Howard R. Hughes College of Engineering

At the Howard R. Hughes College of Engineering, we live by our mission: Educate, Engage, Inspire, Innovate.

We are dedicated to:
- Creating a hands-on experiential learning experience for all our students,
- Fostering an environment of innovation that allows the pursuit of high-impact research,
- Engaging the community and collaborating with partners to reach creative solutions for societal problems, and
- Inspiring the next generation of technology entrepreneurs.

As a graduate student in our college, you will join a thriving community of scholars who are working on cutting-edge research. Our students have access to first-class research facilities as well as world-renowned faculty members who have won national and international recognition in their research areas. Our students and faculty explore many areas, including nano-materials and devices, unmanned aerial systems and robotics, big data, cybersecurity, air and water quality and resources, transportation, renewable energy, sensors and systems for space, and national security applications.

We offer our students premier graduate programs in a variety of disciplines, including aerospace, biomedical, civil, environmental, electrical, materials, mechanical, nuclear, and transportation engineering as well as construction management and computer science.

Our graduates work locally, nationally, and internationally in some of the top national laboratories, research centers, universities, and corporations across the world.

As the boundaries of science and engineering continue to expand, UNLV's College of Engineering is committed to offering our students a variety of competitive programs. We are confident that you will find our graduate programs both challenging and rewarding.

Rama Venkat, Ph.D., Dean, Howard R. Hughes College of Engineering
Mohamed Trabia, Ph.D., Associate Dean for Research Plans
Graduate Certificate in Solar & Renewable Energy

Graduate Certificate in Solar & Renewable Energy

Plan Description

The Howard R. Hughes College of Engineering offers a Graduate Certificate in Solar and Renewable (SRE) Energy. The Certificate is designed for individuals already in possession of either a baccalaureate degree or a graduate degree. More specifically, the Certificate provides a specialized qualification for career professionals in the energy industry, professionals from other fields and individuals with baccalaureate degrees seeking entry into the renewable energy field, or currently enrolled graduate students seeking an additional specialization. This Certificate is designed to:
- Provide an interdisciplinary approach to SRE grounded in the three critical pillars of policy and governance, technology and physical science, and the built environment.
- Develop within students the intellectual and problem–solving foundation for a successful professional career in the SRE field.
- Improve the overall effectiveness of the solar and renewable energy sector in Nevada and the Western U.S.

Students earning the Certificate may apply for admission into UNLV graduate degree programs as long as they meet the existing admissions criteria for said programs.

For more information about your program, including your graduate program handbook and learning outcomes, please visit the Degree Directory.

Plan Admission Requirements

Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.
1. Applicants must have earned an undergraduate degree from a regionally accredited college or university with an overall undergraduate GPA of 2.75 or higher.
2. Applicants must be accepted by the Graduate College and the Advisory/Admissions Committee for the SRE Certificate program.
3. All applicants must review and follow the Graduate College Admission and Registration Requirements.

Students are accepted into a certificate 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
Total Credits Required: 18
Course Requirements
Required Course – Credits: 3
ME 677 - Solar and Renewable Energy Utilization

Environmental Decision Making Course – Credits: 3
Complete one of the following courses:
ENV 702 - Environmental Problem Solving

ENV 720 - Natural Resource Valuation

PAF 703 - Individual and Group Decision Making

Built Environment Course – Credits: 3
Complete one of the following courses:
CEM 680 - Sustainable Construction

ABS 632 - Solar Energy Applications in Architecture

Energy Policy Course – Credits: 3
Complete three credits from the following list of courses:
ENV 611 - Environmental Risk Management

ENV 702 - Environmental Problem Solving

ENV 703 - Environmental Law and Policy Seminar

ENV 711 - Risk Assessment and Risk Management

ENV 720 - Natural Resource Valuation

ENV 750 - Environmental Studies and Public Policy

LAW 651 - Environmental Quality Law

ECO 707 - Environmental and Natural Resource Economics

PAF 701 - Origins and Development of Public Policy in America

PAF 702 - Role of Government in Society

PUA 725 - Policy Analysis and Program Evaluation

PUA 745 - Administration in a Federal and Intergovernmental Perspective

PUA 756 - Policy Implementation

Engineering & Science Course – Credits: 3
Complete three credits from the following list of courses:
CEM 680 - Sustainable Construction

CEM 755 - Renewable Energy Capital Facility Projects

ABS 531 - Environmental Control Systems I

ABS 532 - Environmental Control Systems II

ABS 632 - Solar Energy Applications in Architecture

GEOL 610 - Soil Classification and Resource Management

GEOL 630 - Geographic Information Systems (GIS): Theory and Applications

GEOL 646 - Geologic Applications in Remote Sensing

ENV 660 - Environmental Modeling

ENV 680 - Geographic Information Systems for Environmental & Socioeconomic Analysis

ECG 646 - Photovoltaic Devices and Systems

ECG 642 - Power Electronics

ECG 653 - Introduction to Nanotechnology

ECG 740 - Computer Analysis Methods for Power Systems

ECG 741 - Electric Power Distribution System Engineering

ECG 742 - Power System Stability and Control

ECG 757 - Electron Transport Phenomena in Solid State Devices

ME 619 - Advanced HVAC and Energy Conservation Systems

ME 705 - Conduction Heat Transfer

ME 707 - Radiation Heat Transfer

ME 711 - Advanced Thermodynamics

ME 714 - Computational Aspects of Solar Energy

ME 746 - Experimental Design and Analysis of Digital Process Control Systems

Elective Course – Credits: 3
Complete three credits from the Energy Policy or Engineering & Science courses listed above.

Certificate Requirements
Completion of a minimum 18 credit hours with a minimum GPA of 3.00.

Plan Certificate Completion Requirements
The student must submit all required forms to the Graduate College and then apply for graduation in MyUNLV by the appropriate deadline.

Civil and Environmental Engineering and Construction

Well-equipped facilities developed by the department faculty include a computer assisted design laboratory, an engineering geophysics laboratory and test site, an environmental engineering laboratory, a soil and rock mechanics laboratory, the Nevada University Transportation Center, and a water resources laboratory. These facilities provide state-of-the-art research tools. Among these are a MTS dynamic testing machine, a triaxial testing apparatus, a large-scale structural load frame, a 50-foot tilting flume, concrete testing facilities, a portable wind tunnel, a broad geophysical test equipment base anchored by a 7,000-lb (3 metric ton) programmable seismic source with 144-channel recording system, PCs, workstations, and current software programs are available within these facilities, with additional facilities being available in the college. Additional assets include access to high speed multiprocessor computers housed in the National Supercomputing Center for Energy and the Environment. Facilities are located in the Thomas T. Beam Engineering Complex. Additional research facilities nearby include one of twelve national EPA laboratories (located on campus) and the Department of Energy's Nevada Test Site, which has been designated an Environmental Research Park.

Students with backgrounds in civil engineering as well as related disciplines are invited to apply. Students with science backgrounds desiring admission to the graduate program will be required to complete coursework, prerequisite or otherwise, that will assure successful completion of the graduate program. Specific coursework requirements will depend on the area of specialization desired by the applicant.

Civil engineering applicants must identify a specialization from one of the following areas: construction, environmental, geotechnical, structural, systems, transportation or water resources. Applications for admission to the program are evaluated by faculty members representing each of the respective areas of specialization.

Applications from international students must reach the Graduate College by the dates specified on the Application Deadlines page in order to be considered for financial aid. Offers of financial aid are made in writing by the department, which assumes no responsibility to provide financial support unless an offer is made in writing. Also, when the department has made an offer to provide financial support, it has no obligation to honor the offer unless the student attends UNLV and enrolls in the civil and environmental engineering and construction graduate program during the initial semester for which financial aid was offered.

Applicants should notice that some documents must be mailed to the Graduate College while others must be mailed to the Department of Civil and Environmental Engineering and Construction. It is imperative that the documentation is sent to the appropriate location to aid fast processing of the application.

Donald Hayes, Ph.D., Chair
Nader Ghafoori, Graduate Coordinator

Civil and Environmental Engineering Faculty

Chair

Hayes, Donald Professor; B.S.C.E.,M.S.C.E., Mississippi State University; Ph.D., Colorado State University; PE Louisiana and Mississippi. Rebel since 2011.

Graduate Coordinator

Ghafoori, Nader-Full Graduate Faculty Professor; B.S.C.E., Texas Tech University; M.S.C.E., Ph.D., University of Miami. Rebel since 2003.

Graduate Faculty

Ahmad, Sajjad-Full Graduate Faculty Professor; B.S., University of Engineering and Technology, Lahore, Pakistan; M.E., Asian Institute of Technology, Bangkok, Thailand; Ph.D., University of Western Ontario, London, Ontario, Canada. Rebel since 2006.

Batista, Jacimaria Ramos-Full Graduate Faculty Professor; B.S., Federal University of Ouro Preto; M.S., Montana College of Mineral Science and Technology; Ph.D., Pennsylvania State University. Rebel since 1997.

Choi, Jin Ouk- AssistantProfessor; B.S., Korea University; M.S., PhD., University of Texas at Austin. Rebel since 2016

Gerrity, Daniel-Full Graduate Faculty Assistant Professor; B.S., M.S., Ph.D., Arizona State University. Rebel since 2012.

James, David E.-Full Graduate Faculty Professor; A.B., University of California, Davis; M.S., Ph.D., California Institute of Technology. Rebel since 1990.

Karakouzian, Moses-Full Graduate Faculty Professor; B.C.E., American University of Beirut; M.S., M.B.A., Ph.D., Ohio State University; Nevada. Rebel since 1988.

Kaseko, Mohamed S.-Full Graduate Faculty Associate Professor; B.S., University of Dares-Salaam; M.S., Cornell University; Ph.D., University of California, Irvine. Rebel since 1993.

Ladkany, Samaan-Full Graduate Faculty Professor; B.S., American University of Beirut; B.S., M.S., Ph.D., University of Wisconsin, Madison. Rebel since 1984.

Luke, Barbara-Full Graduate Faculty Professor; A.A., University of Florida; B.S., Ph.D., University of Texas at Austin; M.S., University of California, Berkeley. Rebel since 1995.

Neumann, Edward S.-Full Graduate Faculty Professor; B.S.C.E., Michigan Technological University; M.S., Ph.D., Northwestern University. Rebel since 1991.

Opfer, Neil-Full Graduate Faculty Associate Professor; B.S., B.A., B.A., Washington State University; M.B.A., Purdue University; P.D., University of Wisconsin. Rebel since 1989.

Paz, Alexander-Full Graduate Faculty Assistant Professor; B.S., University of Cauca, Colombia; M.S., University of Puerto Rico, Mayaguez Campus, PR; Ph.D., Purdue University. Rebel since 2008.

Piechota, Thomas-Full Graduate Faculty Associate Professor; B.S., Northern Arizona University; M.S., Ph.D., University of California, Los Angeles. Rebel since 1999.

Sherman, Ryan Assistant Professor; B.S. Michigan Technical University; M.S., Purdue University. Rebel since 2016

Shrestha, Pramen P.-Full Graduate Faculty Associate Professor; B.S., National Institute of Technology, India; M.S., Oklahoma State University; Ph.D., University of Texas at Austin; P.E. (Texas). Rebel since 2007.

Teng, Hualiang-Full Graduate Faculty Associate Professor; B.S., M.S., Northern Jiaotong University; M.S.C.E., West Virginia University; Ph.D., Purdue University. Rebel since 2004.

Tian, Ying-Full Graduate Faculty Associate Professor; B.S., Hebei Polytechnic University;M.S., Tsinghua University; M.S., Ohio State University; Ph.D., University of Texas at Austin. Rebel since 2007.

Professor Emeriti

Frederick, Gerald R. Emeritus Professor; B.S., University of Toledo; M.S., Ph.D., Purdue University. UNLV Emeritus 1993.

Vodrazka, Walter C. Emeritus Professor; B.C.E., Manhattan College; M.S., Mississippi State University; Ph.D., Purdue University. UNLV Emeritus 1990.

Wyman, Richard V. Emeritus Professor; B.S., Case Western Reserve University; M.S., University of Michigan; Ph.D., University of Arizona. UNLV Emeritus 1969-1992.

Doctor of Philosophy - Civil and Environmental Engineering

Plan Description

The Department of Civil and Environmental Engineering & Construction at UNLV offers a number of program degree options leading to the Doctor of Philosophy (Ph.D.) - Civil and Environmental Engineering. Specific areas of engineering that are currently available include Construction, Environmental, Geotechnical, Structural, Transportation, and Water Resources.

For more information about your program, including your graduate program handbook and learning outcomes please visit the Degree Directory.

Plan Admission Requirement

Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

Admission to the program leading to the Ph.D. in Engineering in the field of Civil and Environmental Engineering is open to those students completing the following requirements:

1. Application must be made to the Department of Civil and Environmental Engineering. Applications must include all documentation as required by the Graduate College. The Department of Civil and Environmental Engineering will admit the student and supervise the student's Ph.D. program.
2. The applicant must have a Master of Science in Engineering degree or equivalent with a major in civil engineering or a closely allied field. Students with non-engineering backgrounds will be required to complete a set of course work requirements that will assure successful completion of the Ph.D. specialization and qualify the student to sit for the Fundamentals of Engineering (FE) exam. Special cases will be decided upon by the Graduate Program Committee (GPC).
3. The applicant must submit a written statement of purpose indicating interests and objectives in working toward a Ph.D. degree. In addition, three letters of recommendation for Ph.D.-level study must be submitted.
4. Applicants from countries where English is not the native language must take the Test of English as a Foreign Language, earn scores of at least 213 (computerized) or 550 (written), and submit an official report of the score to the Graduate College.
5. The GPC will examine the applicant's academic record and will make the final determination of the applicant's admissibility to the Ph.D. program. In general, a minimum post-baccalaureate GPA of 3.20 on a 4.00 scale or equivalent is required for admission.
6. All applicants are required to take the verbal, quantitative, and analytical writing portions of the GRE General Test and submit the scores to the Civil and Environmental Engineering department. Successful applicants generally have a combined verbal and quantitative GRE score of at least 300 on the new test (1000 on all GRE exams taken before August 2011) and GRE analytical writing score of at least 3.

7. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

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
Total Credits Required: 45
Course Requirements
Elective Courses – Credits: 27
Complete 27 credits of advisor-approved elective coursework.

Dissertation – Credits: 18
CEE 799 - Dissertation Research

Degree Requirements
1. A minimum of 27 credit hours of course work beyond the degree of Master of Science in Engineering or equivalent is required (excluding dissertation) with a minimum GPA of 3.00.
   a. A minimum of 18 of these credits must be 700-level courses.
   b. In addition to these course requirements, a dissertation consisting of at least 18 credits (CEE 799) is required.
2. A Doctoral Advisory Committee composed of at least five members of the UNLV graduate faculty is to be formed for the student. At least three of the committee members must be from tenured or tenure-track members of the Department of Civil and Environmental Engineering, the fourth from the Department of Civil and Environmental Engineering or a related field, and the fifth must be appointed by the Graduate College.
3. The student's Doctoral Advisory committee may add additional requirements in accordance with the individual's background and area of study.
4. Doctoral students who have not completed CEE 700, or equivalent, or did not write a thesis as part of their Master of Science studies, may be required to complete CEE 700 as a deficiency course. This course will not count towards their doctoral degree program.
5. Students whose mother tongue is not English must demonstrate a satisfactory command of the English language by passing the advanced level on the Michigan test during the first year of study.
6. In order to show breadth and depth of knowledge in his/her discipline, the doctoral student must pass either a written qualifying exam, an oral qualifying exam, or both as determined by the student's Doctoral Advisory Committee. These examinations are prepared by the faculty and supervised by the GPC. These qualifying exams must be scheduled after the completion of one year of study but not before the completion of at least 12 credits of course work.
7. The doctoral student must pass a preliminary exam consisting of the preparation of a written proposal for the dissertation research followed by an oral defense of the proposal. The dissertation must be approved by the student's Doctoral Advisory Committee. Students are advanced to candidacy for the Ph.D. upon the completion of all course work and approval of the dissertation research proposal.
8. All requirements for the Ph.D. are met upon the satisfactory completion of the proposed research, the submission of a satisfactory dissertation, and the successful oral defense of the dissertation before the Doctoral Advisory Committee.

