG for the detection of 9 types of cardiac abnormalities. 3. The developed system shall be able to extract and preserve useful information under the constraints of computational power, storage

	and energy budget that are applied to edge/fog devices. 4. The hardware/software of the entire system on both cloud and fog ends is fully integrated, tested and validated for reliable ECG recording and long-term heart health monitoring.
Oral Communication (Type)**/Date	1. Prospectus defense / Jan. 29 th , 2021 2. Oral presentation of conference paper / Jul. 13 th , 2021
Written Presentation (Type)**/Date	Conference paper / Jul. 13 th , 2021
Professional Leadership (State type with brief details)***	1. Teaching labs. 2. Writing a patent. 3. Publishing paper.
Comment on any peer review of the critical thinking problem. Comment on the quality of the student's communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Jian Ni made improved his communication skills considerably over the year. He drafted his manuscript and delivered a few presentations.
Degree Awarded; (Type, date)	
Student efforts beyond the degree	

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups),
NOTE: Presentations in courses outside of seminar are not appropriate here.

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Jian Ni / Yingtao Jiang
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	Advances: 1. Developed a multi-class ECG classification model based on 12-lead ECG for detecting 9 types of common cardiac rhythms and published a paper. 2. Designed an edge-cloud signal stratification and preprocessing method in support of IoT-based ECG monitoring systems and wrote a draft.
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	Difficulties: 1. Electrode motion noise in ECG signals is difficult to be mathematically modelled and be removed by simple filters. 2. DNN models cannot identify targeted morphological features and novel structures are expected for this purpose.
Other:	
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	5
No.# courses in ECE Minor Area (MS** or PhD***)	3
No.# course in Second Minor (PhD only)	3
Pass Qualifier Exam?	Passed
Pass Comprehensive Exam?	Passed
Pass Preliminary Exam?	Passed in Jan. 2021

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Saugat Sharma/ Henry Selvaraj
Year Admitted:	Fall 2019
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	PhD in electrical and computer engineering
Tentative Title of Thesis/Dissertation:	IoT real time applications: Using ML and RTOS
Hypothesis:	Solving the time critical applications using RTOS in various application areas
Motivation:	Growth of IoT and real time application demand
Objectives:	Real time and ML based solution for IoT areas
Oral Communication (Type)**/Date	Conference/ 12-14-2020
Written Presentation (Type)**/Date	Conference/ 12-16-2021
Professional Leadership (State type with brief details)***	CPE Lab class TA from August of 2019. Teaching lab classes for CPE100L, 200L, 300L,301L and 310L. Helping students to do the lab experiments and grading there works.
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	
Degree Awarded; (Type, date)	
Student efforts beyond the degree	

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Saugat Sharma/ Henry Selvaraj
Critical Thinking-Culminating Exp. 1/1/2021 – 12/31/2021	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	Failure detection and solving in progress studying on RTOS and looking for IoT application areas
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	To get a more general area for IoT applications to work on.
Other:	
Intellectual Depth (since beginning of program)	
No.# courses in ECE Major Area (MS* or PhD***)	5 courses completed 1 left
No.# courses in ECE Minor Area (MS** or PhD***)	2 course complete 1 left
No.# course in Second Minor (PhD only)	3 courses completed none left.
Pass Qualifier Exam?	Yes
Pass Comprehensive Exam?	Do not have to take this
Pass Preliminary Exam?	

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2018 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Smit Patel/ Sarah Harris
Year Admitted:	Spring 2019
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	PhD
Tentative Title of Thesis/Dissertation:	Cost-Effective Approach to Bipedal Locomotion
Hypothesis:	By using bio-inspired strategies for robots and prosthetics, we can minimize mechanical cost of transport.
Motivation:	Collision mechanics is a new analytical theory of legged locomotion, but it has only, as yet, been used to measure the energetics of legged locomotion. This thesis aims to use collision mechanics to actively control legged locomotion.
Objectives:	This thesis aims to use collision mechanics to minimize the mechanical cost of prosthetic devices and robots by modeling the algorithm on a Dynamic Control Platform.
Oral Communication (Type)**/Date	Preliminary Defense: 3/23/22
Written Presentation (Type)**/Date	None
Professional Leadership (State type with brief details)***	N/A
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	The student is developing his ability to communicate and present complex problems and analysis. This was further developed in preparation for his preliminary defense.
Degree Awarded; (Type, date)	None yet.
Student efforts beyond the degree	Not yet graduated.

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Smit Patel / Sarah Harris
Critical Thinking-Culminating Exp. 1/1/2021 – 12/31/2021	Developed preliminary algorithm of collision control in prosthetic devices.
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	<ul style="list-style-type: none"> • Designed preliminary algorithm of collision control for prosthetic prototype • Developed initial simulation model for prosthetic prototype • Developed initial machine learning model for predicting forces / velocity given IMU input
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	<ul style="list-style-type: none"> • Student is making progress on pushing through temporary roadblocks, but he is making progress in that area
Other:	
Intellectual Depth (since beginning of program)	
No.# courses in ECE Major Area (MS* or PhD***)	Completed all requirements
No.# courses in ECE Minor Area (MS** or PhD***)	Completed all requirements
No.# course in Second Minor (PhD only)	Completed all requirements
Pass Qualifier Exam?	Yes.
Pass Comprehensive Exam?	N/A
Pass Preliminary Exam?	Yes. Apr. 2021

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Md. Arshad Rashid Shaon/Yahia Baghzouz
Year Admitted:	Fall, 2021
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	PhD/combination
Tentative Title of Thesis/Dissertation:	Co-optimization of DERs for providing grid services and customer bill management.
Hypothesis:	
Motivation:	
Objectives:	
Oral Communication (Type)**/Date	
Written Presentation (Type)**/Date	
Professional Leadership (State type with brief details)***	
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	
Degree Awarded; (Type, date)	Graduation was delayed to Spring 2022
Student efforts beyond the degree	The student is working full time in industry.

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/<u>Adviser Name:</u> (BOTH names required) If no grad. Students, type DNA for student name.	Md. Arshad Rashid Shaon/Yahia Baghzouz
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	<ul style="list-style-type: none"> • Assessment of solar forecasting techniques • Analyzing local measurements of solar DNI and GHI • Customer bill management using thermal and virtual electricity storage.
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	<ul style="list-style-type: none"> • Basic functions of HRRR forecasting model • Co-optimization of energy and demand charges • Navigating Python programming
Other:	n/a
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	2
No.# courses in ECE Minor Area (MS** or PhD***)	2
No.# course in Second Minor (PhD only)	
Pass Qualifier Exam?	Not yet.
Pass Comprehensive Exam?	Not yet
Pass Preliminary Exam?	Not yet

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/<u>Adviser Name</u>: (BOTH names required) If no grad. students, type DNA for student name.	Ahmed Sony Kamal Chowdhury/Yahia Baghzouz
Year Admitted:	2021
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	PhD/combination
Tentative Title of Thesis/Dissertation:	Potential Grid Services from DERs
Hypothesis:	Distributed Energy resources can be aggregated to expand demand response programs.
Motivation:	Local power company project sponsored by the US Department of Energy
Objectives:	Develop algorithm on how to schedule DER operations for the benefit of both the utility and customer.
Oral Communication (Type)**/Date	n/a
Written Presentation (Type)**/Date	n/a
Professional Leadership (State type with brief details)***	n/a
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	n/a – the student completed the course requirements, but did little in terms of research due to health problems.
Degree Awarded; (Type, date)	n/a
Student efforts beyond the degree	n/a