Plan Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her dissertation by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy dissertation to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Master of Science - Construction Management

Plan Description

The Master of Science degree in Construction Management provides graduate-level study for those seeking mid- and upper-level management positions in the construction industry or continued study for the doctorate. Students with degrees in construction management, engineering, science, architecture and business, as well as related disciplines are invited to apply. Applications for admission to the program are evaluated on an individual basis by the program's faculty.

For more information about your program, including your graduate program handbook and learning outcomes please visit the Degree Directory.

Plan Admission Requirements

Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

Applicants are considered on an individual basis. Candidates can be admitted on a regular or provisional status. Qualified applicants who are not admitted on either status can take graduate courses as a non-degree student. A maximum of 15 credits taken as a UNLV non-degree graduate student may be applied toward the M.S.C.M. degree.

To be considered for admission:

1. Applicants must have an earned baccalaureate degree from a regionally accredited four-year college or university with preferred study in construction, engineering, architecture, business, or closely related area.
2. Overall undergraduate GPA should be at least 2.75 (4.00=A) for the bachelor's degree or at least 3.00 (4.00=A) for the last two years of undergraduate work.
3. Credit (in semester hours) must have been earned in the following subjects or their equivalents:
   MATH 181 – Calculus I
   PHYS 151/151L – General Physics I
   CEM 250/250L – Construction Materials & Methods
   CEM 270 – Construction Engineering Mechanics
   A course in construction or engineering graphics

   The leveling courses required of a student before entering the M.S. program will be determined on an individual basis. The student will be notified in writing of any deficiencies prior to admission to the program. Students with deficiencies exceeding two courses may need to satisfactorily complete them before admission to the graduate program.
4. The applicant must obtain a satisfactory score on the Graduate Record Examination (GRE) as determined by the Graduate Program Committee (GPC).
5. Each applicant must submit to the program two letters of recommendation from individuals familiar with their knowledge, skills and abilities, and a one-page Statement of Objectives describing the reasons why they wish to earn a master's degree and indicating the area of concentration within the construction management discipline in which they wish to pursue graduate work.
6. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

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 Requirements: Thesis Track
Total Credits Required: 30
Course Requirements
Required Courses – Credits: 13

CEM 651 - Construction Estimating

CEM 653 - Construction Scheduling and Resource Optimization

CEM 700 - Research Methods in Construction Management

MBA 775 - Data Modeling and Analysis

Core Course – Credits: 3

Complete one of the following courses:

CEM 750 - Advanced Construction Scheduling

CEM 751 - Construction Cost Analysis and Estimating

Specialty Course – Credits: 3

Complete one of the following courses:

CEM 685 - Construction Law and Contracts

CEM 740 - Construction Safety and Performance Improvement

CEM 775 - Construction Operations and Management

CEM 705 - Construction Engineering Management

Elective Courses – Credits: 5

Complete 5 credits of elective coursework.

Thesis – Credits: 6

CEM 797 - Research Thesis in Construction Engineering and Management

Degree Requirements

1. Completion of at least 30 credits, comprised of 18 required 600/700-level credits of CEM and MBA course work, 6 credits of approved electives, and 6 credits of thesis research. The final examination will include a defense of the thesis.
2. MBA 775 and CEM 700 must be completed within the first two semesters of study.
3. Other courses may be substituted upon written permission of the student's graduate faculty advisor. Students who have credit in CEM 451 and CEM 453 or equivalent courses will select two other courses from the approved elective list.
4. The thesis option program of study will be jointly developed by the student and advisor, approved by the student's advisory committee.
5. Student's pursuing the thesis option shall have an Advising Committee composed of at least four members of the UNLV Graduate Faculty of which at least two must be tenured or tenure-track members of the Construction Management Program, the third from the Construction Management Program or a related field, and the fourth must be appointed by the Graduate College.

6. Completion of a thesis requires the student to make a unique contribution to the existing knowledge in the field of construction management or engineering. The effort must include the development of a contemporary research topic and the methodology for investigating the topic. The student is required to undertake the research effort to investigate the topic. The thesis prepared as part of this option shall include a literature review, description of the research topic, methodology, and results, and present conclusions obtained from the research effort and recommendations for further work.
7. Each student's program should show suitable breadth and coherence, as specified in the Graduate Catalog. Prior to filing, the program must receive approval by the student's committee. An approved program must be filed before the completion of nine credits of course work after admission (regular or provisional). The responsibility rests with the student. Students will be dropped from the graduate engineering program if they neglect this requirement.
8. Students must make satisfactory progress and comply with all Graduate College and Howard R. Hughes College of Engineering policies. If progress is not satisfactory, probation and separation from the graduate program may result, in accordance with the rules of the Graduate College. Satisfactory progress is defined as filing an proposed graduate degree program before the completion of 16 credit hours of course work, completion of at least six credits of the approved program per calendar year, maintenance of a GPA of 3.00 (4.00), no grades below C and compliance with the letter and spirit of the Graduate Catalog and published policies of the Howard R. Hughes College of Engineering. Additionally, no more than nine credits below B are allowed in the student's graduate program. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College. Any student whose GPA falls below 3.00 will be placed on probation and will have two semesters to raise it to 3.00 or above. Students who are awarded a graduate assistantship must be enrolled in a minimum of 6 credit hours per semester and must elect the thesis option.

Graduation Requirements

1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Subplan 2 Requirements: Non-Thesis Track
Total Credits Required: 36
Course Requirements
Required Courses – Credits: 13
CEM 651 - Construction Estimating

CEM 653 - Construction Scheduling and Resource Optimization

CEM 700 - Research Methods in Construction Management

MBA 775 - Data Modeling and Analysis

Core Course – Credits: 3
Complete one of the following courses:
CEM 750 - Advanced Construction Scheduling

CEM 751 - Construction Cost Analysis and Estimating

Specialty Course – Credits: 3
Complete one of the following courses:
CEM 685 - Construction Law and Contracts

CEM 740 - Construction Safety and Performance Improvement

CEM 775 - Construction Operations and Management

CEM 705 - Construction Engineering Management

Elective Courses – Credits: 14
Complete 14 credits of advisor-approved elective coursework.

Special Project – Credits: 3
CEM 796 - Special Project in Construction Engineering and Management

Degree Requirements

1. Completion of at least 36 credits comprised of 18 required 600/700-level credits of CEM and MBA course work, 15 credits of approved electives of which nine credits must be 600/700-level credits of CEM.
2. MBA 775 and CEM 700 must be completed within the first two semesters of study.
3. Other courses may be substituted upon written permission of the student's graduate faculty advisor. Students who have credit in CEM 451 and CEM 453 or equivalent courses will select two other courses from the approved elective list.
4. The project option program of study will be jointly developed by the student and advisor.
5. Completion of a project requires the student to investigate and solve, or propose solutions to, a problem related to the field of construction management. It is expected that the results of this effort will be beneficial for and applied to other construction-related projects or problems. The project report prepared for this option shall include a description of the issue investigated, how the investigation was performed, the results obtained, conclusions regarding the investigation, and recommendations for further work.
6. Each student's program should show suitable breadth and coherence, as specified in the Graduate Catalog. Prior to filing, the program must receive approval by the student's committee. An approved program must be filed before the completion of nine credits of course work after admission (regular or provisional). The responsibility rests with the student. Students will be dropped from the graduate engineering program if they neglect this requirement.
7. Students must make satisfactory progress and comply with all Graduate College and Howard R. Hughes College of Engineering policies. If progress is not satisfactory, probation and separation from the graduate program may result, in accordance with the rules of the Graduate College. Satisfactory progress is defined as filing an proposed graduate degree program before the completion of 16 credit hours of course work, completion of at least six credits of the approved program per calendar year, maintenance of

a GPA of 3.00 (4.00), no grades below C and compliance with the letter and spirit of the Graduate Catalog and published policies of the Howard R. Hughes College of Engineering. Additionally, no more than nine credits below B are allowed in the student's graduate program. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College. Any student whose GPA falls below 3.00 will be placed on probation and will have two semesters to raise it to 3.00 or above. Students who are awarded a graduate assistantship must be enrolled in a minimum of 6 credit hours per semester and must elect the thesis option.

Graduation Requirements

1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. Successfully complete a project.

Plan Graduation Requirements

Refer to your subplan for Graduation Requirements.

Master of Science in Engineering - Civil and Environmental Engineering

Plan Description

The Department of Civil and Environmental Engineering & Construction at UNLV offers a number of program degree options leading to the Master of Science in Engineering (M.S.E.) - Civil and Environmental Engineering. Specific areas of engineering that are currently available include Construction, Environmental, Geotechnical, Structural, Transportation, and Water Resources.

For more information about your program, including your graduate program handbook and learning outcomes please visit the Degree Directory.

Plan Admission Requirements

Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

In addition to the general requirements for admission to the Graduate College, an applicant for the M.S.E. program must:

1. Have a bachelor's degree in engineering or a closely related discipline. Applicants desiring to specialize in environmental engineering who have baccalaureate degrees in the natural sciences may require at least an additional semester of full-time study to complete engineering prerequisite undergraduate course work; this may include fluid mechanics, calculus through differential equations, engineering physics, chemistry and engineering economics. Successful environmental engineering applicants are expected to complete a set of graduate courses in engineering hydrology, hydraulics, statistics, water and wastewater treatment, and wastewater treatment plant design during their graduate study.
2. Submit a one-page Statement of Objectives indicating the area of civil engineering in which they wish to pursue graduate work and the reason they wish to earn a master's degree.
3. All applicants are required to take the verbal, quantitative, and analytical writing portions of the GRE General Test and submit the scores to the Civil and Environmental Engineering department. Successful applicants generally have a combined verbal and quantitative GRE score of at least 300 on the new test (1000 on all GRE exams taken before August 2011) and GRE analytical writing score of at least 3.
4. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

The Integrated BS-MS Program

This program is designed to provide high-achieving CEE undergraduate students with the opportunity to be exposed to graduate courses and encourage them to continue with a graduate degree by reducing the time needed for degree completion. Up to six credit hours of approved graduate-level course work can be taken as technical electives for the grade of B or better during the senior year and those credit hours will be waived for the graduate degree. The following conditions are needed to enroll in this program:

1. A minimum of two semesters of full-time enrollment in B.S. of Civil and Environmental Engineering program at UNLV is required.
2. A minimum of 90 credit hours of course work applicable to the B.S. of Civil and Environmental Engineering degree must be completed before beginning the joint degree program.
3. An overall cumulative GPA of 3.30 or higher and a cumulative GPA in math/science/engineering of 3.50 or higher are needed to begin the joint degree program.

Once a student has been admitted into the Integrated BS-MS program, they must then submit an application for an M.S. program in Civil Engineering. The student has to follow the normal application procedures found on the UNLV Graduate College website.

1. Student must meet all the application deadlines.
2. Student should indicate in their application materials that they are participating in the Integrated BS-MS program.
3. Student should request a letter of nomination from a Civil and Environmental Engineering and Construction faculty member. Submit this letter along with a short resume (no more than 2 pages) to the main office of the Department of Civil and Environmental Engineering and Construction. The materials will be evaluated by three faculty members in the student's technical area of interest or nearby areas.
4. Student does not need to submit GRE scores.
5. Student must choose the thesis option.

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 Requirements: Thesis Track
Total Credits Required: 30
Course Requirements
Required Course – Credits: 3
CEE 700 - Research Methods in Civil and Environmental Engineering

Elective Courses – Credits: 21
Complete 21 credits of advisor-approved elective coursework.

Thesis – Credits: 6
CEE 797 - Thesis in Civil Engineering

Degree Requirements
1. Satisfactory completion of CEE 700 during the first year and 21 credits of approved graduate courses plus six credits of work associated with the master's level thesis, for a total of 30 credits. The final examination will include a defense of thesis.
2. At least 15 credits must be 700-level, of which at least 12 credits must be offered by the College of Engineering.
3. The program of study for each student must be approved by the student's advisory committee.
4. Satisfactory progress is defined as filing an approved program before the completion of nine credits of course work, completion of at least six credits of the approved program per calendar year, maintenance of a GPA of 3.00 (4.00), no grades below C and compliance with the letter and spirit of the Graduate Catalog and published policies of the Howard R. Hughes College of Engineering. Additionally, no more than nine credits below B are allowed in the student's graduate program. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College. Any student whose GPA falls below 3.00 will be placed on probation and will have one semester to raise it to 3.00 or above.
5. The student's Advising Committee should be composed of at least four members of the UNLV Graduate Faculty of which at least two must be tenured or tenure-track members of the Department of Civil and Environmental Engineering, the third from the Department of Civil and Environmental Engineering or a related field, and the fourth will be the Graduate College Representative. The Graduate College Representative must have Full Graduate Faculty Status and cannot have Graduate Faculty Status within the Department of Civil and Environmental Engineering.
6. Each student's program should show suitable breadth and coherence, as specified in the Graduate Catalog. Prior to filing, the program must receive approval by the student's committee. An approved program must be filed before the completion of nine credits of course work after admission (regular or provisional). The responsibility rests with the student. Students will be dropped from the graduate engineering program if they neglect this requirement.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. Student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Subplan 2 Requirements: Non-Thesis Track
Total Credits Required: 33
Course Requirements
Required Courses – Credits: 33
Complete 33 credits of advisor-approved graduate coursework.

Degree Requirements
1. Satisfactory completion of 33 credits of graduate courses approved by the student's advisory committee, of which at least 50 percent must be 700-level offered by the College of Engineering.
2. The program of study for each student must be approved by the student's advisory committee.
3. Satisfactory progress is defined as filing an approved program before the completion of nine credits of course work, completion of at least six credits of the approved program per calendar year, maintenance of a GPA of 3.00 (4.00), no grades below C and compliance with the letter and spirit of the Graduate Catalog and published

policies of the Howard R. Hughes College of Engineering. Additionally, no more than nine credits below B are allowed in the student's graduate program. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College. Any student whose GPA falls below 3.00 will be placed on probation and will have one semester to raise it to 3.00 or above.
4. The student's Advising Committee should be composed of at least four members of the UNLV Graduate Faculty of which at least two must be tenured or tenure-track members of the Department of Civil and Environmental Engineering, the third from the Department of Civil and Environmental Engineering or a related field, and the fourth must be appointed by the Graduate College.
5. Each student's program should show suitable breadth and coherence, as specified in the Graduate Catalog. Prior to filing, the program must receive approval by the student's committee. An approved program must be filed before the completion of nine credits of course work after admission (regular or provisional). The responsibility rests with the student. Students will be dropped from the graduate engineering program if they neglect this requirement.

Graduation Requirements
The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.

Subplan 3 Requirements: Geographic Information Systems Thesis Track
Total Credits Required: 30
Course Requirements
Required Courses – Credits: 9
CEE 668 - GIS Applications in Civil Engineering

CS 733 - Geographic Data Base Systems

STA 751 - Spatial Statistics

Applied Concepts Course – Credits: 4
Complete one of the following courses:

CEE 768 - Applied Geographic Information Systems

EGG 768 - Applied Geographic Information Systems

Statistics Course – Credits: 3
Complete one of the following courses:

STA 667 - Introduction to Mathematical Statistics I

STA 691 - Statistics for Scientists I

Research Course – Credits: 3
CEE 700 - Research Methods in Civil and Environmental Engineering

Elective Courses – Credits: 5
Complete 5 credits of advisor-approved elective coursework.