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Ahmed Sony Kamal Chowdhury/Yahia Baghzouz
Critical Thinking-Culminating Exp. <i>1/1/2021 – 12/31/2021</i>	n/a – no measurable progress due to health problems
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	n/a – no measurable progress
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	n/a – no measurable progress
Other:	n/a
Intellectual Depth (since beginning of program)	
No.# courses in ECE Major Area (MS* or PhD***)	4
No.# courses in ECE Minor Area (MS** or PhD***)	6
No.# course in Second Minor (PhD only)	
Pass Qualifier Exam?	Yes
Pass Comprehensive Exam?	Not yet
Pass Preliminary Exam?	Not yet

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Rojin Aslani/Ebrahim Saberinia
Year Admitted:	2020
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	PhD/Theory
Tentative Title of Thesis/Dissertation:	Resource Allocation for Vehicular Communication Systems
Hypothesis:	Mathematical optimization can be used to maximize communication throughput with limited bandwidth and power resources.
Motivation:	Cellular 5G systems becoming more relevant for vehicular communications and smart transportation systems
Objectives:	Design optimization problem to use resources from 5G cellular systems to implement a vehicular communication system
Oral Communication (Type)**/Date	
Written Presentation (Type)**/Date	Journal paper submitted.
Professional Leadership (State type with brief details)***	
Comment on any peer review of the critical thinking problem. Comment on the quality of the student's communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	The draft of the paper submitted to the advisor needed major editing but it is getting better with each iteration.
Degree Awarded; (Type, date)	
Student efforts beyond the degree	

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Rojin Aslani/Ebrahim Saberinia
Critical Thinking-Culminating Exp. 1/1/2021 – 12/31/2021	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	- Formulation of problems regarding cellular communication in vehicular setting
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	- Simple geometric model for intersections and roads
Other:	
Intellectual Depth (since beginning of program)	
No.# courses in ECE Major Area (MS* or PhD***)	3
No.# courses in ECE Minor Area (MS** or PhD***)	2
No.# course in Second Minor (PhD only)	1
Pass Qualifier Exam?	Yes
Pass Comprehensive Exam?	No
Pass Preliminary Exam?	No

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Mario Valles Montenegro / Jacob R. Baker
Year Admitted:	2020
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	PhD
Tentative Title of Thesis/Dissertation:	Fast neutron solid state imager through plasmonic perturbation on BN nanotubes
Hypothesis:	neutron kinetic energy perturbs plasmons on BN nanotubes producing an image on a CMOS imager
Motivation:	Diagnostics for Fusion energy and nuclear weapon radiography
Objectives:	Study a new method for fast neutron detection and imaging and fabricate, build and test a solid state imager
Oral Communication (Type)**/Date	Student Summit at LANL Summer 2019
Written Presentation (Type)**/Date	10.1063/1.5039407 / february 2019
Professional Leadership (State type with brief details)***	EE221L Instructor
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	The student has demonstrated to be self-driven in his own studies. Performing research and looking for new ideas for his dissertation. He continuously produces presentations and engineering reports on his job as a radiation engineer and on school courses. The student shows a clear understanding of complex semiconductor and radiation concepts. He shows deep understanding by doing problem solving designing rad-hard circuits
Degree Awarded; (Type, date)	N/A
Student efforts beyond the degree	Working full time as radiation engineer

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b

*Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Mario Valles Montenegro / Jacob R. Baker
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	N/A
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	N/A
Other:	
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	4
No.# courses in ECE Minor Area (MS** or PhD***)	5
No.# course in Second Minor (PhD only)	3
Pass Qualifier Exam?	Yes
Pass Comprehensive Exam?	N/A
Pass Preliminary Exam?	N/A

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Manisha Ghimire/ Emma Regentova
Year Admitted:	2018
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	PhD/ combination of theoretical, supported by experiments
Tentative Title of Thesis/Dissertation:	Hyperspectral Data compression and implementation using systolic cube architecture
Hypothesis:	The modern deep learning methods allow for exploring the learning ability for compact representation of the large volumes of data.
Motivation:	NASA on-board hyperspectral imagers, such as AVIRIS, for example collect huge amount of datacubes. For communication and efficiency, data are to be represented in lesser bandwidths. The implementation on on-board NASA platform need on the other hand low power, low cost implementation. The dissertation is concerned with development of both the compression method and the hardware architecture capable to meet the constraints,
Objectives:	a) Explore modern learning networks b) develop a new architectural solution
Oral Communication (Type)**/Date	Prospectus presentation. On 04/20/22
Written Presentation (Type)**/Date	PPT slides
Professional Leadership (State type with brief details)***	Not assessed
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	The power point presentation was of a satisfactory quality, and the student were able to convey the ideas and findings. The student were able to handle the question and carry on the discussion.
Degree Awarded; (Type, date)	
Student efforts beyond the degree	

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups),

NOTE: Presentations in courses outside of seminar are not appropriate here.

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b

Minor – Critical Thinking, Intellectual Depth

After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Manisha Ghimire
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	??
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	The student has found a niche for the research. Specifically, an application for GAN to hyperspectral data.
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	The student didn't have a clear understanding of how to evaluate the method.
Other:	
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	5
No.# courses in ECE Minor Area (MS** or PhD***)	3
No.# course in Second Minor (PhD only)	3
Pass Qualifier Exam?	Yes, Fall 2018
Pass Comprehensive Exam?	N/A
Pass Preliminary Exam?	Yes, April 20, 2021

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Ginger-marie Wilkins / Biswajit Das
Year Admitted:	2020
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	PhD Experimental
Tentative Title of Thesis/Dissertation:	Nanoparticle strain gauges
Hypothesis:	Tunneling current between nanoparticles can be used to implement sensitive strain gauges
Motivation:	Applications in wearable electronics and smart healthcare
Objectives:	Study tunneling mechanisms between nanoparticles and develop a sensitive strain gauge
Oral Communication (Type)**/Date	
Written Presentation (Type)**/Date	
Professional Leadership (State type with brief details)***	
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	
Degree Awarded; (Type, date)	
Student efforts beyond the degree	

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Ginger-marie Wilkins / Biswajit Das
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	Identified thesis topic and carrying out literature search
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	Experiments delayed by pandemic
Other:	
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	5
No.# courses in ECE Minor Area (MS** or PhD***)	2
No.# course in Second Minor (PhD only)	
Pass Qualifier Exam?	
Pass Comprehensive Exam?	
Pass Preliminary Exam?	