Thesis – Credits: 6
CEE 797 - Thesis in Civil Engineering

Degree Requirements
1. The Geographic Information Systems Thesis track requires the satisfactory completion of CEE 700 during the first year, 17 credits of required coursework, 4 credits of approved graduate courses and six credits of work associated with the master's level thesis, for a total of 30 credits. The final examination will include a defense of thesis.
2. At least 15 credits must be 700-level, of which at least 12 credits must be offered by the College of Engineering.
3. The program of study for each student must be approved by the student's advisory committee.
4. Satisfactory progress is defined as filing an approved program before the completion of nine credits of course work, completion of at least six credits of the approved program per calendar year, maintenance of a GPA of 3.00 (4.00), no grades below C and compliance with the letter and spirit of the Graduate Catalog and published policies of the Howard R. Hughes College of Engineering. Additionally, no more than nine credits below B are allowed in the student's graduate program. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College. Any student whose GPA falls below 3.00 will be placed on probation and will have one semester to raise it to 3.00 or above.
5. The student's Advising Committee should be composed of at least four members of the UNLV Graduate Faculty of which at least two must be tenured or tenure-track members of the Department of Civil and Environmental Engineering, the third from the Department of Civil and Environmental Engineering or a related field, and the fourth will be the Graduate College Representative. The Graduate College Representative must have Full Graduate Faculty Status and cannot have Graduate Faculty Status within the Department of Civil and Environmental Engineering.
6. Each student's program should show suitable breadth and coherence, as specified in the Graduate Catalog. Prior to filing, the program must receive approval by the student's committee. An approved program must be filed before the completion of nine credits of course work after admission (regular or provisional). The responsibility rests with the student. Students will be dropped from the graduate engineering program if they neglect this requirement.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. Student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Subplan 4 Requirements: Geographic Information Systems Non-Thesis Track
Total Credits Required: 33
Course Requirements
Required Courses – Credits: 9
CEE 668 - GIS Applications in Civil Engineering

CS 733 - Geographic Data Base Systems

STA 751 - Spatial Statistics

Applied Concepts Course – Credits: 4
Complete one of the following courses:
CEE 768 - Applied Geographic Information Systems

EGG 768 - Applied Geographic Information Systems

Statistics Course – Credits: 3
Complete one of the following courses:

STA 667 - Introduction to Mathematical Statistics I

STA 691 - Statistics for Scientists I

Elective Courses – Credits: 17
Complete 17 credits of advisor-approved elective coursework.

Degree Requirements
1. The Geographic Information Systems Non-Thesis track requires satisfactory completion of 17 credits of required coursework and 16 credits of graduate courses approved by the student's advisory committee, of which at least 50 percent must be 700 level offered by the College of Engineering.
2. The program of study for each student must be approved by the student's advisory committee.
3. Satisfactory progress is defined as filing an approved program before the completion of nine credits of course work, completion of at least six credits of the approved program per calendar year, maintenance of a GPA of 3.00 (4.00), no grades below C and compliance with the letter and spirit of the Graduate Catalog and published policies of the Howard R. Hughes College of Engineering. Additionally, no more than nine credits below B are allowed in the student's graduate program. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College. Any student whose GPA falls below 3.00 will be placed on probation and will have one semester to raise it to 3.00 or above.
4. The student's Advising Committee should be composed of at least four members of the UNLV Graduate Faculty of which at least two must be tenured or tenure-track members of the Department of Civil and Environmental Engineering, the third from the Department of Civil and Environmental Engineering or a related field, and the fourth must be appointed by the Graduate College.
5. Each student's program should show suitable breadth and coherence, as specified in the Graduate Catalog. Prior to filing, the program must receive approval by the student's committee. An approved program must be filed before the completion of nine credits of course work after admission (regular or provisional). The responsibility rests with the student. Students will be dropped from the graduate engineering program if they neglect this requirement.

Graduation Requirements
The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.

Subplan 5: The Integrated BS-MS Track
Total Credits Required: 24 – 30
BS Degree Requirements
1. Students must meet all of the existing B.S. degree requirements for Civil Engineering at UNLV.
2. Students may take up to 6 credits of approved graduate level courses in place of undergraduate courses. These classes would typically substitute for the undergraduate technical electives.
3. Undergraduates taking graduate courses will pay the graduate tuition for these courses.
4. Students will graduate with the BS degree as soon as all BS degree requirements are completed.

MS Degree Requirements
1. Students must meet all of the other degree requirements for the M.S. degree including a minimum 15 credits of "700" level courses. If a student takes a 3-credit "700" level course as part of their undergraduate degree; it will count towards the 15 credit minimum.
2. Students may be released from up to 6 credits of classes towards completion of the M.S. degree as long as their grades in these courses taken as part of the undergraduate program are a B- or better and their average G.P.A for these classes is a 3.0 or above.
3. Students must take the thesis option to receive the course release.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. Student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Plan Graduation Requirements
Refer to your subplan for Graduation Requirements.

Master of Science in Transportation

Plan Description
The Master of Science in Transportation degree program is terminal in nature and oriented toward the practice of transportation science, with emphasis on the planning and operations aspects of transportation systems. It is intended for applicants who have backgrounds in areas other than engineering or closely related disciplines, and who either presently work for or aspire to work for transportation agencies or firms.

For more information about your program, including your graduate program handbook and learning outcomes, please visit the Degree Directory.

Plan Admission Requirements
Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

To be considered for admission:
1. Applicants must have a Bachelor of Science or Bachelor of Arts degree. It is desirable to have a degree in one of the following areas: urban or regional planning, architecture, business, economics, public administration, quantitative geography, computer science, mathematics, operations research, statistics, political science, physical science, or similar discipline.
2. Undergraduate GPA must be at least 3.00 and credit must have been earned in the following subjects, or equivalent subjects, with a grade of B or better: MAT 180 (3 credits), PHY 155 (4 credits), computer Science or Management Information Systems (3 credits), ECO 201 or ECO 202 (3 credits), and STA 391 or ECO 261 (3 credits). CEE 362 (3 credits) also is required of applicants who have not had at least one year of acceptable experience with a transportation agency.
3. Submit a two-page Statement of Objectives indicating:
   a. Previous work experience, particularly in transportation.
   b. The reason they wish to pursue the M.S.T. program.
   c. How the degree will be utilized following graduation.
4. Submit two letters of recommendation from individuals familiar with their skills and abilities. Contact the department for additional information.
5. Take the verbal, quantitative, and analytical writing portions of the GRE General Test and submit the scores to the Civil and Environmental Engineering department. Successful applicants generally have a combined verbal and quantitative GRE score of at least 300 on the new test (1000 on all GRE exams taken before August 2011) and GRE analytical writing score of at least 3.
6. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

The degree offered is a Master of Science in Transportation (M.S.T.). Completion of the degree does not qualify the student with a non-engineering background to sit for the Fundamentals of Engineering (FE) exam.

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
Total Credits Required: 33
Course Requirements
Required Courses – Credits: 6
Complete two of the following courses:
CEE 609 - Engineering Project Management

CEE 663 - Traffic Engineering

CEE 760 - Transportation Planning

CEE 671 - Public Transportation Systems

Elective Courses – Credits: 24
Complete 24 credits of advisor-approved elective coursework.

Project – Credits: 3
CEE 796 - Design Project in Civil Engineering

Degree Requirements
1. The program of study for each student must be approved by the student's advisory committee. The degree requires completion of 33 credits including a 3 credit project.
2. A minimum of 21 credits must be taken in civil engineering courses, and 12 credits may be taken from other departments.
3. The program is highly quantitative in nature and requires aptitude and familiarity with analytic and mathematical reasoning. Course work is rigorous, and students in the program will be taking the same courses offered to engineering students.
4. Satisfactory progress is defined as filing an approved program before the completion of 12 credits of course work, completion of at least six credits of the approved program per calendar year, maintenance of a GPA of 3.00 (4.00), not grades below C and compliance with the letter and spirit of the Graduate Catalog and published policies of the Howard R. Hughes College of Engineering. Additionally, no more than nine credits below B are allowed in the student's graduate program. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College. Any student whose GPA falls below 3.00 will be placed on probation and will have one semester to raise it to 3.00 or above.
5. The student's Advising Committee should be composed of at least four members of the UNLV Graduate Faculty of which at least two must be tenured or tenure track members of the Department of Civil and Environmental Engineering, the third from the Department of Civil and Environmental Engineering or a related field, and the fourth must be appointed by the Graduate College.

Plan Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. Successfully complete a project.

CEE 604 - Open Channel Flow
Detailed examination and design of open channel flow systems. Includes energy and momentum principles, non-uniform flow, transition design, design of channel controls, design of hydraulic structures, wave motions, unsteady flow, and flood routing. Note(s): This course is crosslisted with CEE 404. Credit at the 600-level requires additional work.

CEE 606 - Hydrologic Analysis and Design
Modeling and analysis of hydrologic systems with application to engineering design. Includes rainfall-runoff analysis, dynamic flood routing, statistical theories, and stochastic processes. Note(s): This course is crosslisted with CEE 406. Credit at the 600-level requries additional work.

CEE 607 - Computer Applications in Environmental and Water Resources Engineering Credits 3
Application of computer models for analysis and design of environmental and water resource systems. Includes surface and groundwater hydrology, pipe networks, and water quality computer programs.

CEE 609 - Engineering Project Management
Engineering aspects of contracts, labor law, specification development, and cost estimating. Project scheduling and cost using critical path methods. Note(s): This course is crosslisted with CEE 409. Credit at the 600-level requires additional work.

CEE 610 - Highway Construction Materials Credits 3
Composition, properties, and production of Portland cement, concrete, bituminous materials, and bituminous mixtures. Note(s): This course is crosslisted with CEE 410. Credit at the 600 level requires additional work.

CEE 612 - Advanced Mechanical Properties of Engineering Materials Credits 3
This upper-division engineering course is open to graduate students, provided it demonstrates a level of accomplishment suitable to graduate study. The Undergraduate Catalog should be consulted for a description of the course. In the Undergraduate Catalog, the course is numbered as 4XX, where the XX represents the same last two digits as the 600 course listed (for example, the description for CEE 604 appears under CEE 404). *Formerly* CEG 611

CEE 613 - Water Resources Engineering Credits 3
Hydraulic and hydrologic design of water distribution, stormwater, and wastewater collection systems. Introduction to groundwater hydrology. Pumps, pipe flow, and pipe networks. Hydraulic design of open channels, culverts, and sanitary sewers.

CEE 621 - Professional Engineering Practice
This upper-division engineering course is open to graduate students, provided it demonstrates a level of accomplishment suitable to graduate study. The Undergraduate Catalog should be consulted for a description of the course. In the Undergraduate Catalog, the course is numbered as 4XX, where the XX represents the same last two digits as the 600 course listed (for example, the description for CEE 604 appears under CEE 404).

CEE 632 - Geological Engineering Credits 3
Incorporation of geologic factors in civil engineering works. Engineering properties of rocks and soils; engineering implications of geologic structure and processes; geologic hazards; geologic/geotechnical site investigations, including engineering geophysics. Note(s): This course is crosslisted with CEE 432. Credit at the 600-level requires additional work.

CEE 634 - Rock Mechanics Credits 3
Mechanical behavior of rock with engineering and geologic application; basic solid mechanics and rheology of rocks; rock testing; theories of failure; Griffith theory, McClintock-Walsh theory; scale effects and creep. Engineering applications in tunneling and dam foundations. Geologic applications in faulting, folding, isostasy, igneous intrusion, and petroleum formation. Note(s): This course is crosslisted with CEE 434. Credit at the 600-level requires additional work.

CEE 635 - Foundations Engineering Credits 3
Site investigations, footings, slope stability, rock and soil foundations, piles. Note(s): This course is crosslisted with CEE 435. Credit at the 600-level requires additional work.

CEE 636 - Engineering Geophysics Credits 3
Introduction to geophysical methods used in shallow earth explorations for engineering purposes, such as site characterization and waste site investigations. Emphasis on seismic and electrical/electromagnetic methods. Laboratory experience includes hands-on use of state-of-the-art equipment. Appropriate for students in Civil Engineering, Geoscience, and Physics. Note(s): This course is crosslisted with CEE 436. Credit at the 600-level requires additional work.

CEE 644 - Steel Structural Design Credits 3
Introduction to design of structural systems in steel; LRFD method. Design of tension members, beams, columns and beam-columns. Design of connections, welded and bolted. Introduction to torsion. Note(s): This course is crosslisted with CEE 444. Credit at the 600-level requires additional work.

CEE 650 - Unit Operations/Processes in Environmental Engineering Credits 3
Water, wastewater system design overview. Water demand, wastewater generation. Water quality criteria. Mass balances, kinetics, reactor design. Coagulation, sedimentation, filtration, disinfection. Suspended, attached processes. Sludge and residual management. Measurements of solids, pH, alkalinity, hardness, DO, BOD, COD, SVI, turbidity, MPN, chlorine residual, nitrogen, phosphorus. Note(s): This course is crosslisted with CEE 450. Credit at the 600-level requires additional work.

CEE 650L - Unit Operations/Processes Laboratory Credits 1
Instrumental and wet chemical laboratory methods commonly used for characterization of water and wastewater. Measurements of solids, pH, alkalinity, hardness, dissolved oxygen, BOD, COD, SVI, turbidity, chlorine residual, MPN, nitrogen and phosphorus. Note(s): This course is crosslisted with CEE 450L. Credit at the 600-level requires additional work.

CEE 651 - Water and Wastewater Quality Analysis Credits 3
Theory and analysis of the standard methods used by environmental engineers to analyze drinking, industrial, and domestic wastewaters to control water quality and monitor efficiency of treatment. Topics may include biological oxygen demand (BOD), chemical oxygen demand (COD), coagulation, carbon absorption, ion-exchange resins, solids analysis, analysis by atomic absorption spectrometry, alkalimetry anions and determination. Laboratory intensive course. Note(s): This course is crosslisted with CEE 451. Credit at the 600-level requires additional work.

CEE 652 - Air Pollution Control Fundamentals Credits 3
Components of polluted air and air quality regulations. Control equipment material balances and process design for particulate removal. Combustion fundamentals and VOC removal. Meteorology and dispersion modeling. Automotive emissions controls. Note(s): This course is crosslisted with CEE 452. Credit at the 600-level requires additional work.

CEE 654 - Solid and Hazardous Wastes Engineering Credits 3
Solid waste collection, separation and disposal. Recycling and containment technologies. Adsorption and microbial degradation. Thermal, radiation, and solidification methods for destruction of hazardous wastes. Site remediation. Note(s): This course is crosslisted with CEE 454. Credit at the 600-level requires additional work.

CEE 655 - Chemical Processes for Water Quality Control Credits 3
This upper-division engineering course is open to graduate students, provided it demonstrates a level of accomplishment suitable to graduate study. The Undergraduate Catalog should be consulted for a description of the course. In the Undergraduate Catalog, the course is numbered as 4XX, where the XX represents the same last two digits as the 600 course listed (for example, the description for CEE 604 appears under CEE 404).

CEE 661 - Introduction to Railroad Transportation Credits 3
This course will cover aspects in railway track, vehicle motion, signals and communications, railway track maintenance, railway operations, freight operations, and passenger train operations. Prerequisite(s): Consent of instructor.

CEE 662 - Railroad Engineering Credits 3
Design of major elements of railroad track, including track, subgrade materials, design and construction, construction costs and stability problems, drainage, ballast, cross ties, concrete and other artifical ties, rail, fastenings and other track material, track geometry, turnouts and crossings, track-train dynamics, conduct of work, and railroad right of way. Prerequisite(s): Consent of instructor.

CEE 663 - Traffic Engineering Credits 3
Studies in highway and traffic planning and principles of traffic operations. Note(s): This course is crosslisted with CEE 463. Credit at the 600-level requires additional work.

CEE 664 - Airport Design Credits 3
Fundamental engineering principles in planning, location, design, and operation of airport facilities (terminals, apron areas, taxiways, and runways); ground access, drainage, aircraft characteristics and performance as they relate to airport design, aircraft noise and environmental considerations; elements of air traffic control. Note(s): This course is crosslisted with CEE 464. Credit at the 600-level requires additional work.

CEE 665 - Fire Protection Engineering
This upper-division engineering course is open to graduate students, provided it demonstrates a level of accomplishment suitable to graduate study. The Undergraduate Catalog should be consulted for a description of the course. In the Undergraduate Catalog, the course is numbered as 4XX, where the XX represents the same last two digits as the 600 course listed (for example, the description for CEE 604 appears under CEE 404).

CEE 666 - Geometric Design of Highways Credits 3
Design of visible elements of highways such as horizontal and vertical alignment and cross-section in accordance with design controls derived from characteristics of vehicles, drivers, traffic, and pedestrians interacting with geometry, terrain, and environment to yield a safe roadway at design capacity. Note(s): This course is crosslisted with CEE 466. Credit at the 600-level requires additional work.