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Ramu Gautam/ Dr. Mei Yang
Year Admitted:	Fall 2021
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	Ph. D./ Combination
Tentative Title of Thesis/Dissertation:	TBD
Hypothesis:	TBD
Motivation:	TBD
Objectives:	
Oral Communication (Type)**/Date	
Written Presentation (Type)**/Date	Ramu is writing a journal paper on correlation analysis framework for proteins in 4D fluorescent datasets.
Professional Leadership (State type with brief details)***	Ramu worked as the TA in Fall 2021. He taught CpE100L and graded homework for CpE100.
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	We had group discussion with my collaborator in life science every other week in Fall 2022. Ramu has good communication skill. He was able to present his progress on the correlation analysis clearly and raise his questions.
Degree Awarded; (Type, date)	TBD
Student efforts beyond the degree	

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Ramu Gautam/ Dr. Mei Yang
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	Ramu conducted research in correlation analysis of different proteins in 4D fluorescent datasets.
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	Ramu completed the work on family tree construction of protein objects, correlation analysis, and student test.
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	
Other:	
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	2
No.# courses in ECE Minor Area (MS** or PhD***)	0
No.# course in Second Minor (PhD only)	0
Pass Qualifier Exam?	No
Pass Comprehensive Exam?	NA
Pass Preliminary Exam?	No

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Yang Jiao/ Dr. Mei Yang
Year Admitted:	Fall 2017
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	Ph. D./ Combination
Tentative Title of Thesis/Dissertation:	Modeling and Analysis of Subcellular Protein localization in Hyper-Dimensional Fluorescent Microscopy Images using Deep Learning Methods
Hypothesis:	In analyzing hyper-dimensional images, modeling spatial, temporal, and causal relationships is important in modeling the mapping function.
Motivation:	Most of the methods only model the mapping functions between input and output by focusing on the spatial relationship, whereas neglect the temporal and causal relationships.
Objectives:	The objective of this dissertation is to comprehensively study the mapping function modeling of the spatial-temporal and the spatial-temporal-causal relationship in hyper-dimensional data with deep learning approaches.
Oral Communication (Type)**/Date	Yang presented the prospectus of his dissertation in Jan. 2021.
Written Presentation (Type)**/Date	Yang completed the prospectus of his dissertation in Jan. 2021. He submitted one journal paper in Oct. 2021. He is writing another journal paper.
Professional Leadership (State type with brief details)***	Yang worked as intern at Amazon in Summer 2021. His work was focused on developing new research projects to expand the breadth and depth of advanced domain for Amazon technology and development including machine learning and artificial intelligence.
Comment on any peer review of the critical thinking problem. Comment on the quality of the student's communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Yang has excellent communication skills. In his work on the protein localization prediction, he has tried different ways to model the problem and tested different deep learning methods. In our group meeting with my collaborator, he could present his results clearly, understand the questions from others deeply and propose his ideas.
Degree Awarded; (Type, date)	PhD, Spring 2022
Student efforts beyond the degree	Excellent

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups),

NOTE: Presentations in courses outside of seminar are not appropriate here.

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b

Minor – Critical Thinking, Intellectual Depth

After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Yang Jiao/ Dr. Mei Yang
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	Yang proposed the method of protein localization prediction based on four-dimensional reslicing generative adversarial network (4DR-GAN) which captures the complex relationships between the input and the target proteins. He further proposed the digital activation and inactivation tools.
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	Yang completed extensive experiments of 4DR-GAN and DA/DI tools.
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	The process of finding the right way of modeling the inter-class relationship was not easy. It took more than one year to try and test different deep learning methods.
Other:	
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	5
No.# courses in ECE Minor Area (MS** or PhD***)	3
No.# course in Second Minor (PhD only)	3
Pass Qualifier Exam?	Yes
Pass Comprehensive Exam?	NA
Pass Preliminary Exam?	Yes, Jan. 2021

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Binayak Tiwari/ Dr. Mei Yang
Year Admitted:	Fall 2016
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	Ph. D./ Combination
Tentative Title of Thesis/Dissertation:	EFFICIENT NETWORKS-ON-CHIP COMMUNICATION SUPPORT SOLUTIONS FOR DEEP NEURAL NETWORK ACCELERATION
Hypothesis:	Efficient communication support of many-to-one traffic and one-to-many traffic that largely exist in deep neural network (DNN) workloads are critical in improving the performance of DNN accelerators.
Motivation:	For mesh-based DNN accelerators, many-to-one traffic and one-to-many traffic are not supported inherently.
Objectives:	This dissertation aims to provide solutions to enhance the communication support and computation throughput in DNN accelerators.
Oral Communication (Type)**/Date	Binayak presented the prospectus of his dissertation in Jan. 2021. He presented one conference paper on SoCC 2021.
Written Presentation (Type)**/Date	Binayak completed the prospectus of his dissertation in Jan. 2021. He submitted one journal paper in Jun. 2021.
Professional Leadership (State type with brief details)***	Binayak worked as the TA for a number of ECE courses. He also developed the course materials for the training course on Arduino and Internet of Things for the NSF-funded UNLV ITEST Program. Binayak worked as intern in SiFive Inc. in Summer and Fall 2021. His work included RTL study, power analysis/reduction, and redesigning/improving CPU modules.
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Binayak has excellent communication skills. He has in-depth understanding of the features of different dataflow models. In our meetings, he can clearly present his ideas, analyze the results, and understand others’ comments and suggestions.
Degree Awarded; (Type, date)	PhD, Spring 2022
Student efforts beyond the degree	Excellent

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups),

NOTE: Presentations in courses outside of seminar are not appropriate here.

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b

Minor – Critical Thinking, Intellectual Depth

After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Binayak Tiwari/ Dr. Mei Yang
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	Binayak proposed to use the data streaming bus to distribute the input and weights in the DNN accelerator and support multiple PEs per router to improve the computation throughput. He also proposed the in-network-accumulator to improve the efficiency of weight stationary models.
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	Binayak did extensive experiments on evaluating the proposed solutions and conducted analysis to verify the experimental results.
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	
Other:	
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	5
No.# courses in ECE Minor Area (MS** or PhD***)	3
No.# course in Second Minor (PhD only)	3
Pass Qualifier Exam?	Yes
Pass Comprehensive Exam?	NA
Pass Preliminary Exam?	Yes, Jan. 2021

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Martin Arguelles-Perez/ Venki Muthukumar
Year Admitted:	Spring 2022
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	Direct PhD
Tentative Title of Thesis/Dissertation:	Navigation and Control of Heterogeneous Swarm of Robots
Hypothesis:	Achieve accurate distributed control and navigation in GPS denied environments.
Motivation:	Use of Heterogeneous Swarm of Robots for optimal explorations
Objectives:	
Oral Communication (Type)**/Date	TBD
Written Presentation (Type)**/Date	TBD
Professional Leadership (State type with brief details)***	Used the knowledge gained to coach undergraduate students in the Las Vegas Chapter of The American Institute of Aeronautics and Astronautics (AIAA) and a high school intern student.
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	The student possesses a clear understanding of the requirements of his thesis goals. He understands the importance of learning ROS for simulation and testing of his thesis hypothesis.
Degree Awarded; (Type, date)	
Student efforts beyond the degree	