CEE 667 - Computer Applications in Transportation Engineering Credits 3
Application of computer software models and programs for solving planning, design, and operations problems in transportation engineering. Includes traffic network analysis models, transportation planning, and impact models. Note(s): This course is crosslisted with CEE 467. Credit at the 600-level requires additional work.

CEE 668 - GIS Applications in Civil Engineering Credits 3
Introduction to the basics of Geographic Information Systems software and hardware and their use in civil engineering. Emphasis on the application of GIS for the planning, design, operations, and maintenance of civil engineering systems. Laboratory sessions provide hands-on experience with GIS software and hardware using specific examples/case studies of GIS applications in various areas of civil engineering. Note(s): This course is crosslisted with CEE 468. Credit at the 600-level requires additional work.

CEE 670 - High Speed Rail Credits 3
This course covers high speed rail stations, tracks, traction and power, rolling stock, signals and communications, traffic organization, passenger service, and maintenance. Prerequisite(s): Consent of instructor.

CEE 671 - Public Transportation Systems Credits 3
Analysis and evaluation of mass transit systems; their operation and management: demand and cost analysis; route design, schedules and fare policy. Technology of transit systems including vehicles and structures. Transit financing. Impact on land use and environment. *Formerly* CEE 765. Prerequisite(s): Consent of instructor.

CEE 676 - Earthquake Engineering Credits 3
Introduction to vibration theory; seismic hazards; spectra of vibrations. Application of UBC Simplified Static Method and Static Method. Introduction to design of earthquake resistant structures. Discussion of diaphragms, chords and struts. *Formerly* CEG 681 Note(s): This course is crosslisted with CEE 476. Credit at the 600-level requires additional work.

CEE 677 - Design of Underground Structures Credits 3
Design of tunnels, shafts, and underground chambers in soil and hard rocks. *Formerly* CEG 683 Note(s): This course is crosslisted with CEE 477. Credit at the 600-level requires additional work.

CEE 678 - Applied Finite Element Analysis Credits 3
Introduction to the finite element method with computer applications to engineering problems in structural analysis, two- and three-dimensional solid mechanics and continuum. Note(s): This course is crosslisted with CEE 478. Credit at the 600-level requires additional work.

CEE 680 - Concrete Design Credits 3
Introduction to design of structural systems in concrete. Design of beams, one-way slabs, columns and beam-columns. Design of T-beams and doubly-reinforced beams. Anchorage and bar cutoffs. *Formerly* CEG 643 Note(s): This course is crosslisted with CEE 480. Credit at the 600-level requires additional work.

CEE 682 - Design of Timber Structures Credits 3
Determination of simple wind and seismic forces on one and two story structures. Discussion of engineering properties of wood. Introduction to the design of sawn beams for flexure, shear, bearing and deflection. Introduction to the design of axially loaded columns. Brief introduction to the design of trusses, diaphragms and shear walls. *Formerly* CEG 648 Note(s): This course is crosslisted with CEE 482. Credit at the 600-level requires additional work.

CEE 695 - Special Topics Credits 1-3
Outlet for experimental and other topics which may be of current interest. Note(s): This course is crosslisted with CEE 495. Credit at the 600 level requires additional work. Topics and credits to be announced. May have a laboratory. May be repeated to a maximum of 9 credits.

CEE 700 - Research Methods in Civil and Environmental Engineering **Credits 3**
Methods to improve and develop research skills and prepare students for professional careers at the graduate level. Includes principles of scientific research, ethics, writing skills, methods for compiling scientific literature, identification of research questions and specific hypotheses, presentation of research results, writing research papers, proposal preparation, preparation of grant proposals, thesis and dissertation.

CEE 703 - Turbulence **Credits 3**
Topics include the origin of turbulence, dynamics of turbulent flows, free shear flows, bounded shear flows, transport phenomena, semiempirical theories, statistical descriptions, spectral dynamics. Prerequisite(s): ME 700 and Graduate standing.

CEE 704 - Environmental & Water Systems **Credits 3**
Introduction to techniques to evaluating alternatives in environmental and water resources systems. Topics include southwest U.S. water economic analysis, optimization using linear and dynamic programming, systems modeling using STELLA, analysis of droughts, and current research topics. Applications focus on surface water systems, operation, and reservoirs, water distribution and environmental systems. Prerequisite(s): CEE 413

CEE 705 - Fluid Dynamics in Porous Media I **Credits 3**
Engineering analysis of fluid flows in porous media. Includes development of the basic equations, analysis of steady and unsteady flows, multidimensional flows, analytical solutions using conformal mapping, analog methods, finite difference and finite element modeling, and transport phenomena. Prerequisite(s): ME 700 or consent of instructor.

CEE 706 - Fluid Dynamics in Porous Media II **Credits 3**
Finite element solution of flow problems in porous media. Topics include steady and unsteady saturated flows, unsaturated flows, mass transport problems, and coupled transport problems such as combined mass-thermal flows. Prerequisite(s): ME 700 or consent of instructor.

CEE 708 - Hydraulic Transients **Credits 3**
Analysis of unsteady fluid flow problems in liquid and gas transmission systems of practical interest. Emphasis placed on computer solutions. Topics include methods of characteristics, water-hammer, effect of pumps, turbines, valves, etc.; column separation; control of transient conditions; oscillatory flow and resonance; open channel transient flow. Prerequisite(s): Graduate standing or consent of instructor.

CEE 709 - Numerical Methods in Mechanics **Credits 3**
Numerical solution of partial differential equations arising from problems in mechanics. Emphasis on finite difference techniques. Topics include classification of equations: solutions of elliptic, parabolic, and hyperbolic equations; stability, consistency and convergence and nonlinear equations; multidimensional problems; systems of equations; discontinuous solutions. Prerequisite(s): MATH 466 or ME 445 or consent of instructor.

CEE 711 - Continuum Mechanics **Credits 3**
Matrices and tensors, stress deformation and flow, compatibility conditions, constitutive equations, field equations and boundary conditions in fluids and solids, applications in solid and fluid mechanics. Prerequisite(s): MATH 431 and graduate standing.

CEE 722 - Advanced Air Pollution Control **Credits 3**
Fundamental chemical and physical principles of generation and control of air pollutants, and applications to pollution control equipment. Pollutant and particle formation during combustion. Gas absorption and absorption fundamentals and tower/column design. Pollution control strategies. Prerequisite(s): CEE 452/CEE 652, MATH 432, ME 311, or equivalents. Strongly recommended: ME 314 and MAT 665 or equivalents.

CEE 725 - Freight Transportation **Credits 3**
This course covers freight, commodities, facilities and operations in the major modes of the transportation system and freight planning. Prerequisite(s): Consent of instructor.

CEE 726 - Railroad Operations **Credits 3**
This course covers the dynamics of train movements, spacing trains, interlock principles, capacity, scheduling and control of railroad operations. Prerequisite(s): Consent of instructor.

CEE 731 - Pavement Materials and Design **Credits 3**
In-depth study of pavement materials such as soils, asphaltic concrete and Portland cement concrete; analytical and empirical methods for design of flexible and rigid pavements; pavement rehabilitation management. Includes highway and airfield pavements. Prerequisite(s): CEE 334, CEE 334L, CEE 362

CEE 732 - Advanced Foundation Engineering **Credits 3**
Detailed study and analysis of the mechanical properties of soils with applications to foundation behavior. Prerequisite(s): CEE 334, CEE 334L, CEE 435

CEE 734 - Advanced Soil Mechanics **Credits 3**
Stress-strain properties and shear strength of soil: settlements and stability analysis. Prerequisite(s): CEE 334, CEE 334L

CEE 735 - Earth Dams and Embankments **Credits 3**
Principles governing the flow of water through soils and their applications to design of earth dams and embankments. Methods of earth dam design, including earthquake design, theory of wells, and groundwater flow. Prerequisite(s): CEE 334 and CEE 478/CEE 678

CEE 736 - Earth Slopes and Retaining Structures **Credits 3**
Analysis and design of stable earth slopes, including slopes cut from natural deposits and engineered embankments. Analysis and design of earth retaining structures. Both theoretical and practical aspects of design discussed. Prerequisite(s): CEE 334, CEE 334L

CEE 737 - Soil Dynamics and Earthquake Engineering **Credits 3**
Use of dynamics in geotechnical engineering, for nondestructive characterization of engineering materials, and for design of foundations subjected to dynamic loads. Geotechnical aspects of earthquake engineering, particularly effect of soils on ground-surface motions, and soil liquefaction during earthquakes. Prerequisite(s): CEE 334, CEE 334L

CEE 741 - Design of Highway Bridge Structures **Credits 3**
Review of types of highway bridges. Application of the AASHTO Bridge Specifications including dead load, live load and impact. Design of steel, reinforced and prestressed concrete bridge superstructures and their substructures. Span lengths through 150 feet. Prerequisite(s): CEE 444, CEE 480 and graduate standing.

CEE 743 - Design of Masonry Structures **Credits 3**
Study of the principles of masonry design applied to structural design of building components and retaining walls. Discussion of wind and seismic loadings. Analysis and design of shear walls. Prerequisite(s): CEE 480 and graduate standing.

CEE 744 - Design of Prestressed/Post-Tensioned Concrete Structures **Credits 3**
Study of principles of prestressed concrete, both pre-tensioned and post-tensioned, applied to structural design of buildings and bridges. Discussion of effects of lateral loads on structures. Introduction to analysis and design of shear walls. Discussion of connections between members. Prerequisite(s): CEE 480 and graduate standing.

CEE 745 - Advanced Topics in Concrete and Steel Structures **Credits 3**
Advanced theoretical analysis and design of reinforced concrete, prestressed and composite steel-concrete structures. Topics include beam torsion, stability of tall columns, local buckling effects, biaxially loaded columns, composite decks, ponding on steel roofs, and introduction to prestressed concrete structures. Prerequisite(s): CEE 480 or consent of instructor.

CEE 747 - Introduction to Analysis and Design of Plates and Shells **Credits 3**
Introduction to the analysis and design of plates and shell structures. Bending of flat rectangular and circular plates with various boundary and loading conditions. Membrane analysis of spherical, cylindrical shells, and shells of revolution with ring reinforcement. Prerequisite(s): CEE 381 and graduate standing.

CEE 748 - Advanced Design of Timber Structures **Credits 3**
Study of wood as an engineering material used in various types of construction. Strength properties of timber, structural properties of plywood, analysis and design of timber beams, timber columns, analysis and design of connections using nails, bolts, and adhesives. Prerequisite(s): MATH 431 and any one of CEE 444, 480 or 482.

CEE 749 - Advanced Topics in Finite Element Analysis **Credits 3**
Properties and applications of isoparametric elements, solids of revolution elements, plate bending elements, finite elements of dynamics, vibrations and buckling instability. Introduction to nonlinear problems using finite element analysis. Prerequisite(s): CEE 478 or consent of instructor.

CEE 750 - Urban Runoff Quality and Control **Credits 3**
Study of the quality of urban runoff during wet and dry periods. Topics include: review of hydrologic concepts, modeling water quantity and quality in stormwater systems, water quality of non-point sources, control structures or Best Management Practices (BMPs), evaluation of current research, discussion of current regulations. Prerequisite(s): CEE 413 and CEE 450 or consent of instructor.

CEE 751 - Advanced Topics in Wastewater Engineering **Credits 3**
Fundamentals of aeration and gas transfer, natural systems for effluent polishing, impacts of effluent discharges in natural water systems. Wastewater reuse issues. Sludge management including dewatering, conditioning, composting, and final disposal. Prerequisite(s): Graduate standing and CEE 450/CEE 650 or equivalent.

CEE 752 - Advanced Water and Wastewater Analysis **Credits 3**
Fundamentals and quantitative analysis or the standard methods used by environmental engineers to analyze drinking water and wastewater and control water quality. Topics include total organic carbon, solids analysis, alkalimetry, UV/VIS spectrophotometry, carbon absorption, ion exchange, AA spectrometry, ion chromatography (IC), phase partitioning, advanced oxidation. Prerequisite(s): CEE 451/CEE 651 and graduate standing, or consent of instructor.

CEE 753 - Air Pollution Atmospheric Processes **Credits 3**
Fundamentals of aerosol composition, formation and coagulation. Atmospheric photochemistry and atmospheric transport. Computer methods emphasized. Applications to pollution control strategies for urban areas. Prerequisite(s): CS 117, CEE 452/CEE 652 or equivalent, MATH 431.

CEE 754 - Biochemical Wastewater Treatment Fundamentals **Credits 3**
Underlying chemical, microbiological, and biochemical principles considered when designing suspended and attached growth biological processes for water quality control. Topics covered include activated sludge design, selector design, filamentous growth control, toxicity to biological systems, biofilm processes, and design of nutrient (phosphorus and nitrogen) removal systems. Prerequisite(s): CEE 450/CEE 650 or equivalent.

CEE 755 - Advanced Physicochemical Methods for Water Treatment **Credits 3**
Fundamentals of chemical equilibrium, ion exchange, chemical kinetics, gas transfer and absorption theory. Applications to design of water treatment facilities, including disinfection basins, ion exchange and activated carbon columns for treatment of water for drinking, agriculture, and industry. Prerequisite(s): CEE 455/CEE 655 and MATH 431 or equivalent.

CEE 756 - Advanced Waste Treatment Design **Credits 3**
Application of optimization methods to the physical, chemical, and biological reaction engineering principles used in air, water, and solid waste treatment plant design. Review and critique of plans for existing treatment works, and incorporation of new technologies. Waste minimization. Prerequisite(s): CEE 450/CEE 650 or CEE 455/CEE 655 or equivalent.

CEE 757 - Engineering Modeling of Natural Systems **Credits 3**
Application of physical, chemical, and ecological concepts to mathematical modelling of fluid mixing, nutrient cycling and population dynamics. Applications to waste treatment and impacts in natural water systems. Prerequisite(s): CS 117, CEE 450/CEE 650, MATH 431

CEE 758 - Air Quality Modeling **Credits 3**
Data requirements for inputs to air quality models. Review of photochemical and transport processes used in models. Influence of local topography and meteorology. Review of photochemical computer models. Use of models in evaluation of strategies for improvement of air quality. Prerequisite(s): CEE 753 or equivalent; course in numerical methods recommended.

CEE 759 - Mass Transfer in Environmental Systems **Credits 3**
Fundamentals of mass transfer by diffusion and advection. Solutions to steady-state and transient problems in several dimensions. Applications to natural and engineered systems. Prerequisite(s): CEE 367, MATH 432, and ME 400/ME 600 or ME 700, or equivalent, or consent of instructor.

CEE 760 - Transportation Planning **Credits 3**
Network representation methods; minimum-path trees; traffic assignment algorithms and their performance; trip distribution models; travel surveys and data needs; applications of statistical methods to develop methods of ownership, trip generation, vehicle occupancy, and model choice. Prerequisite(s): CEE 362 and graduate standing, or consent of instructor.

CEE 761 - Transportation Demand Analysis **Credits 3**
Problems dealing with transportation-systems as they affect travel behavior; study of the demand for transportation theoretical concepts and analytical methods; urban and regional travel demand analysis, forecasting methods and behavioral demand models. Prerequisite(s): CEE 362 and graduate standing, or consent of instructor.

CEE 762 - Operations Research Applications in Civil Engineering **Credits 3**
Analysis of civil engineering systems using operations research methods and techniques. Methods covered include optimization models in deterministic systems, network models, and modeling of stochastic systems, including queuing theory. Applications drawn from various civil engineering contexts, particularly transportation systems. Prerequisite(s): MATH 466 or STAT 411, or consent of instructor.

CEE 763 - Advanced Traffic Engineering **Credits 3**
Theories of traffic flow and signal operations with application to activated, coordinated, and networked intersections using computerized models such as PASSER, NETSIM, TRANSYT, SOAP, CALSIG. Analysis of arterial/freeway operations techniques including HOV and reverse lanes, ramp metering, freeway surveillance, TSM, demand modification. Evaluation of objectives, measures of effectiveness. Note(s): Two hours lecture, three hours laboratory. Prerequisite(s): CEE 463/CEE 663 or consent of instructor.

CEE 764 - Air Transportation **Credits 3**
Nature of civil aviation, aviation system planning, airline operations, aircraft characteristics, airline economics, structure of the airline industry, aircraft fleet planning and scheduling, aviation safety. Prerequisite(s): CEE 362 and graduate standing, or consent of instructor.

CEE 766 - Analysis of Hazardous Materials Transportation **Credits 3**
Hazardous materials transportation analysis using probabilistic risk assessment, including concept measures, models, and methodologies; routing analysis including measures and models, background and scope of hazardous materials transportation issues; mitigation including engineering applications in risk management and emergency preparedness. Prerequisite(s): CEE 362 and graduate standing, or consent of instructor.

CEE 767 - Human Factors in Transportation Engineering **Credits 3**
Application of human factors to transportation system planning, design, operation, and management with emphasis on transportation safety; ergonomic principles; driver, vehicle, and guideway interaction; highway safety problems; human factors analytical methods; engineering and management solutions. Prerequisite(s): CEE 362, or consent of instructor.

CEE 768 - Applied Geographic Information Systems **Credits 4**
Review of data structures and algorithms for surfaces, volumes and time, elevation models, spatial interpolation. Error modeling and data uncertainty. Visualization of spatial data. Decision making in a GIS context. Emphasis on interdisciplinary group project constructing a data base and maps involving several areas of expertise using popular GIS software. *Same as* EGG 768 Prerequisite(s): EGG 668, STA 751, and CS 733 or CS 432.

CEE 770 - Shell Structures, Bending and Membrane Theories **Credits 3**
Analysis and design of curved thin shell structures using two methods: the approximate membrane force analysis and the exact bending moment and membrane force analysis combined. Introductions provided to the theory of elasticity and specialized solutions to partial differential equations as needed for the analysis of shell structures. Prerequisite(s): CEE 342 and graduate standing.

CEE 772 - Theory of Composite Structures **Credits 3**
Analysis and design of structures using composite materials and sandwich construction. Elasticity and failure theories of fiber composites and laminates discussed, unidirectional, multidirectional and random fiber reinforcement considered. Prerequisite(s): CEE 381 and graduate standing.

CEE 774 - Introduction to Theory of Elasticity and Plasticity I **Credits 3**
Introduction to theoretical and applied elasticity and plasticity theory-solutions to engineering problems in structural mechanics and geotechnical engineering. Response of isotropic, orthotropic and layered media to applied stresses and strains. Prerequisite(s): MATH 431 and graduate standing only.

CEE 775 - Seismic Response of Structures **Credits 3**
Application of principles of vibration theory to structures. Determination of natural frequencies and mode shapes using classical methods and energy techniques. Response of structures to harmonic, impulse, periodic and earthquake loadings. Prerequisite(s): CEE 381 and graduate standing.

CEE 776 - Experimental Techniques in Structural Mechanics **Credits 3**
Application of various experimental techniques to stress analysis problems. Comparison of experimental and analytical methods. Theory of electric resistance strain gages. Brittle lacquer coatings and their photoelasticity and its application including photoelastic coatings. Introduction to similitude. Prerequisite(s): CEE 381 and graduate standing.

CEE 778 - Theory of Elastic Stability **Credits 3**
Buckling of centrally loaded and eccentrically loaded compression members. Variational methods of determining critical loads. Stability of rigid frame members, effective lengths of compression members in trusses, lateral buckling of beams, torsional buckling. Buckling of compressed rings and curved bars. Prerequisite(s): CEE 381 and graduate standing.

CEE 785 - Construction Engineering Management **Credits 3**
Concepts of construction project management of heavy civil, and capital facility projects. Covers the project phases: pre-project planning, engineering, procurement, construction and start up. Prerequisite(s): Graduate standing in civil engineering or consent of instructor.

CEE 791 - Independent Study in Civil Engineering **Credits 1 – 3**
Independent study of a selected civil engineering topic. Note(s): May be repeated to a maximum of six credits. Prerequisite(s): Graduate standing in civil engineering and consent of instructor.

CEE 795 - Special Topics in Civil Engineering **Credits 1 – 6**
Outlet for experimental and other topics of current interest. Topics and credits to be announced. Note(s): May have a laboratory. May be repeated for credit. Prerequisite(s): Graduate standing in civil engineering and consent of instructor.

CEE 796 - Design Project in Civil Engineering **Credits 1 – 3**
Synthesis course to involve students in the design process from analysis and proposal to solution. Note(s): May be repeated to a maximum of three credits. Not permitted for students pursuing the M.S.E. Thesis option or for those in the Ph.D. Program. Prerequisite(s): Graduate standing in civil engineering and consent of instructor.

CEE 797 - Thesis in Civil Engineering **Credits 3 – 6**
Research, analysis, and writing towards completion of thesis and subsequent defense. Note(s): May be repeated but only six credits will be applied to program. Grading: S/F grading only. Prerequisite(s): Graduate standing in civil engineering.

CEE 799 - Dissertation Research **Credits 1 – 6**
Research analysis and writing towards completion of dissertation and subsequent defense. Note(s): May be repeated with a maximum of 18 credits allowed to be used towards the degree. Grading: S/F grading only. Prerequisite(s): Graduate standing in Ph.D. program and consent of advisor.

CEM 632 - Temporary Construction Structures **Credits 3**
Analysis, design, and construction of temporary structures including formwork, falsework, shoring, rigging, and access units. Cost analysis. Computer analysis applications. Safety consideration. Note(s): This course is crosslisted with CEM 432. Credit at the 600-level requires additional work.

CEM 651 - Construction Estimating **Credits 4**
Principles and procedures used in estimating construction costs. Application of quantity determination, estimate pricing, specifications, subcontractor and supplier solicitation, risk assessment and risk analysis, and final bidding preparation. Computer-based estimating used for semester project. Note(s): This course is crosslisted with CEM 451/CEM 451L. Credit at the 600 level requires additional work.

CEM 653 - Construction Scheduling and Resource Optimization **Credits 3**
Scheduling and resource optimization. Includes short-interval scheduling, Gantt charts, linear, and matrix scheduling formats. Network techniques including CPM and PERT concepts and calculations. Computer applications. Note(s): This course is crosslisted with CEM 453/CEM 453L. Credit at the 600 level requires additional work.

CEM 654 - Heavy Construction Equipment & Methods **Credits 3**
Characteristics, capabilities, limitations, uses and selection of heavy construction equipment. Construction methods selection. Construction equipment process planning and improvement, fleet operations, and maintenance programs. Note(s): This course is crosslisted with CEM 454. Credit at the 600-level requires additional work. Field Trips

CEM 680 - Sustainable Construction **Credits 3**
Overview of sustainable design and construction. Introduction to green buildings, LEED assessment process, high-performance building, and green building material.Economic analysis of green buildings. Note(s): This course is crosslisted with CEM 480. Credit at the 600-level requires additional work. Prerequisite(s): Consent of instructor.

CEM 685 - Construction Law and Contracts **Credits 3**
Legal problems in the construction process. Stipulated sum, unit price, and cost-plus contracts. Construction lien rights and bond rights. Scope of work issues. Builders risk issues. Risk-shifting. Case studies. Note(s): This course is crosslisted with CEM 485. Credit at the 600-level requires additional work.

CEM 693 - Independent Study **Credits 1-3**
Independent study of a selected construction topic. Note(s): This course is crosslisted with CEM 493. Credit at the 600 level requires additional work.

CEM 695 - Special Topics in Construction Management **Credits 1-4**
Experimental and other topics which may be of current interest in construction management. Note(s): This course is crosslisted with CEM 495. Credit at the 600-level requires additional work.

CEM 700 - Research Methods in Construction Management **Credits 3**
Introduction to research process, design, measurement, sampling, analysis, and results, research information resources, and literature review. Corequisite(s): MBA 775 or STAT 463 or equivalent or consent of instructor.

CEM 701 - Construction Seminar II **Credits 1**
Presentations by students on research studies or projects. Presentations and discussions by local construction industry representatives on current construction engineering and management research and practice topics. Prerequisite(s): CEM 700

CEM 705 - Construction Engineering Management **Credits 3**
Technical project management applications for pre-project planning, design, pre-construction services, value engineering, construction, start up/commissioning and decommissioning of capital facilities. Corequisite(s): CEM 451/CEM 651 and CEM 451/CEM 653

CEM 740 - Construction Safety and Performance Improvement **Credits 3**
Introduction to construction safety issues, regulations and ways to improve safety on the job site. Accidents and their causes, OSHA regulations, and worker safety programs. Productivity concepts, data collection, and analysis of data and factors affecting construction productivity. Means for improving production and study of productivity improvement programs. Prerequisite(s): CEE 381 or ABS 341, and graduate standing.

CEM 750 - Advanced Construction Scheduling **Credits 3**
Models of network theory and non-network theory for construction scheduling. Systems theory, resource leveling and resource algorithms, project diagnostics, optimum workforce/equipment movement, and as-built schedule coordination. Cost control and computer applications, and expert systems. Case studies. Prerequisite(s): CEM 453/CEM 653 and graduate standing.

CEM 751 - Construction Cost Analysis and Estimating **Credits 3**
Advanced topics in construction estimating including value engineering, pricing strategies, and computer concepts. Development of estimating data. Computer-aided design and cost integration. Range, factor, and parametric estimating. Production factors. Prerequisite(s): CEM 451 or CEM 651 or consent of instructor.

CEM 755 - Renewable Energy Capital Facility Projects **Credits 3**
Overview of control and management of the cost, timing, and value of capital-investment in renewable energy projects such as solar thermal power plants, photovoltaic plants, biomass power plants, biofuel power plants, hydroelectric power plants, geothermal power plants, tidal power station, wave power station and on-shore/off-shore wind power plants. Prerequisite(s): Graduate standing.

CEM 775 - Construction Operations and Management **Credits 3**
Theory and practice of construction operations and management. Roles of the designer, owner, constructor, and construction manager. Systems approach to project, firm, and organization issues for construction management. Decision modeling. Readings, case studies, and analysis of construction problems and solutions. Computer applications, case studies. Note(s): May be taken concurrently with CEM 751. Prerequisite(s): EGG 307, CEM 740, CEM 750, CEM 751

CEM 780 - Construction Engineering **Credits 3**
Advanced topics in construction engineering addressing techniques and sequences employed in the construction of heavy and industrial projects. Prerequisite(s): CEE 334 or CEM 330, CEE 381 or CEM 370

CEM 793 - Advanced Independent Study **Credits 1 – 3**
Advanced independent study of a selected construction topic. Paper required. Note(s): May be repeated to a maximum of six credits. Prerequisite(s): Graduate standing and consent of instructor.

CEM 795 - Advanced Special Topics in Construction Management **Credits 1 – 6**
Outlet for experimental and other topics of interest in advanced construction management. Paper required. Topics and credits to be announced. Note(s): May be repeated to a maximum of six credits. Prerequisite(s): Graduate standing in major.

CEM 796 - Special Project in Construction Engineering and Management **Credits 1 – 3**
Development and undertaking of a project investigating a topic of interest related to construction engineering or construction management. Note(s): May be repeated for a maximum of three credits. Prerequisite(s): Graduate standing.

CEM 797 - Research Thesis in Construction Engineering and Management **Credits 1 – 3**
Development and undertaking of a research study on a contemporary topic related to construction engineering or construction management. Preparation and presentation of a research thesis. Preparation of a project report. Note(s): May be repeated for a maximum of six credits. Prerequisite(s): Graduate standing.

EGG 651 - Ergonomics **Credits 3**
Design of the work environment to facilitate the safety of the worker and the improvement of work performance, with emphasis on the biomechanical requirements and musculoskeletal consequences of work activity. Note(s): This course is crosslisted with EGG 451. Credit at the 600-level requires additional work.

EGG 695 - Special Topics **Credits 3**
This upper-division engineering course is open to graduate students, provided it demonstrates a level of accomplishment suitable to graduate study. The Undergraduate Catalog should be consulted for a description of the course. In the Undergraduate Catalog, the course is numbered as 4XX, where the XX represents the same last two digits as the 600 course listed (for example, the description for CEE 604 appears under CEE 404).

EGG 747 - Orthopedic Biomechanics - Lower Extremities and Spine **Credits 3**
Biomechanics of the lower extremities and spine; engineering properties and physiology of bone, cartilage, and tendon; analysis of gait; effects of orthopedic impairment and injury; design and surgical implantation of prosthetic joints and fracture fixation devices; engineering of tissue regeneration and replacement. *Same as* ME 747 Prerequisite(s): Graduate standing in engineering or kinesiology or consent of instructor.

EGG 748 - Prosthetic Systems Engineering **Credits 3**
Engineering design to prosthetic feet, ankles, knees, and prehension devices; materials and manufacturing; the biomechanics of movement using a prosthesis; residual limb morphology and surgical enhancements; socket design and tissue response; myoelelectric devices; microprocessor control; psychophysical and motor control considerations; aspects of clinical science. Emphasis on R&D needs. *Same as* ME 748 Prerequisite(s): Graduate standing in engineering or kinesiology or consent of instructor.

EGG 750 - Analysis of Human Movement **Credits 3**
Analysis of the kinematics and kinetics of human movement in two and three dimensions with emphasis on methods used in motion capture, including joint and segment position; acceleration, velocity, force and torque; work and power; and inverse solution methods. *Same as* ME 750 Prerequisite(s): Graduate standing in engineering or kinesiology or consent of instructor.

EGG 768 - Applied Geographic Information Systems **Credits 4**
Review of data structures and algorithms for surfaces, volumes and time, elevation models, spatial interpolation. Error modelling and data uncertainty. Visualization of spatial data. Decision making in a GIS context. Emphasis on interdisciplinary group project constructing a data base and maps involving several areas of expertise using popular GIS software. Prerequisite(s): EGG 668, STA 751, and CS 733 or CS 432.

EGG 769 - Applied Modeling with Geographic Information Systems **Credits 3**
Design and interfacing of civil engineering models of transportation and finite element, finite difference, and hydrologic models with geographic data base systems. Applications in general air, water, transportation, and land use management. Prerequisite(s): EGG 768

EGG 795 - Special Topics **Credits 3**
Directed research course under the supervision of a member of the graduate faculty culminating in a written paper. Note(s): May be repeated twice with permission of instructor and advisor. Prerequisite(s): Graduate standing and permission of instructor.

Computer Science

The Department of Computer Science offers programs leading to the Master of Science in Computer Science and the Doctor of Philosophy in Computer Science. Areas of school strength include both theoretical and experimental computer science, especially within such areas as information and network security, internet forensics, real-time algorithms, information retrieval, document analysis, graphics, computational geometry, networking and distributed systems, parallel programming, artificial intelligence, and software engineering.

The distributed computing environment of the College of Engineering is housed in the Thomas T. Beam Engineering Complex. Several hundred modern computing systems are operated for purposes of instruction, experimentation, laboratory instrument control, data acquisition, and research. More than fifty of the systems are in public laboratories accessible to all computer science students. These laboratories contain both Windows and Unix/Linux clients and servers in a variety of modern configurations.

Students can also obtain permission to access the machines of the National Supercomputer Center for Energy and the Environment (NSCEE).

Laxmi Gewali, Ph.D., Chair
Ajoy Datta, Ph.D., Graduate Coordinator

Computer Science Faculty
Chair
Gewali, Laxmi P. - Full Graduate Faculty Professor; B.S., Gauhati University, India; M.S., Tribhuwan University, Nepal; M.S., Ph.D., University of Texas-Dallas. Rebel since 1989.
Graduate Coordinator
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Graduate Faculty
Bein, Wolfgang - Full Graduate Faculty Professor; M.S., Ph.D., University of Osnabruck. Rebel since 1998.
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Pedersen, Jan B. - Full Graduate Faculty Associate Professor; B.S., M.S., University of Aarhus, Denmark; Ph.D., University of British Columbia. Rebel since 2003.
Stefik, Andreas - Full Graduate Faculty Assistant Professor; B.A., Central Washington University; M.S., Washington State University; Ph.D., Washington State University

Taghva, Sidkazem - Full Graduate Faculty Professor; B.S., Pahlavi University; M.S., University of Kansas; Ph.D., University of Iowa. Rebel since 1987.