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	
Critical Thinking-Culminating Exp. 1/1/2021 – 12/31/2021	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	The student has showed superior ability to use knowledge, facts, and data to effectively solve problems. A specific task assigned to the student was to assemble, calibrate test and control multiple small UAVs with different configurations, calibrate path with VICON camera system. The student was able to achieve all of these goals within the first few months of his tenure through extensive online research, collect materials, interpret and apply knowledge.
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	The student has exceeded expectations in all assigned requirements.
Other:	
Intellectual Depth (since beginning of program)	
No.# courses in ECE Major Area (MS* or PhD***)	2
No.# courses in ECE Minor Area (MS** or PhD***)	1
No.# course in Second Minor (PhD only)	0
Pass Qualifier Exam?	In process
Pass Comprehensive Exam?	NA
Pass Preliminary Exam?	NA

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Lihao Qiu / Advisor: Dr. Yingtao Jiang, Co-advisor: Dr. Ming Zhu
Year Admitted:	2020
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	MS thesis, Combination of Theory and Experiments
Tentative Title of Thesis/Dissertation:	Development of UAV-Based Rail Track Geometry Irregularity Monitoring and Measuring Platform Empowered by Artificial Intelligence
Hypothesis:	Geometry measurement of rails are feasible by using optical sensors carried by a UAV and ML techniques
Motivation:	Rail geometry inspection is important to rail maintenances. Current method is mostly manual and/or on ground, which is less efficient and can only be performed outside of railway's normal operation schedules
Objectives:	Development of UAV-Based Rail Track Geometry Irregularity Monitoring and Measuring Platform Empowered by Artificial Intelligence to improve the inspection efficiency and flexibility
Oral Communication (Type)**/Date	Thesis Defense 4/6/2022
Written Presentation (Type)**/Date	Thesis Defense 4/6/2022
Professional Leadership (State type with brief details)***	NA
Comment on any peer review of the critical thinking problem. Comment on the quality of the student's communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Above average
Degree Awarded; (Type, date)	MSEE, May 2022
Student efforts beyond the degree	Above average

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

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Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Lihao Qiu / Advisor: Dr. Yingtao Jiang, Co-advisor: Dr. Ming Zhu
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	Thesis defense completed
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	The project involves a lot of aspects of research, including ML, data fusion, data registration, geometry analysis, etc.
Other:	
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	3
No.# courses in ECE Minor Area (MS** or PhD***)	2
No.# course in Second Minor (PhD only)	
Pass Qualifier Exam?	Yes
Pass Comprehensive Exam?	Not yet
Pass Preliminary Exam?	Not yet

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Carlos Camacho/Shahram Latifi
Year Admitted:	Fall 2013
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	MS Thesis
Tentative Title of Thesis/Dissertation:	Target Detection using UWB radar
Hypothesis:	The type of materials can be identified by processing the radar signals.
Motivation:	Remote identification of the objects is extremely useful
Objectives:	To remotely identify the size and type of objects
Oral Communication (Type)**/Date	None
Written Presentation (Type)**/Date	None
Professional Leadership (State type with brief details)***	He served as a TA instructing different labs in the department. In 2021, he was working outside the campus.
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Student has postponed his graduation to a later time due to being a full-time employee. His communication skills are very good and he can explain and analyze difficult topics in machine learning very well.
Degree Awarded; (Type, date)	
Student efforts beyond the degree	Student has a full-time job as a technician in town.

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Carlos Camacho/Shahram Latifi
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	Challenges in setting up the experiments (Radar and Antenna Design)
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	Made progress in having the most part of the experiments in place.
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	Difficulty in finding sample materials and building custom radar for experiments.
Other:	None
<i>Intellectual Depth (since beginning of program)</i>	N/A
No.# courses in ECE Major Area (MS* or PhD***)	N/A
No.# courses in ECE Minor Area (MS** or PhD***)	N/A
No.# course in Second Minor (PhD only)	N/A
Pass Qualifier Exam?	N/A
Pass Comprehensive Exam?	N/A
Pass Preliminary Exam?	N/A

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Neha Raste/Shahram Latifi
Year Admitted:	Fall 2015
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	MS course only
Tentative Title of Thesis/Dissertation:	N/A
Hypothesis:	N/A
Motivation:	N/A
Objectives:	N/A
Oral Communication (Type)**/Date	None
Written Presentation (Type)**/Date	None
Professional Leadership (State type with brief details)***	None
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Student has postponed her graduation to a later time due to being a full-time employee. Her communication skills are very good and she can explain and analyze difficult topics in machine learning very well.
Degree Awarded; (Type, date)	
Student efforts beyond the degree	Student has a full-time job as a programmer in town.

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Neha Raste/Shahram Latifi
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	Student finished course work. Switched to course only.
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	N/A
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	N/A
Other:	None
<i>Intellectual Depth (since beginning of program)</i>	N/A
No.# courses in ECE Major Area (MS* or PhD***)	N/A
No.# courses in ECE Minor Area (MS** or PhD***)	N/A
No.# course in Second Minor (PhD only)	N/A
Pass Qualifier Exam?	N/A
Pass Comprehensive Exam?	N/A
Pass Preliminary Exam?	N/A

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2018 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Rocky Gonzalez / Robert Schill, Jr.
Year Admitted:	Spring 2020
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	MS Thesis / experimental and theoretical
Tentative Title of Thesis/Dissertation:	Redirection of the Current in a Dense Plasma Focus
Hypothesis:	<i>It is hypothesized that current redirection, due to restrike, behind the dynamic sheath of a dense plasma focus will result in a measurable change in the magnetic field along the longitudinal axis of a DPF. It is further hypothesized that the electromagnetic dot sensors will be able to measure the loss current and determine the location of redirection.</i>
Motivation:	MSTS observations
Objectives:	<ul style="list-style-type: none"> • Model and construct a dense plasma focus to resemble similar geometries to that produced by MSTS. • Examine the different mechanisms that may lead to the potential loss of current due to restrike within the dense plasma focus. • Utilize theory and software to demonstrate the expected current distribution within a dense plasma focus. Simulated results will then be compared to experimental data. • Measure the magnetic fields in the dense plasma focus system to determine the mechanism for current redirection. This determination can be concluded by comparing theoretical results to the collected data by an array of electromagnetic dot sensors.
Oral Communication (Type)**/Date	To program manager
Written Presentation (Type)**/Date	DNA
Professional Leadership (State type with brief details)***	DNA
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Student wrote most of his thesis. His thought process allowed him to rethink how to perform different experiments to match or guide theory.
Degree Awarded; (Type, date)	
Student efforts beyond the degree	

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.),

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Rocky Gonzalez / Robert A. Schill, Jr.
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	Student guided by theory and experiment was able to conduct key experiments to address his hypothesis
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	Writing stage. Second draft.
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	Many dead-ends due probably to cross talk, noise, and incomplete research vessel to contain signals generated by mock DPF shorting.
Other:	
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	Degree requirement: Completed
No.# courses in ECE Minor Area (MS** or PhD***)	Degree requirement: Completed
No.# course in Second Minor (PhD only)	DNA
Pass Qualifier Exam?	DNA
Pass Comprehensive Exam?	DNA
Pass Preliminary Exam?	DNA