Yfantis, Evangelos A. - Full Graduate Faculty Professor; B.S., University of Athens; M.S., Fairleigh Dickinson University; M.S., Rutgers University; M.S., New Jersey Institute of Technology; Ph.D., University of Wyoming. Rebel since 1979.

Yang, Jisoo - Full Grauate Faculty Professor; B.S., Seoul National University; M.S., University of Michigan; Ph.D., University of Michigan. Rebel since 2015.

Zhan, Justin - Full Graduate Faculty Professor; B.S., Liaoning University; M.S., Syracuse University; Ph.D., University of Ottawa. Rebel since 2015.

Doctor of Philosophy - Computer Science

Plan Description

The Ph.D. degree is awarded to a candidate who has demonstrated breadth of knowledge in computer science in general and has displayed depth of knowledge in the area of specialty as well as the ability to make original contributions to the body of knowledge in this field.

For more information about your program, including your graduate program handbook and learning outcomes, please visit the Degree Directory.

Plan Admission Requirements

Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

Applicants for admission to the Ph.D. program in computer science must meet the following:

1. A GPA of 3.70 (on a 4.00 scale) or higher in post-baccalaureate course work is required for admission. Students entering with a bachelor's degree must have a GPA of 3.5 or higher for the courses at the 200-level or above.
2. Students are expected to have a master's degree in computer science before applying to the Ph.D. program. On rare occasions, an unusually capable student may be admitted to work directly for the Ph.D. degree without having a master's degree.
3. At least three letters of recommendation (preferably from academic sources) attesting to the applicant's professional competence and academic potential are required.
4. A personal statement of purpose, which should be as specific as possible and should include the applicant's objectives and area(s) of interest, is required.
5. A minimum score of 315 on the general test of the Graduate Record Examination (GRE) is required. Official score reports from the last five years are acceptable.
6. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

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 Requirements: Post-Master's Track
Total Credits Required: 48

Course Requirements

Required Courses – Credits: 30

Complete 30 credits of 600- or 700- level Computer Science (CS) courses.

Dissertation – Credits: 18

CS 799 - Dissertation Research

Degree Requirements

1. A student entering the Ph.D. program with a master's degree in computer science is required to take at least 48 credits of coursework.
2. At least 24 credits must be in computer science (excluding dissertation).
3. A minimum of 12 credits of 700-level Computer Science courses (excluding CS 791, CS 795, CS 798, CS 799).
4. A maximum of 12 credits of 600-level Computer Science courses.
5. A maximum of 6 credits of 600/700 level non-Computer Science courses (with departmental approval).
6. A Ph.D. student can take at most 9 credits per semester from a combination of CS 795, CS 798, CS 799 and any other course. During the summer a Ph.D. student can take at most 9 credits overall, not per summer session, from a combination of CS 795, CS 798, CS 799, and any other course.
7. Satisfactorily pass a written comprehensive examination within the first four semesters.
   a. The written comprehensive examination will be given twice a year. The comprehensives will assess the student's breadth of knowledge through examinations covering the six Core Areas listed below:
      1. Automata and formal languages
      2. Algorithms and data structures
      3. Programming languages
      4. Compiler construction
      5. Computer architecture
      6. Operating systems
   b. A syllabus will be published well in advance of the exams listing the topics to be covered in each exam. Students are expected to take the comprehensive examination within two years of entering the Ph.D. program. All Ph.D. students are urged to take this examination as early as possible. Preference is given in the allocation of student financial support to those who have passed the comprehensive examination. The comprehensive examination may be attempted at most twice. Students who do not pass the comprehensive examination the first time must retake the examination at the next scheduled offering. Failure to pass the comprehensive examination after two attempts will normally lead to dismissal from the Ph.D. program. After passing the comprehensive examination, a research topic of mutual interest to the student and his/her proposed committee is selected. At this point, the student formally begins his/her research study.
8. The qualifying examination is an oral examination designed to test the depth of the student's knowledge in his or her area of research specialization.
   a. It must be taken before either:
      i. Two years after passing the comprehensive examination or
      ii. Four years after entering the Ph.D. program.
   b. It generally focuses on his/her dissertation proposal. The main purpose of this exam is to evaluate the technical merits and feasibility of the student's proposal for his/her Ph.D. dissertation.
   c. The student's Ph.D. committee must conduct the examination. This committee consists of five faculty members of whom one must be from outside the Department of Computer Science. The student's advisor is the chairperson of this committee. Please see Graduate College policy for committee appointment guidelines.
   d. The student must prepare a dissertation proposal before taking this examination. The student's advisor should have already approved this proposal. This proposal must be given to the Ph.D. committee members at least two weeks before the date of the qualifying exam. The proposal must contain a discussion of the background literature on the problem area, description of the specific topic of research proposal approach, feasibility arguments, the objective of the research project, and a list of references.
   e. The student begins the exam with a presentation of the dissertation proposal. The remaining time is used for discussion and asking questions to determine if the student has sufficient depth of knowledge to carry out the proposed research.
   f. The examination cannot be taken more than twice. After successful completion of the qualifying examination, the student is advanced to candidacy for the doctoral degree.
2. Satisfactorily pass a dissertation proposal defense by the end of year 4.
3. The candidate must prepare a dissertation on his or her research. The doctoral dissertation should represent a significant original research contribution to the field of computer science and be publishable in a recognized refereed journal.
4. After completion of the dissertation, the candidate must pass a final oral defense of his/her dissertation. The candidate must make the final changes, if any, in the dissertation within three months from the date of the oral defense. A candidate can defend the dissertation no more than twice. Each member of the committee must approve the final dissertation.
5. Maintain a satisfactory rate of progress and a yearly progress report must be submitted. To maintain satisfactory progress in the Ph.D. program a student must:
   a. Pass the comprehensive examination within 4 semesters of entering the Ph.D. program.
   b. Maintain a minimum grade point average required by the College of Engineering.
   c. Pass the qualifying examination within four years of entering the Ph.D. program.
   d. Maintain satisfactory progress towards research.
   e. Students who enter the Ph.D. program with a master's degree must complete all requirements for the Ph.D. degree within six years. If these requirements are not met, the department may place the student on academic probation or drop him/her from the Ph.D. program.

Graduation Requirements

1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.

2. The student must submit and successfully defend his/her dissertation by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy dissertation to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Subplan 2 Requirements: Post-Bachelor's Track
Total Credits Required: 72
Course Requirements
Required Courses – Credits: 54
Complete 54 credits of 600- or 700- level Computer Science (CS) courses.

Dissertation – Credits: 18
CS 799 - Dissertation Research

Degree Requirements
1. Complete a minimum of 72 credits of coursework with a minimum GPA of 3.00.
2. At least 42 credits must be in computer science (excluding dissertation).
3. A minimum of 12 credits of 700-level Computer Science courses (excluding CS 791, CS 795, CS 798, CS 799)
4. A maximum of 12 credits of 600-level Computer Science courses.
5. A maximum of 6 credits of 600/700 level non-Computer Science courses (with departmental approval).
6. A Ph.D. student can take at most 9 credits per semester from a combination of CS 795, CS 798, CS 799 and any other course. During the summer a Ph.D. student can take at most 9 credits overall, not per summer session, from a combination of CS 795, CS 798, CS 799, and any other course.
7. Satisfactorily pass a written comprehensive examination within the first four semesters.
   a. The written comprehensive examination will be given twice a year. The comprehensives will assess the student's breadth of knowledge through two examinations covering the six Core Areas listed below:
      1. Automata and formal languages
      2. Algorithms and data structures
      3. Programming languages
      4. Compiler construction
      5. Computer architecture
      6. Operating systems
   b. A syllabus will be published well in advance of the exams listing the topics to be covered in each exam. Students are expected to take the comprehensive examination within two years of entering the Ph.D. program. All Ph.D. students are urged to take this examination as early as possible. Preference is given in the allocation of student financial support to those who have passed the comprehensive examination. The comprehensive examination may be attempted at most twice. Students who do not pass the comprehensive examination the first time must retake the examination at the next scheduled offering. Failure to pass the comprehensive examination after two attempts will normally lead to dismissal from the Ph.D. program. After passing the comprehensive examination, a research topic of mutual interest to the student and his/her proposed committee is selected. At this point, the student formally begins his/her research study.
8. The qualifying examination is an oral examination designed to test the depth of the student's knowledge in his or her area of research specialization.
   a. It must be taken before either:
      i. Two years after passing the comprehensive examination or
      ii. Four years after entering the Ph.D. program.
   b. It generally focuses on his/her dissertation proposal. The main purpose of this exam is to evaluate the technical merits and feasibility of the student's proposal for his/her Ph.D. dissertation.
   c. The student's Ph.D. committee must conduct the examination. This committee consists of five faculty members of whom one must be from outside the Department of Computer Science. The student's advisor is the chairperson of this committee. Please see Graduate College policy for committee appointment guidelines.
   d. The student must prepare a dissertation proposal before taking this examination. The student's advisor should have already approved this proposal. This proposal must be given to the Ph.D. committee members at least two weeks before the date of the qualifying exam. The proposal must contain a discussion of the background literature on the problem area, description of the specific topic of research proposal approach, feasibility arguments, the objective of the research project, and a list of references.
   e. The student begins the exam with a presentation of the dissertation proposal. The remaining time is used for discussion and asking questions to determine if the student has sufficient depth of knowledge to carry out the proposed research.
   f. The examination cannot be taken more than twice. After successful completion of the qualifying examination, the student is advanced to candidacy for the doctoral degree.
2. Satisfactorily pass a dissertation proposal defense by the end of year 4.
3. The candidate must prepare a dissertation on his or her research. The doctoral dissertation should represent a significant original research contribution to the field of computer science and be publishable in a recognized refereed journal.
4. After completion of the dissertation, the candidate must pass a final oral defense of his/her dissertation. The candidate must make the final changes, if any, in the dissertation within three months from the date of the oral defense. A candidate can defend the dissertation no more than twice. Each member of the committee must approve the final dissertation.
5. Maintain a satisfactory rate of progress and a yearly progress report must be submitted. To maintain satisfactory progress in the Ph.D. program a student must:
   a. Pass the comprehensive examination within 4 semesters of entering the Ph.D. program.
   b. Maintain a minimum grade point average required by the College of Engineering.

c. Pass the qualifying examination within four years of entering the Ph.D. program.
d. Maintain satisfactory progress towards research.
e. Those who enter the Ph.D. program with a bachelor's degree must complete all requirements for the Ph.D. degree within eight years. If these requirements are not met, the department may place the student on academic probation or drop him/her from the Ph.D. program.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her dissertation by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy dissertation to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Plan Graduation Requirements
Refer to your subplan for Graduation Requirements.

Master of Science in Computer Science

Plan Description
Our master's program gives you the opportunity to study different areas, including:
- Design and analysis of algorithms
- Operating and distributed systems
- Computer architecture and networking
- Computational geometry and robotics
- Computer graphics and image processing
- Programming languages and compiler construction
- Artificial intelligence and expert systems
- Database design, document analysis, and retrieval
- Software engineering

For more information about your program including your graduate program handbook and learning outcomes please visit the Degree Directory.

Plan Admission Requirements
Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

Applicants must submit the following to the Graduate College:
1. An application and official transcripts of all college level work with a minimum GPA of 3.00.
2. Two letters of recommendation concerning the student's potential for succeeding in the graduate program.
3. A set of official transcripts.
4. The results of the Graduate Record Examination current to within five years should be sent directly to the department.
5. In addition, applicants must have completed courses and their prerequisites equivalent to our undergraduate Programming Languages (CS 326), Operating Systems (CS 370), Discrete Mathematics II (MATH 351), and Statistical Methods I (STAT 411) with an average grade of B or better.
6. The Computer Science Admission Committee may elect to admit an outstanding applicant who has not satisfied all of the background requirements on a conditional basis.
7. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

The student must complete these requirements before full admission to the program is granted.

Students who have not completed all the following courses (or equivalent courses) as part of their bachelor's degree may be required to complete them as a condition of their admission. If taken as part of their master's degree program, these courses may count toward the 30 credits required.

CS 656 - Automata and Formal Languages

CS 677 - Analysis of Algorithms

CS 660 - Compiler Construction

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 Requirements: Thesis Track
Total Credits Required: 30
Course Requirements
Computer Science Courses – Credits: 24
Complete 24 credits of 600- or 700- level Computer Science (CS) courses. Students may complete up to 3 credits outside of CS. Outside credits must be related to the student's research area and be approved by the department graduate committee.

Thesis – Credits: 6
CS 791 - Thesis

Degree Requirements
1. The student must pass at least 30 credits of 600- and 700-level courses with grades of C or better.
2. Students must complete 12 credits of 700-level CS courses (excluding thesis).
3. Courses in which the student earns a grade lower than C cannot be included in his or her program, and the student's total grade point average (GPA) must be 3.00 or higher while in the program. A student whose GPA falls below 3.00 will be placed on academic probation. That student must have an overall GPA of at least 3.00 by the end of two subsequent semesters; otherwise the student will be separated from the graduate program. A student on probation will not be allowed to register for CS 690, CS 790, CS 791, CS 792, CS 799, or equivalent courses in another department.
4. In consultation with his/her 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.

5. The student must submit a thesis conforming to the specifications of the Graduate College and pass a final oral examination covering the thesis and relevant course work.

Graduation Requirements

1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public. .
3. The student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Subplan 2 Requirements: Project Track
Total Credits Required: 30
Course Requirements
Computer Science Courses – Credits: 27
Complete 27 credits of 600- or 700- level Computer Science (CS) courses. Students may complete up to 3 credits outside of CS. Outside credits must be related to the student's research area and be approved by the department graduate committee.

Project – Credits: 3
CS 790 - Master's Project

Degree Requirements

1. The student must pass at least 30 credits of 600- and 700-level courses with grades of C or better.
2. Students must complete 15 credits of 700-level CS courses (excluding the project).
3. Courses in which the student earns a grade lower than C cannot be included in his or her program, and the student's total grade point average (GPA) must be 3.00 or higher while in the program. A student whose GPA falls below 3.00 will be placed on academic probation. That student must have an overall GPA of at least 3.00 by the end of two subsequent semesters; otherwise the student will be separated from the graduate program. A student on probation will not be allowed to register for CS 690, CS 790, CS 791, CS 792, CS 799, or equivalent courses in another department.
4. The student must complete a computer science project and a report approved by his/her advisor and pass a final oral examination over the project and relevant course work.

Graduation Requirements

1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must successfully complete a master's project.

Plan Graduation Requirements
Refer to your subplan for Graduation Requirements.

CS 617 - Introduction to Computer Simulation **Credits 3**
Simulation as a tool for the investigation of random phenomena. Emphasis on discrete simulation. Preparation of input for simulation and analysis of results. Use of SIMSCRIPT for discrete simulation. Comparison of discrete and continuous simulation. Simulation problems in several disciplines examined in detail. Note(s): This course is crosslisted with CS 417. Credit at the 600-level requries additional work.

CS 620 - Human-Computer Interaction **Credits 3**
Overview of human-computer interaction principles, guidelines, methods, and tools. User research, low-fidelity prototyping, participatory design, usability evaluation, visual design, usability principles, and affordances. Graphical user interface implementation, including design patterns, event handling, widget tool kits, languages, and development environments. Note(s): This course is crosslisted with CS 420. Credit at the 600-level requires additional work. Prerequisite(s): Consent of Instructor

CS 641 - Advanced Internet Programming **Credits 2**
Advanced Internet programming design and applications including client/server technologies and environment and software, client/server network operating systems, client/server database management systems, data warehousing environments, data mining, basic networking models and protocols, CASE tools, Groupware, Middleware, Internet security, privacy considerations. Note(s): This course is crosslisted with CS 441. Credit at the 600-level requires additional work.

CS 641L - Advanced Internet Programming Lab **Credits 1**
Helps student develop practical skills and learn to apply industry-wide standards and practices for advanced Internet and Internet 2 applications. Note(s): This course is crosslisted with CS 441L. Credit at the 600-level requires additional work.

CS 643 - Information Assurance **Credits 3**
Introduction to the principles of information assurance. Security awareness, Survey of information security technologies, cryptography, management and administration techniques necessary to improve information security and respond to a security breach, survey of threats to information security, privacy in computing, legal and ethical issues relating to information security, and case studies. *Same as* CS 443

CS 645 - Internet Security **Credits 3**
Internet security theory and practice, advanced IP concepts, the concepts of stimulus and response in the context of securing a network, network packet and traffic analysis, internet protocol (IP) vulnerabilities, packet filtering, intrusion detection, internet exploits, exploit signatures, internet forensics, network security investigation. Note(s): This course is crosslisted with CS 445. Credit at the 600-level requires additional work.

CS 648 - Computer Security **Credits 3**
Overview of computer security, threats, vulnerabilities and controls. Physical security, computer security policies and implementation plans, and computer forensics including penetration testing and investigation. Management issues. Legal, privacy and ethical issues. Note(s): This course is crosslisted with CS 448. Credit at the 600-level requires additional work.

CS 649 - Computer and Network Forensics **Credits 3**
Basics of Computer Forensics and Network Forensics. How to protect your privacy on the internet: Email, obfuscation, web sites and servers. Encryption, data hiding, and hostile code. Investigating Windows and Unix. File system recovery/analysis and file management in different OSes. Technical and legal issues regarding digital evidence collection and forensics analysis. This course is crosslisted with CS 449. Credit at the 600-level requires additional work. Prerequisite(s): CS 645 or CS 648

CS 651 - Multimedia Systems Design **Credits 2**
Theory and practice of multimedia system design overview. High-level topics include multimedia content and formats, underlying technologies, digital cinematography, scripting, storyboarding, CD-ROM production and online publication, porting multimedia to the Web. Emphasis on the design process and the seamless integration of content in an interactive environment. Note(s): This course is crosslisted with CS 451. Credit at the 600-level requires additional work.

CS 651L - Multimedia Systems Design Lab **Credits 1**
Helps student develop practical skills and learn to apply industry-wide standards and practices for the design of multimedia systems. Note(s): This course is crosslisted with CS 451L. Credit at the 600-level requires additional work.

CS 656 - Automata and Formal Languages **Credits 3**
Regular expressions. Regular, context-free, and unrestricted grammars. Finite and pushdown automata. Turing machines and the halting problem; introduction to decidability. Note(s): This course is crosslisted with CS 456. Credit at the 600-level requires additional work.

CS 657 - Database Management Systems **Credits 3**
Concepts and structures necessary for design and implementation of a database management system. Survey of current database management systems and use of a DBMS. Note(s): This course is crosslisted with CS 457. Credit at the 600-level requires additional work.

CS 660 - Compiler Construction **Credits 3**
Current methods in the design and implementation of compilers. Construction of the components of an actual compiler as a term project. Note(s): This course is crosslisted with CS 460. Credit at the 600-level requires additional work.

CS 663 - Computer Architecture **Credits 3**
Introduction to computer architecture. Topics include basic computer organization concepts; history and taxonomy of computer architectures; language and software influences on architecture; instruction set design; stack, array, data flow, and database machines; multiprocessor and network architectures; and fault tolerant designs. Note(s): This course is crosslisted with CS 463. Credit at the 600-level requires additional work.

CS 665 - Computer Networks I **Credits 3**
An introduction to the design and implementation of computer communication networks, their protocols and applications. It covers the technologies and standards in data transmission, telecommunication networks, network architectures, networking hardware, wireless networks, and the basis of the Internet including UDP and TCP as well as a number of application protocols. Note(s): This course is crosslisted with CS 465. Credit at the 600-level requires additional work. Prerequisite(s): CS 370

CS 666 - Computer Networks II **Credits 3**
Explores advanced topics in computer networks, the protocols, algorithms, hardware, and performance issues, especially in TCP/IP networks. Details of IP routing algorithms, quality of service, protocol implementation issues, router architecture and types, various TCP versions and their performance, the related telecommunication networks, and wireless technologies are discussed. Note(s): This course is crosslisted with CS 466. Credit at the 600-level requires additional work. Prerequisite(s): CS 665 or CS 465

CS 669 - Introduction to Digital Image Processing **Credits 3**
Background and basics of digital image processing. Topics include: the human visual system, image representation, sampling, image mathematics, and geometry, image enhancement, smoothing and sharpening, the fast Fourier transform, and a survey of image restoration methods. Note(s): This course is crosslisted with CS 469. Credit at the 600-level requires additional work. Prerequisite(s): MATH 365 and STAT 411 and CS 117 or CS 135

CS 670 - Networks and Distributed Systems **Credits 3**
Explores protocols and experiments with creating and implementing new protocols. In addition, students will be introduced to concepts such as deadlocks in networks/distributed applications, communication in distributed systems (among other RPC/RMI and the client server model in more detail), synchronization, reliability, transparency, and atomicity/transaction semantics. Note(s): This course is crosslisted with CS 470. Credit at the 600-level requires additional work.

CS 671 - Program Derivation **Credits 3**
Introduction to the formal derivation of computer programs from program specifications. Review of the logical and notational prerequisites needed for formal derivation. Guarded commands and the predicate transformer WP. Developing loops from invariants. Program development via sequence of refinements. Note(s): This course is crosslisted with CS 471. Credit at the 600-level requires additional work.

CS 672 - Software Product Design and Development I **Credits 3**
Current techniques in software design presented with emphasis on architecture first development. Introduction to the processes involved in development. Practice architectural design through a series of homework problems. Students work in teams to prepare the architecture for a software product. Note(s): This course is crosslisted with CS 672. Credit at the 600-level requires additional work. Prerequisite(s): CS 326 and CS 370

CS 673 - Software Product Design II **Credits 3**
Synthesis (term project) course to involve students, working in teams, in all of the activities necessary to define, model, implement, test, document, and deliver a program product. Students practice Object-Oriented and Component Based development and utilize UML and CASE tools to model the product and document the process. Note(s): This course is crosslisted with CS 473. Credit at the 600-level requires additional work. Prerequisite(s): CS 672 or CS 472

CS 674 - Decision Environments for Software Product Development **Credits 3**
Term project course to involve students, working in teams, with all of the activities and tools necessary to measure progress and monitor the development of a software product. Students utilize CASE tools for planning, for requirements management, for configuration management, for change management, and for product and process measurement for a product development project. Note(s): This course is crosslisted with CS 474. Credit at the 600-level requires additional work. Prerequisite(s): CS 672 or CS 472

CS 677 - Analysis of Algorithms **Credits 3**
Analysis of the time and space complexity of algorithms. Techniques for efficient algorithm design and effect of structure choice on efficiency. Fast algorithms for problems such as set, graph and matrix manipulations, pattern matching, sorting, and storage organization. Exponential time problems and introduction to NP-completeness. Note(s): This course is crosslisted with CS 477. Credit at the 600-level requires additional work. Prerequisite(s): CS 302 and MATH 351

CS 680 - Computer Graphics **Credits 3**
Graphics hardware, software and applications. Data structures for graphics, graphics languages, computer-aided design, and three-dimensional graphics. Note(s): This course is crosslisted with CS 480. Credit at the 600-level requires additional work. Prerequisite(s): CS 302 and MATH 365

CS 682 - Artificial Intelligence **Credits 3**
Survey of current artificial intelligence technologies: game playing, theorem-proving, natural language processing, pattern recognition, and heuristic programming. Note(s): This course is cross listed with CS 482. Credit at the 600 level requires additional work. Prerequisite(s): CS 302 and PHIL 422

CS 689 - Advanced Computer Science Topics **Credits 3**
Undergraduate-level course in advanced topics of computer science, depending upon the interest of faculty and students. Note(s): This course is crosslisted with CS 489. Credit at the 600-level requires additional work.

CS 690 - Independent Study **Credits 1-3**
Library research and reports on topics of computer science interest. May be repeated for credit with the consent of the Department of Computer Science Note(s): This course is crosslisted with CS 490. Credit at the 600-level requires additional work.

CS 715 - Advanced Analysis of Algorithms **Credits 3**
Analysis of the complexity and correctness of asymptotically efficient algorithms, including set partitioning, matrix multiplication, integer multiplication and pattern matching algorithms. The theory of NP-completeness; Cook's theorem and polynomial transformations. Basic NP-complete problems, such as the three-satisfactory, three dimensional matching and Hamiltonian circuit problems. PSPACE-completeness results, such as quantified Boolean formulas. Prerequisite(s): CS 656 and CS 677

CS 717 - Advanced Computer Simulation **Credits 3**
Advanced discrete simulation modeling using SIMSCRIPT 11.5 and SLAM. Advanced continuous simulation using ACSL. Modeling concepts, measuring random phenomena. Passive objects, application of simulation to operating systems and software design in general. Digital- analog solution of linear differential equations, industrial dynamics. Feedback systems. Prerequisite(s): CS 617

CS 718 - Theory of Computation **Credits 3**
Computability of functions and sets in terms of Turing machines and other computational models. Universal Turing machines and examples of unsolvable problems. Introduction to other computational models, such as the lambda-calculus, Post systems, Markov algorithms and recursive function theory. The Church-Turing thesis and proofs of equivalence between the models. Prerequisite(s): CS 656

CS 719 - Advanced Automata and Formal Languages **Credits 3**
Extensive study of context-sensitive, recursive and recursively enumerable languages, including ambiguity and closure properties: decidable and undecidable properties of the different language classes: the halting problem and Post's correspondence problem; properties of the deterministic context-free languages; LR(k) and LL(k) grammars. Prerequisite(s): CS 656

CS 733 - Geographic Data Base Systems **Credits 3**
Spatial data types and operators: point queries, range queries, translation, rotation, and scaling. Data structures for object representation: arc tree, quadtrees. Commercial data bases vs. spatial data bases: relational, hierarchical, network. Note(s): (May not be used to satisfy degree requirements in Computer Science.) Prerequisite(s): CS 135 or CS 117 or equivalent and STAT 611

CS 740 - Statistical Pattern Recognition **Credits 3**
Concepts and formal theoretical structures necessary for design and implementation of a pattern recognition system. Topics include: parametric and non-parametric methods, linear and non-linear classifiers and clustering algorithms. Prerequisite(s): STA 667, MATH 253 or 265, and CS 302

CS 741 - Structural Pattern Recognition **Credits 3**
Survey of advanced pattern recognition techniques. Topics include: graph matching methods, syntactic approaches, neural nets, and context-dependent methods. Prerequisite(s): CS 656 and CS 677

CS 742 - Document Image Understanding **Credits 3**
Survey of document understanding methods and related topics that include: data compression, document exchange standards, layout analysis methods, logical analysis methods, OCR, error correction, and document routing. Prerequisite(s): CS 740 and CS 669

CS 747 - Cryptography and Information Theory **Credits 3**
Cryptography, cryptographic systems, encryption algorithms, cryptographic techniques, access control, lattice model of information flow, flow control mechanisms, inference control mechanisms, mechanisms restricting noise, mechanisms restricting statistics, statistical database models. Prerequisite(s): CS 370, STAT 411

CS 750 - Computational Algorithms in VLSI **Credits 3**
Application and inherent limitations of using VLSI to implement computational algorithms, design and analysis of algorithms for design of VLSI circuits, introduction to VLSI implementation of computational algorithms represented by logic circuits, lower bounds on area and time, systolic arrays and their applications, VLSI layout algorithms, VLSI test generation and simulation. Prerequisite(s): CS 677

CS 754 - Discrete Optimization **Credits 3**
Network optimization problems, use of advanced data structures. Topics may vary and include maximum-flow algorithms, multiterminal maximum flows, minimum cost flows and circulations, matching algorithms, approximation algorithms, and applications. Hamiltonian circuits in dense graphs, disjoint paths, the postman problem, introduction to combinatorial geometry, and linear programming. Prerequisite(s): CS 677

CS 756 - Formal Semantics **Credits 3**
Coverage of formal methods for defining the semantics of programming languages, including the operational, denotation and axiomatic approaches. Proof techniques for verifying properties of programs. Consistent and complementary definitions for a Pascal-like language discussed. Prerequisite(s): CS 326 and CS 656

CS 758 - Computational Geometry **Credits 3**
Geometric searching, point location, range searching, convex hull, Graham's scan, gift wrapping, dynamic convex hull, proximity closest pair, Voronoi diagram, triangulation. Intersection, visibility shortest paths, geometry of rectangles. Prerequisite(s): CS 677

CS 763 - Advanced Computer Architecture **Credits 3**
Advanced study of various current computer architectures. Examples taken from specialized architectures that support modern general-purpose programming, operating systems, artificial intelligence and data bases. SIMD and MIMD parallel architectures. Prerequisite(s): CS 326 and CS 663

CS 767 - Advanced Computer Graphics **Credits 3**
Hidden line elimination algorithms and implementation. Perfect interpolators, cubic and bicubic splines, Kriging, Hermite surfaces, nonperfect interpolators, Bezier curves and surfaces, B-splines, ray tracing algorithms, shading, lightness, motion, moving pictures, two- and three- dimensional fractals. Special topics. Prerequisite(s): CS 680

CS 768 - Surface Estimation for Computer-Aided Geometric Design **Credits 3**
Affine maps, function spaces, the DeCasteljan algorithm, Bernstein polynomials, Bezier surfaces, nonparametric curves, Lagrange polynomials, C continuity, B-spline basis, Frenet frame, G continuity, gamma splines, beta splines, geometric continuity, tensor product interpolants, volume deformations, curvatures. Prerequisite(s): CS 767

CS 769 - Advanced Data Base Management **Credits 3**
Continuation of CS 632, including normalization of relational data bases using functional and multivalued dependencies. Query processing, query interpretation, query optimization, and methods for implementing and optimizing logic queries. Knowledge data bases, distributed data bases and object-oriented data bases. Prerequisite(s): CS 657

CS 770 - Advanced Operating Systems **Credits 3**
Study of the design principles, organization, and performance analysis of large-scale computer operating systems. Particular subjects emphasized include coordination of tasks, solutions of deadlock problems, theories of segmentation and paging, and performance prediction. Prerequisite(s): CS 370

CS 771 - Concurrent Computation **Credits 3**
Study of concurrent programming methods and applications; event spaces; models of concurrency, such as Petri nets, CCS and CSP. Synchronization, data sharing and communication. Concurrency constructs in various programming languages. Scheduling and implementation techniques. Applications of concurrency in operating system design, fault-tolerance, and reliability. Prerequisite(s): CS 326 and CS 370.

CS 772 - Software Architecture **Credits 3**
Survey of advanced techniques for specifying and designing large software systems. System verification. Reliability and project management. Prerequisite(s): CS 370, CS 672, and CS 660, or consent of instructor.

CS 777 - Parallel Algorithms **Credits 3**
Methods for creating and analyzing parallel algorithms. Parallel programming languages and programming models of shared-memory and distributed architectures. Measuring complexity of parallel algorithms. NC-class versus P-class algorithms. Prerequisite(s): CS 677

CS 778 - Advanced Translation **Credits 3**
Formal semantics, automatic compiler generation, attribute grammars. Language issues as they relate to compiler generation. Prerequisite(s): CS 660

CS 779 - Supercompliers for Parallel and Vector Computers **Credits 3**
Dependence analysis, Diophantine equations, the GCD test, the Banerjee test, do-loop normalization, concurrency in loops, vector code generation, control dependence and vectorization, parallel code generation for doall-loops, parallel code generation for doacross-loops, shared memory parallelization, parallelization for distributed memory architectures. Prerequisite(s): CS 778

CS 780 - Distributed Computing and Algorithms **Credits 3**
Methods and algorithms of distributed computing. Topics may include architecture and design goals, formal approaches to distributed computing problems, networks and protocols, models of distributed computing, synchronization and communication, synchronous and asynchronous systems, fault-tolerance and reliability, self-stabilization, distributed algorithms and applications. Prerequisite(s): CS 370, CS 677

CS 781 - Automated Deduction **Credits 3**
Use of computers for forming deductions and proving theorems in symbolic logic covered. Topics include resolution, unification, proof strategies, and equality. Also examines areas of application: problem solving, question answering, program verification, automatic programming and logic programming (Prolog). Prerequisite(s): CS 682

CS 782 - Expert System Construction **Credits 3**
Design, organization, and construction of expert systems. Includes general concepts, characteristics, elements, advantages, and examples of expert systems. Also rule-based knowledge representations, inference techniques, implementation tools and shells, and advanced topics. Prerequisite(s): CS 682

CS 783 - Genetic Algorithms and Neural Networks **Credits 3**
A study of the utility of adaptive methods and their limitations across optimization problems spanning areas of engineering. Topics include genetic algorithms and genetic programming, simulated annealing, tabu search, neural networks, artificial life. Use of software tools for implementations.