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Ivan Soto / Brendan Morris
Year Admitted:	Fall 2021
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	MS thesis / Experimental
Tentative Title of Thesis/Dissertation:	Spectral Fusion for Tissue Perfusion Classification
Hypothesis:	The combination of color (RGB), thermal IR, and near-IR imaging will improve detection of tissue perfusion over any individual modality.
Motivation:	Tissue perfusion
Objectives:	<ul style="list-style-type: none"> • Collect dataset for tissue perfusion based on tourniquet procedure • Develop image system using deep learning to classify different stages of perfusion • Perform ablation study of various DL backbone networks and sensor fusion schemes for perfusion classification • Implement tissue perfusion detection on emergency room prototype
Oral Communication (Type)**/Date	Weekly meetings with student to discuss research progress.
Written Presentation (Type)**/Date	NA. Only informal writing through weekly research logs
Professional Leadership (State type with brief details)***	Occasional presentations/updates to DoD during the senior design competition semesters.
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	
Degree Awarded; (Type, date)	
Student efforts beyond the degree	

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Ivan Soto / Brendan Morris
Critical Thinking-Culminating Exp. 1/1/2021 – 12/31/2021	NA
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	<ul style="list-style-type: none"> • Implemented hand and finger detection/counting systems using deep learning • Implemented image classification systems for tissue perfusion in PyTorch (ResNet) • Learned single camera and multi-camera calibration
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	<ul style="list-style-type: none"> • Calibration of thermal IR camera is difficult since standard checkerboard patterns cannot be use without modification <ul style="list-style-type: none"> ○ Looking to heating checkerboard in the sun • Needs to understand different fusion strategies (early to late)
Other:	
Intellectual Depth (since beginning of program)	
No.# courses in ECE Major Area (MS* or PhD***)	4, ECG 703, ECG 621, ECG 707, ECG 695
No.# courses in ECE Minor Area (MS** or PhD***)	6 Remaining. 2 of which are thesis credits. 3 700 level courses and 1 600/700 level course.
No.# course in Second Minor (PhD only)	NA
Pass Qualifier Exam?	NA
Pass Comprehensive Exam?	NA
Pass Preliminary Exam?	NA

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Stryder Loveday/Yahia Baghzouz
Year Admitted:	2018
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	MS Thesis/Theory
Tentative Title of Thesis/Dissertation:	Impact of DER on bulk power system operation
Hypothesis:	Aggregation of DERs can lead to false results when evaluation the impact of bulk power system reliability.
Motivation:	Calls from the National Electric Reliability Council (NERC) on the importance of the above topic
Objectives:	Evaluate the impact of distributed DERs on the transmission side of the system through simulations using OpenDSS software.
Oral Communication (Type)**/Date	Thesis defense (4/7/22)
Written Presentation (Type)**/Date	Thesis completion (4/7/22)
Professional Leadership (State type with brief details)***	n/a
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	The student is found to clearly express difficult conceptual topics as demonstrated in his thesis defense.
Degree Awarded; (Type, date)	MS degree in Electrical Engineering, Spring 2022
Student efforts beyond the degree	The student is working full time with the local power company

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Stryder Loveday/Yahia Baghzouz
Critical Thinking-Culminating Exp. <i>1/1/2021 – 12/31/2021</i>	DNA
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	<ul style="list-style-type: none"> • Impact of DERs on voltage profile • Interaction between transmission and distribution systems
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	<ul style="list-style-type: none"> • Dynamic models of various DERs
Other:	n/a
Intellectual Depth (since beginning of program)	
No.# courses in ECE Major Area (MS* or PhD***)	4
No.# courses in ECE Minor Area (MS** or PhD***)	8
No.# course in Second Minor (PhD only)	n/a
Pass Qualifier Exam?	n/a
Pass Comprehensive Exam?	n/a
Pass Preliminary Exam?	n/a

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/<u>Adviser Name</u>: (BOTH names required) If no grad. students, type DNA for student name.	Anh Bui/Yahia Baghzouz
Year Admitted:	2013
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	MS course only/Theory
Tentative Title of Thesis/Dissertation:	DNA
Hypothesis:	DNA
Motivation:	DNA
Objectives:	DNA
Oral Communication (Type)**/Date	DNA
Written Presentation (Type)**/Date	The student took the comprehensive exam on 3/27/21 and passed.
Professional Leadership (State type with brief details)***	DNA
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	DNA
Degree Awarded; (Type, date)	Graduation was delayed to Spring 2022
Student efforts beyond the degree	The student is working full time in industry.

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Anh Bui/Yahia Baghzouz
Critical Thinking-Culminating Exp. <i>1/1/2021 – 12/31/2021</i>	DNA
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	DNA
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	DNA
Other:	
Intellectual Depth (since beginning of program)	
No.# courses in ECE Major Area (MS* or PhD***)	4
No.# courses in ECE Minor Area (MS** or PhD***)	8
No.# course in Second Minor (PhD only)	
Pass Qualifier Exam?	
Pass Comprehensive Exam?	Yes
Pass Preliminary Exam?	

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Christopher Barr/Dr. Baker
Year Admitted:	Spring 2021
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	MS Thesis/Undecided
Tentative Title of Thesis/Dissertation:	N/A
Hypothesis:	N/A
Motivation:	N/A
Objectives:	N/A
Oral Communication (Type)**/Date	N/A
Written Presentation (Type)**/Date	N/A
Professional Leadership (State type with brief details)***	N/A
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	N/A
Degree Awarded; (Type, date)	MS Electrical Engineer/Spring 2024
Student efforts beyond the degree	Continued education through online GTRI courses encompassing Cybersecurity.

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Christopher Barr/Dr. Baker
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	N/A
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	N/A
Other:	
<i>Intellectual Depth (since beginning of program)</i>	Graduating from UNLV with a BS in CpE, my focus was primarily on digital design and electronics. Going into the MS program for EE, I learned and understood the various types of methods involved in AI/Machine Learning and their tools – broadening my understanding of programming and CS related toolsets. I also learned how to design, analyze, and simulate memory circuits (DRAM, SRAM, Flash Memory, etc.), advancing my techniques in electronics and IC design.
No.# courses in ECE Major Area (MS* or PhD***)	2
No.# courses in ECE Minor Area (MS** or PhD***)	0
No.# course in Second Minor (PhD only)	DNA
Pass Qualifier Exam?	DNA
Pass Comprehensive Exam?	DNA
Pass Preliminary Exam?	DNA

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Francisco Mata Carlos/Dr. R. Jacob Baker
Year Admitted:	2020 Fall
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	MS thesis/Combination
Tentative Title of Thesis/Dissertation:	A Wearable Electronic Monitoring Device for Low Pressure Garment Applications and Temperature Analysis for Prevention of Ulceration and Infection
Hypothesis:	If an electronic sensing device (composed of a force sensor and a thermal sensor) is placed over the extremity and under a pressure garment to sense and monitor low force/pressure values and skin temperature changes, then the healing process of certain ailments can be improved.
Motivation:	Improve the medical condition of patients suffering from chronic venous insufficiency (CVI) and burn scar management by using a wearable electronic device that can be designed and assembled to monitor pressure and temperature variations.
Objectives:	<ul style="list-style-type: none"> - The first task is to identify the how much pressure the garment is applying at the baseline in order to make adjustments if needed or be sent back to the manufacturing facilities for modifications. - The second task is to monitor the pressure during the day and the weeks after to provide feedback to the user and medical personnel about important changes within the system arrangement. - The third task is to observe temperature changes over the damaged area and use the readings as a preventive indicator
Oral Communication (Type)**/Date	Thesis – 04/08/2022
Written Presentation (Type)**/Date	Thesis – 04/08/2022
Professional Leadership (State type with brief details)***	DNA
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	The student sought peer review from two colleague engineers. One of them has recently received a MS in electrical engineering and the second has been working in the field as a product engineer for over 10 years.

Degree Awarded; (Type, date)	BS in electrical engineering – May 2020 MS in electrical engineering – expected graduation May 2022
Student efforts beyond the degree	Seek employment

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups),

NOTE: Presentations in courses outside of seminar are not appropriate here.

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b

Minor – Critical Thinking, Intellectual Depth

After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Francisco Mata Carlos/Dr. R. Jacob Baker
Critical Thinking-Culminating Exp. <i>1/1/2021 – 12/31/2021</i>	Thesis
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	<ul style="list-style-type: none"> • Improvement on writing skills • Improvement on research tactics • Formation of full understanding of product assembly • Understanding of medical terminology
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	<ul style="list-style-type: none"> • Software/Hardware Implementation • Software/Hardware Agreement • App Development across multiple OS platforms • Calibration of newly-designed sensing systems
Other:	
Intellectual Depth (since beginning of program)	
No.# courses in ECE Major Area (MS* or PhD***)	8
No.# courses in ECE Minor Area (MS** or PhD***)	0
No.# course in Second Minor (PhD only)	DNA
Pass Qualifier Exam?	DNA
Pass Comprehensive Exam?	DNA
Pass Preliminary Exam?	DNA

* Number of courses in a major concentration field in ECE

** Number of all remaining courses in ECE

*** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Minsung Cho/Professor R. J. Baker
Year Admitted:	2018
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	MS
Tentative Title of Thesis/Dissertation:	Machine Learning and Integrated Circuit
Hypothesis:	Flash or memristor design can be used to improve machine learning process.
Motivation:	Modern processors and their architectures are not optimized for machine learning computation and is bottlenecked.
Objectives:	To compare the performance between standard PC processor, FPGA, and optimized IC simulation for machine learning image processing.
Oral Communication (Type)**/Date	Thesis/
Written Presentation (Type)**/Date	Thesis/
Professional Leadership (State type with brief details)***	
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	
Degree Awarded; (Type, date)	
Student efforts beyond the degree	

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
Minor – Critical Thinking, Intellectual Depth
After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	
<i>Critical Thinking-Culminating Exp.</i> <i>1/1/2021 – 12/31/2021</i>	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	
Other:	
<i>Intellectual Depth (since beginning of program)</i>	
No.# courses in ECE Major Area (MS* or PhD***)	
No.# courses in ECE Minor Area (MS** or PhD***)	
No.# course in Second Minor (PhD only)	
Pass Qualifier Exam?	
Pass Comprehensive Exam?	
Pass Preliminary Exam?	

- * Number of courses in a major concentration field in ECE
- ** Number of all remaining courses in ECE
- *** Number of courses includes both MS and PhD programs together

UNLV Outcome Assessed: Activities requiring student engagement in research, scholarship, creative expression, and/or appropriate high-level professional practice
ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth

Part 1a

To ease the burden of assessment, complete the form below for each student that you have taken the roll of mentor (MS course only option) or adviser (MS thesis or PhD dissertation option). ***If a student entered the graduate program in the Fall of 2021 or later, just complete the first three entries and continue to Part 1b and 2.***

Research Component – Communication and Leadership – 1/1/2021– 12/31/2021*

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Jazmine Boloor / Dr. R. Jacob Baker
Year Admitted:	Fall 2021
Degree (MS course only, MS thesis, PhD) /Type (Theory, Experimental, Numerical Modeling, or Combination)	MS thesis
Tentative Title of Thesis/Dissertation:	
Hypothesis:	
Motivation:	
Objectives:	
Oral Communication (Type)**/Date	
Written Presentation (Type)**/Date	
Professional Leadership (State type with brief details)***	
Comment on any peer review of the critical thinking problem. Comment on the quality of the student’s communication and presentation efforts prior to advisor comments, insertions, or editorial changes. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	
Degree Awarded; (Type, date)	
Student efforts beyond the degree	

* If the student is in the MS course only program, use DNA (Does Not Apply) as a fill-in.

** Examples of presentation types: Prospectus, Conference paper, Journal paper, Proposal, Prelim, Thesis/Dissertation (written and oral; NOTE: faculty advisor help is expected), Teaching, Internal UNLV Presentations (hosted by graduate college, department, Eng. College, Intellectual Property, seminar, etc.), External Presentations (National laboratory, industry, other university, K-12, media, professional groups), **NOTE: Presentations in courses outside of seminar are not appropriate here.**

***Examples of leadership – Teaching a class, leading a discussion group, hold professional office, intellectual property presentation, presentations to the community, presentations to K-12, Thesis/dissertation presentation to community outside of UNLV (includes non-UNLV advisory board members at the preliminary & oral defense)

Part 1b
 Minor – Critical Thinking, Intellectual Depth
 After Completion, continue to Part 2

Student Name/Adviser Name: (BOTH names required) If no grad. students, type DNA for student name.	Jazmine Bolor / Dr. R. Jacob Baker
Critical Thinking-Culminating Exp. 1/1/2021 – 12/31/2021	
Bullet Advances in Thesis/Dissertation (with regards to critical thinking)	
Bullet Difficulties or Dead-Ends in Thesis/Dissertation (with regards to critical thinking)	
Other:	
Intellectual Depth (since beginning of program)	
No.# courses in ECE Major Area (MS* or PhD***)	four
No.# courses in ECE Minor Area (MS** or PhD***)	two
No.# course in Second Minor (PhD only)	
Pass Qualifier Exam?	
Pass Comprehensive Exam?	
Pass Preliminary Exam?	

- * Number of courses in a major concentration field in ECE
- ** Number of all remaining courses in ECE
- *** Number of courses includes both MS and PhD programs together

Appendix C

Faculty Evaluations for 2021 Part 2 Course Assessment

Communication and Leadership/Critical Thinking

Faculty Participants (10/18)

Baghzouz	Chmaj	Das	Harris	Latifi
Morris	Saberinia	Schill	Sun	Yang

UNLV Outcome Assessed: Activities requiring originality, critical analyses, and expertise
ECE Department Major Assessment: Communication and Leadership
 ECE Department Minor Assessment: Critical Thinking
 ECE Department Minor Assessment: Intellectual Depth
Part 2

This section must be filled out for each graduate class taught in the academic year; 1/1/2021 – 12/31/2021.
 Independent study and special topics classes need to be treated as any regular course on this form.

Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECG 703/Dr. Shahram Latifi
Course Title:	Machine Learning and Applications
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	How would one characterize the noise in order to avoid overfitting?
Identify what makes the problem a critical thinking problem	The answer would require knowledge, creativity and ability to collect and interpret the available data
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	The class size is small (8) and the results may not be statistically significant. Students generally performed well in addressing the problem notwithstanding they came up with different results. Some started out with a theoretical analysis and tried to confirm the result through simulation. Some started with a simulation to get an idea for what the results would turn out to be.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Students were assigned term projects and were required to give a presentation on their work. They performed very well in class by adequately preparing a survey around the topic they chose and presenting recommendation for future directions.

UNLV Outcome Assessed: Activities requiring originality, critical analyses, and expertise
ECE Department Major Assessment: Communication and Leadership
 ECE Department Minor Assessment: Critical Thinking
 ECE Department Minor Assessment: Intellectual Depth
Part 2

This section must be filled out for each graduate class taught in the academic year; 1/1/2021 – 12/31/2021.
 Independent study and special topics classes need to be treated as any regular course on this form.

Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECG617 / Grzegorz Chmaj
Course Title:	ECG617
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	The design of the IoT architecture for a building, but with remote facility requiring wireless connection.
Identify what makes the problem a critical thinking problem	Inability to apply one single solution – the correct design had to involve multiple sub-solutions that properly cooperate and address all the constraints. This also included minimization of electrical energy by using IoT-enabled technologies applied to HVAC.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	There were several different approaches to the solution. Most of the students applied separate communication approach to the remote facility, others used same communication standard used in the main building. For the HVAC optimization students typically proposed to use the weather predictions to effectively address the energy optimization.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	The quality of communications was very good, I would only require more descriptive pictures, schematics and diagrams. I was fully satisfied with textual descriptions. Problems were addressed in synthetic and very clear way, without excessive side-descriptions.

UNLV Outcome Assessed: Activities requiring originality, critical analyses, and expertise
ECE Department Major Assessment: Communication and Leadership
 ECE Department Minor Assessment: Critical Thinking
 ECE Department Minor Assessment: Intellectual Depth
Part 2

This section must be filled out for each graduate class taught in the academic year; 1/1/2021 – 12/31/2021.
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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECG 732 (Advanced Electromagnetics II – Radiation Theory) / Robert Schill, Jr. / Spring 2021
Course Title:	Advanced Electromagnetics II – Radiation Theory and Special Relativity
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	The conservation relations are very important in transport theory. The frame of reference that the observer is in makes a difference on how one conceptually and mathematically handle the issue of transport.
Identify what makes the problem a critical thinking problem	One needs to envision how the observer is making measurement using clocks and rulers and phenomena detectors and interpret this vision mathematically.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	There are two graduate students in the class: a MS degree candidate and a PhD degree candidate. Both candidates were on equal level in approaching the problem. Hints were provided to aid in interpreting the vision.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	The problem was in the form of a homework problem. Both students effectively attacked the problem and communicated their results in the form of a mathematical proof.

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ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking
ECE Department Minor Assessment: Intellectual Depth
Part 2

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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECG 646/Yahia Beghzouz
Course Title:	Photovoltaic Devices and Systems
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	Pairing a PV system with energy storage.
Identify what makes the problem a critical thinking problem	No unique solution.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	Some considered PV system size as a constraint, while others considered battery storage size as a constraint to customer bill management. Battery storage purchase or lease option is another variable that was considered.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Most students were hesitant to tackle such an open-ended problem as they are used to solving conventional problems with unique solutions. Nonetheless, all three students made clear assumptions in their presentations while solving such a problem that is classified as an optimization with multi-objective functions.

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ECE Department Major Assessment: Communication and Leadership**

ECE Department Minor Assessment: Critical Thinking

ECE Department Minor Assessment: Intellectual Depth

Part 2

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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECG 743/ Yahia Beghzouz
Course Title:	Smart Grid
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	Power generation forecasting from solar power plants.
Identify what makes the problem a critical thinking problem	Such power forecasting requires forecasting solar irradiance under various weather conditions.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	The students conducted a literature survey on solar power forecasting techniques. Some considered reported relatively simple, but less accurate, methods such as using data from the Numerical Weather Prediction Model. Other went deeper into machine learning and ensemble methodologies, and addressed the shortcomings of each method.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Most students did well in their oral presentations and clearly understood the challenges of short-term solar forecasting in cloudy days. Cloud formation, dissipation and movement are nearly impossible to predict with pinpoint accuracy, as this depends on wind speed and direction at higher altitude. Students came to realize that probabilistic measures are necessary when forecasting solar power.

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ECE Department Minor Assessment: Critical Thinking

ECE Department Minor Assessment: Intellectual Depth

Part 2

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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECG782 Spring 2021 / Brendan Morris
Course Title:	Multidimensional Digital Signal Processing
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	The students are given an open-ended term project to apply course material in a real-world application.
Identify what makes the problem a critical thinking problem	The term project is a critical thinking problem since the students must first make a project proposal, perform research on related research, identify appropriate techniques to solve the problem based on individual application requirements and constraints, followed by a project presentation and conference-styled report.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	There were two types of students in the course: i) those with a background in image/video processing from research, and ii) those just learning for the first time. i) Experienced students selected projects that closely aligned with their thesis/dissertation research. The projects tended to be more sophisticated and used more domain specific approaches. ii) Novice students selected projects which were more straight-forward application of techniques from class. Their effort was more in collecting and appropriate dataset and applying techniques discussed in class. As such, many utilized typical CNN architectures (either small hand designed or using a prototype backbone such as ResNet or Inception).
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Student communication performance was assessed by verbally and in writing for the project. In general the students did a fine job expressing their thoughts, both the presentations and reports were well organized and followed appropriate area norms. Students did tend to do better with the project report than the presentation. The biggest shortcoming was more technical – not being as familiar with the technical details of their approach – than in critical thought.

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ECE Department Major Assessment: Communication and Leadership
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Part 2

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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECG 795 / Sarah Harris
Course Title:	High-Speed PCB Design
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	Students were required to design, build, and simulate an entire high-speed system.
Identify what makes the problem a critical thinking problem	Students needed to synthesize and apply all of the topics discussed throughout the semester to design, test, and present their project.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	Students worked in teams of two (except for one student) to complete the project. The upper half of the class successfully built a system that resulted in an eye diagram with acceptable noise margins and bit error rates (BER). The lower half of the class did not take into account enough noise factors to build a robust system.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Students submitted presentation slides and a final report for their project. They also recorded videos of their presentation. Results varied from professional, thorough reports and presentations to incomplete, non-robust, poorly-written submissions. Although the average leaned heavily toward well-written, professional, and thorough reports.

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ECE Department Minor Assessment: Critical Thinking

ECE Department Minor Assessment: Intellectual Depth

Part 2

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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECG 762/ Ebrahim Saberinia
Course Title:	ECG 762: Detection and Estimation theory
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	In one exam question, the students were asked to discuss what estimator they would choose to solve a specific problem and explain their choice.
Identify what makes the problem a critical thinking problem	It is a critical thinking problem because choice of an estimator is not straight forward based on performance. They should consider different aspects including complexity, practicality etc.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	Around 60% of the class, just chose the estimator we discussed in the class as optimal in terms of performance. However, the rest of the class remembered why we talked about various options because of other criteria and stated advantages and disadvantages of several choices for that problem and described what their personal choice would be and why.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics	I would rate the effectiveness of them expressing their thoughts "average" and I think it can improve as they write more papers and proposals.

especially those requiring critical thinking?	
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**UNLV Outcome Assessed: Activities requiring originality, critical analyses, and expertise
ECE Department Major Assessment: Communication and Leadership**

ECE Department Minor Assessment: Critical Thinking

ECE Department Minor Assessment: Intellectual Depth

Part 2

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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECG 757/Das
Course Title:	Electron Transport Phenomena in Solid State Devices
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	Analyze electron transport across a heterojunction
Identify what makes the problem a critical thinking problem	Complex physics such as band discontinuity, tunneling are involved.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	Student was able to address the complex issues involved.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Effective

UNLV Outcome Assessed: Activities requiring originality, critical analyses, and expertise
ECE Department Major Assessment: Communication and Leadership
 ECE Department Minor Assessment: Critical Thinking
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Part 2

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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECG 753/Das
Course Title:	Advanced Topics in Semiconductor Devices I
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	Analyze a narrow channel HBT transistor
Identify what makes the problem a critical thinking problem	Quantum mechanical effects needed to be considered.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	Students understood the necessity of quantum mechanical effects and included in the analysis
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Effective

UNLV Outcome Assessed: Activities requiring originality, critical analyses, and expertise
ECE Department Major Assessment: Communication and Leadership
 ECE Department Minor Assessment: Critical Thinking
 ECE Department Minor Assessment: Intellectual Depth
Part 2

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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECG702/ Mei Yang
Course Title:	Interconnection Networks for Parallel Applications
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	Students are asked to show how to implement the Discrete Fourier Transform circuit based on butterfly networks.
Identify what makes the problem a critical thinking problem	The question asks for the circuit design. Students need to define the operations conducted at each node and how the data are passed between different stages.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	Some students just showed the structure of a butterfly network but didn't define the operation of each node and the dataflow by assuming the network will work. A few students provided the complete answer to this question.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Because this class was taught online, students seldom asked questions even if they had questions about homework. I held one synchronized session to discuss about the midterm exam questions. After that, still no student asked questions. I think online course for graduate courses degraded the communication between instructor and students.

UNLV Outcome Assessed: Activities requiring originality, critical analyses, and expertise
ECE Department Major Assessment: Communication and Leadership
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Part 2

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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECC604/ Mei Yang
Course Title:	Modern Processor Architecture
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	The first project is to implement a (m, n) correlating branch predictor and evaluate the performance of predictors with different configurations.
Identify what makes the problem a critical thinking problem	Students need to understand how the correlating branch predictor works before design the read/write logic of the predictor memory.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	I added one video explaining the correlating branch predictor with detailed examples which helped students understand the project. Most of the students were able to complete the design with the correct read/write logic.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	Students were active in communicating with me on homework/project questions through emails. A few students attended my virtual office hours.

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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECC600/ Mei Yang
Course Title:	Data Communication Network
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	One homework question asks how to find the best switch node size that results in the three-stage switching fabric using the minimum number of switching elements.
Identify what makes the problem a critical thinking problem	The key is to derive the total switching points as a function of the size of the switch node. Then find the optimal solution resulting in the minimum total number of switching points.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	Most students were able to derive the function. Several students failed to define the function.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	This course was taught online. Students were able to communicate with me through emails. No student came to my virtual office hour.

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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	EE452 / ECG652 Ke-Xun Sun Fall 2021
Course Title:	Optoelectronics
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	The course initiated a novel challenge for students to build high slew rate angular scanner based on grating angle magnification. The instructor previously patented the idea. ECG652 provide a vehicle to its implementation.
Identify what makes the problem a critical thinking problem	The project is challenging, involving many design and engineering steps.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	The class discussed in detail the principle of operations, the application, and the critical steps in design, construction and experiments. The class generated a high quality report, which was submitted to a professional conference on optical imaging. The product can be very useful for next generation optical entertainment system.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	ECG652 provides critical trainings for graduate students learn space research, scientific writing, and presentation at professional conferences.

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Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	EE416 / ECG616 /Ke-Xun Sun
Course Title:	Space Sensors and Instruments
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	The course is in parallel with a funded NASA project to build multiple CubeSats and their test platform for testing in International Space Station.
Identify what makes the problem a critical thinking problem	The project is large and complex, involving many design and engineering steps.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	The class generated three high quality course reports. Two of them have been accepted and presented by a NASA sponsored conference in April 2022. Their talk were commented highly by NASA engineers.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students' communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	ECG616 provides critical trainings for graduate students learn space research, scientific writing, and presentation at professional conferences.

UNLV Outcome Assessed: Activities requiring originality, critical analyses, and expertise

ECE Department Major Assessment: Communication and Leadership

ECE Department Minor Assessment: Critical Thinking

ECE Department Minor Assessment: Intellectual Depth

Part 2

This section must be filled out for each graduate class taught in the academic year; 1/1/2021 – 12/31/2021.

Independent study and special topics classes need to be treated as any regular course on this form.

Course Component – Communication and Leadership/Critical Thinking – 1/1/2021 – 12/31/2021

Course Number/Instructor Name: If did not teach a graduate course, type DNA for course number.	ECG752 Ke-Xun Sun Fall 2021
Course Title:	Physical Electronics
Identify ONE complex critical thinking problem that the students in your class were required to address. The problem could be an examine problem or a homework problem with a complex solution or an open-end problem.	The course requires students to write professional quality course project reports reflecting current research interests. Quantum computing as a “hot topic” attracted two students. Both reports had considerable depth.
Identify what makes the problem a critical thinking problem	The projects involving many intriguing concepts, and require critical thinking.
Address in detail how your class handled the problem. Concrete statements or direct measurements of student performance are sought. Technical terms may be used. Be as specific as possible. If you like, break the class up into two sections. One half of the class is composed of students with the highest half of the course grades. The second half of the class is composed of students with the lower half of the course grades. Explain how the upper and lower halves attacked the problem. If a different division is more suitable for your course, please state the division and provide your explanation.	The class discussed in detail the principles of quantum mechanics, atom and solid state systems, and applications to quantum computing in general. The class introduced recent literature on quantum computing. Project progress reports were required.
Comment on how effective your class is in communicating their thoughts (in writing and/or verbally) regarding the critical thinking problem: clarity, organized, readable, can express conceptual thoughts (analytically, orally, and/or in written English), etc. Comment on the quality of the students’ communication and presentation efforts. Can the student express in words (written and oral) difficult conceptual topics especially those requiring critical thinking?	ECG752 is a heavy loaded course with many problem sets, final exam, and large course projects. Students learned a lot in research, critical thinking, and presentation. They liked the course: Five out of the six students enrolled in ECG752 Fall 2021 took ECG750 Photonics offered by the instructor in Spring 2022, making ECG750 total enrolments to 9 students, one of larger graduate classes.