CS 785 - Computational Linguistics **Credits 3**
Introduction to linguistics and computational linguistics, for natural language. Phonology, morphology, syntax, semantics, and lexicology. Text analysis and processing; construction of lexicons, and indexes and concordances. Introduction to text retrieval, translation, speech understanding and generation. Prerequisite(s): CS 656

CS 786 - Advanced Computational Linguistics **Credits 3**
Advanced study of computational linguistics. Emphasis on cognitive methods in natural language understanding and generation. Pragmatics and discourse. Prerequisite(s): CS 785

CS 788 - Computational Environmetrics **Credits 3**
Applications of sensor networks and pattern recognition to environmental problems. Geometric pattern recognition: metrics for comparing 2-d shapes, signature functions, turning functions. Geometric algorithms in sensor networks. Position based routing, face routing, broadcasting and multi-casting. Interference aware sensor networks. Data gathering and target recognition. Prototype implementation. Prerequisite(s): Consent of instructor.

CS 789 - Topics in Advanced Computer Science **Credits 3 - 24**
Graduate-level course in some field of computer science, at advanced level, depending upon the current interest of the staff and the students. Note(s): May be repeated with a different subject matter to a maximum of twenty four credits. Prerequisite(s): Consent of instructor.

CS 790 - Master's Project **Credits 1 – 3**
Research, analysis, and development work towards completion of an approved project. Note(s): May be repeated, but only three credits will be applied to the student's program. Grading: S/F grading only. Prerequisite(s): Consent of instructor.

CS 791 - Thesis **Credits 3 – 6**
Research, analysis, and development work towards completion of an approved project. Note(s): May be repeated, but only six credits will be applied to the student's program. Grading: S/F grading only. Prerequisite(s): Consent of instructor.

CS 792 - Research Seminar **Credits 1**
Oral presentation of assigned articles. Note(s): May be repeated to a maximum of four credits. Prerequisite(s): Consent of instructor.

CS 795 - Directed Research **Credits 3**
Supervised research in the doctoral program. May be repeated for a maximum of twelve credits. Prerequisite(s): Department consent.

CS 798 - Dissertation Proposal **Credits 3**
Development of a prospectus. Note(s): May be repeated to a maximum of 6 credits. Prerequisite(s): Department consent.

CS 799 - Dissertation Research **Credits 1 – 6**
Research analysis and writing towards completion of dissertation and subsequent defense. Note(s): May be repeated but no more than 18 credits will be allowed in the degree. Grading: S/F grading only. Prerequisite(s): Department consent.

ITE 651 - Managing Big Data and Web Databases Credits 3
This course will teach the concepts and techniques of databases for real-time web and big data applications. The course will focus primarily on NoSQL, object oriented, and XML databases. Topics include characteristics and significance of NoSQL databases, NoSQL data formats, key and value pairs, basic schema in NoSQL, and table structures and data types. *Same as* Crosslisted with ITE 451 Note(s): Not repeatable beyond 3 credits.Grading: Letter

INF 730 - Human Computer Interaction Credits 3
Covers the fundamental concepts and techniques for design, implementation, and evaluation of human computer interfaces. Topics include Foundations of Human computer interaction, design and implementation techniques for graphical user interfaces, evaluation techniques, and different interface models. Prerequisite(s): Consent of instructor.

INF 731 - Advanced HCI - Design and Implementation Credits 3
This course is organized around readings that reinforce the student's knowledge in Human Computer Interaction guidelines, principles, and theories and mainly around projects that allow students to apply theoretical knowledge to the design, implementation, and evaluation of interactive computer systems. Prerequisite(s): INF 730

INF 732 - Affectively Intelligent Systems Credits 3
Focuses on computational emotion modeling which spawns from a variety of interest: improving basic understanding of the functional role of emotions in humans; integrating emotion recognition and prediction techniques; synthesizing emotion and expression of emotion to apply to synthetic characters, autonomous software agents or robots; understanding social implications of affective information and communication technology. Prerequisite(s): INF 700

INF 740 - Digital Media Design, Technology and Representation Credits 3
Covers principles of design to visualize new media concepts in any medium. Exposes students to new and emerging digital media technologies and applications. Prerequisite(s): Consent of instructor.

INF 760 - Advanced Theoretical Foundations of Informatics Credits 3
Advanced course to cover mathematical methods for information modeling, analysis, and manipulation. Requires various research article reading and discussions. Topics include proof techniques, first-order logic, computability theory, complexity theory, model theory, and statistics. Prerequisite(s): INF 700

INF 770 - Social Foundations of Informatics Credits 3
Covers the relationships between social systems and information and communication technologies. Focuses on social factors that influence the organization of information technologies in social and organizational systems, and how the human social factors and technological tools mutually contribute to the field of Informatics. Prerequisite: Consent of instructor.

INF 780 - Special Topics in Informatics Credits 3
Emphasis is on new developments and research in science, humanities, fine arts, and other domain informatics. Prerequisite(s): INF 700

INF 790 - Informatics Project Credits 3
Advanced project in informatics. Note(s): May be repeated for different project topics, but only three credits will be applied to the student's program. Prerequisite(s): INF 700 and consent of instructor.

INF 792 - Internship Credits 3
Supervised internship in business, industry, government, or educational institution providing practical experience to use skills and knowledge acquired in informatics and cognate course work. Prerequisite(s): INF 700 and consent of instructor.

INF 794 - Research Methods Credits 3
Examination of research methods including: the scientific method, sampling, statistics, research design, analytical technique, literature review, technical writing, professional ethics, faculty research areas and potential topics for thesis. Prerequisite(s): INF 700

INF 795 - Independent Study in Informatics Credits 1-6
Supervised independent work in a topic of Informatics. Note(s): May be repeated but no more than 6 credits will be allowed in the degree. Grading: S/F grading only Prerequisite(s): INF 700 and Instructor consent

INF 797 - Master's Thesis Credits 1-6
Research analysis and writing towards completion of Master's thesis and subsequent defense. Note(s): May be repeated but no more than 6 credits will be allowed in the degree. Grading: S/F grading only Prerequisite(s): INF 700 and Instructor consent

INF 799 - Dissertation Research Credits 1 – 6
Research analysis and writing towards completion of dissertation and subsequent defense. Note(s): May be repeated but no more than eighteen credits will be allowed in the degree. Prerequisite(s): Passing the written comprehensive examination.

Electrical & Computer Engineering

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.

Yingtao Jiang, Ph.D., Chair
Robert Schill, Ph.D., Graduate Coordinator

Electrical and Computer Engineering Faculty

Chair

Jiang, Yingtao - Full Graduate Faculty Professor; B.E., Chongqing University; M.S.E.C.E., Concordia University, Montreal; Ph.D., University of Texas at Dallas. Rebel since 2001.

Graduate Coordinator

Schill Jr., Robert A. - Full Graduate Faculty Professor; B.S.E.E., Milwaukee School of Engineering; M.S.E.E., Ph.D., University of Wisconsin-Madison. Rebel since 1993.

Graduate Faculty

Baker, R. Jacob - Full Graduate Faculty Professor, B.S., M.S. University of Nevada Las Vegas, Ph.D. University of Nevada Reno. Rebel since 2012. Research Interests: Integrated circuit design

Baghzouz, Yahia - Full Graduate Faculty Professor; B.S., M.S., Ph.D., Louisiana State University. Rebel since 1987. Research Interests: Power system harmonics/power quality; computer-aided analysis of electric power systems; solar photovoltaic systems; renewable energy integration with the utility grid.

Das, Biswajit - Full Graduate Faculty Professor; B.S.E.E., Indian Institute of Technology, Kharagpur; M.S.E.E., Southern Illinois University, Ph.D., Purdue University. Rebel since 2003. Research Interests: Nanotechnology, Nanoscale device fabrication and characterization, Biomedical applications of nanotechnology, Sensors and sensor networks, RF Circuit Design.

Harris, Sarah - Full Graduate Faculty Associate Professor; B.S., Brigham Young University; M.S., Ph.D. Stanford University Rebel since 2014. Research Interests: Digital design, computer architecture, embedded systems, informatics.

Jiang, Yingtao - Full Graduate Faculty Professor; B.E., Chongqing University; M.S.E.C.E., Concordia University, Montreal; Ph.D., University of Texas at Dallas. Rebel since 2001. Research Interests: Algorithms, VLSI architectures, and circuit level techniques for the design of DSP, networking and telecommunications systems; computer architectures; computer aided designs; biomedical signal processing, instrumentation, and medical informatics; BioMEMS/ BioNEMS; wireless communications and security.

Kachroo, Pushkin - Full Graduate Faculty Professor; B. Tech (Civil Eng), Indian Institute of Technology; MSME, Rice University; Ph.D. University of California at Berkeley, Ph.D. Virginia Polytechnic Institute. Rebel since 2008. Research Interests: Nonlinear and hybrid control systems, intelligent transportation systems, mechatronics, robotics, distributed parameter systems, differential geometric methods, feedback control in e-marketing, and education and learning, bio-dynamics and control, nano-bio transport control and robotics.

Latifi, Shahram - Full Graduate Faculty Professor; B.S., M.S., Teheran University; M.S., Ph.D., Louisiana State University. Rebel since 1989. Research Interests: Computer networks, parallel processing, fault-tolerant computing, data compression.

Morris, Brendan - Full Graduate Faculty Associate Professor; B.S., University of California, Berkeley; Ph.D., University of California, San Diego. Rebel since 2001. Research Interests: Intelligent systems, computer vision, pattern recognition, machine learning, intelligent transportation systems, and intelligent vehicles.

Muthukumar, Venkatesan - Full Graduate Faculty Associate Professor; B.S.E.E., Anna University India; M.S.E.E., Ph.D., Monash University, Australia. Rebel since 2001. Research Interests: Embedded systems, high performance computation on FPGAs, network and system on chips, milti-core and microprocessor systems.

Regentova, Emma - Full Graduate Faculty Professor; M.S.C.E., Ph.D., State Engineering University of Armenia. Rebel since 2001. Research Interests: Classical and applied image processing, image analysis, coding and compression, pattern recognition. Advanced Computer Architectures. Computer Networks.

Saberinia, Ebrahim - Full Graduate Faculty Associate Professor; B.S.E.E., M.S.E.E., Sharif University of Technology; Ph.D., University of Minnesota. Rebel since 2004. Research Interests: Communications; Wireless communication systems and networks; Wireless local, personal and sensor area networks.

Schill, Robert A. - Full Graduate Faculty Professor; B.S.E.E., Milwaukee School of Engineering; M.S.E.E., Ph.D., University of Wisconsin-Madison. Rebel since 1993. Research Interests: Charged particle beams; microwave theory; fiber, traditional and modern optics; plasma physics; electromagnetic fields and material interactions; linear and nonlinear waves; pulsed power; biomedical and environmental applications of electromagnetics and pulse power.

Selvaraj, Henry - Full Graduate Faculty Professor; M.S., Ph.D., Warsaw University of Technology. Rebel since 1994. Research Interests: Digital circuit design; programmable logic devices; logic synthesis; application of logic synthesis techniques in machine learning; data compression and data mining, functional decomposition; PLAs; and FPGAs; multiple valued functions and applications; artificial intelligence and multimedia; microprocessor architecture; and DSP.

Singh, Sahjendra N. - Full Graduate Faculty Professor; B.S., Patna University; M.E., Indian Institute of Science; Ph.D., The Johns Hopkins University. Rebel since 1986. Research Interests: Systems and Control Theory. Robotics. Applications to Aerospace Stability and Control. Fluid Flow Control.

Stubberud, Peter - Full Graduate Faculty Professor; B.S., M.S., Ph.D., University of California, Los Angeles. Rebel since 1991. Research Interests: Digital Signal Processing, multidimensional digital signal processing, adaptive signal processing, neural networks, mixed signal VLSI design, data converters.

Sun, Ke-Xun - Full Graduate Faculty Professor; B.S., Peking (Beijing) University; M.S., Nagoya University; Ph.D., Massachusetts Institute of Technology. Rebel since 2012. Research Interests: Security science and engineering, radiation hard III-V semiconductor and devices, micro and nano technology, radiation detection and measurement, ultrafast electronics, optics and nonlinear optical devices, HEDP diagnostics systems, space flight and payload instruments, scientific computing, and image analysis.

Venkat, Rama - Full Graduate Faculty Professor; B.Tech., Indian Institute of Technology; M.S., Ph.D., Purdue University. Rebel since 1989. Research Interests: Electronic Materials and Devices, Device Physics and Modeling and Process Physics and Modeling.

Yang, Mei - Full Graduate Faculty Professor; B.E.C.E., M.E.C.E., University of Electronic Science and Technology of China; Ph.D., University of Texas at Dallas. Rebel since 2004. Research Interests: Computer architectures, computer networks, wireless sensor networks, and embedded systems.

Professors Emeriti

Brogan, William L. Emeritus Professor; B.S.M.E., State University of Iowa; M.S., Ph.D., University of California, Los Angeles. UNLV Emeritus 1990-1998.

McGaugh, Eugene E. Emeritus Professor; B.S., University of Kansas; M.S., University of Missouri; Ph.D., University of Kansas. UNLV Emeritus 1989-2010.

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

Plan Admission Requirements

Application deadlines available on the UNLV Graduate College website.

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. 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 his/her 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). 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 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.
5. Before international applicants can be considered for admission, the Graduate College requires that all international applicants take the Test of English as a Foreign Language (TOEFL) and obtain a minimum score of 550 or 85 on the Michigan Test. Students whose first language is not English may be required to take and pass the English as a Second Language Placement Test upon arrival at UNLV. If necessary, they will be required to take English as a Second Language (ESL) courses at UNLV.
6. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.
7. 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 Track

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 Track:

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 Track:

The Integrated BS-PHD Track 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 Track. 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).

The GRE entrance requirement will be waived for students entering the Ph.D. program if ALL of the following are satisfied:

1. The candidate receives a MS degree in Electrical and Computer Engineering (ECE) at UNLV.
2. The candidate's BS GPA equals or exceeds 3.0.
3. The candidate's MS GPA equals or exceeds 3.6.
4. The candidate shows evidence that a paper pertaining to his/her research has been published in a refereed conference (minimum requirement). A published article in a refereed journal exceeds this minimum requirement. In all cases, the candidate must be the first author of the publication. Galley proofs along with a letter of acceptance may be used as minimum evidence that a paper will be published.
5. The candidate is not seeking a teaching assistantship.
6. One strong letter of recommendation from the major professor indicating the student's ability for 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 Requirements: Post-Master's Track
Total Credits Required: 45
Course Requirements
Major Field Courses – Credits: 6-15

Complete 6-15 credits of coursework in an approved major in a single area in Electrical and Computer Engineering with a minimum overall average GPA of 3.33.

Communications

ECG 662 - Advanced Digital Communications

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 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

Control Systems Theory

ECG 672 - Digital Control Systems

ECG 770 - Linear Systems Theory

ECG 771 - Optimal and Modern Controls

ECG 772 - Nonlinear Systems I

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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

ECG 750 - Optical Electronics I

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 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 - Advanced Digital Communications

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 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 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

Control Systems Theory
ECG 770 - Linear Systems Theory

ECG 771 - Optimal and Modern Controls

ECG 772 - Nonlinear Systems I

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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

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- will 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 program 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 will 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 Track
Total Credits Required: 69
Course Requirements
Major Field Courses – Credits: 15
Complete 15 credits of coursework in an approved major in a single area in Electrical and Computer Engineering with a minimum overall GPA of 3.33. A minimum of 9 credits must be in 700-level courses.

Communications
ECG 662 - Advanced Digital Communications

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 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

Control Systems Theory
ECG 672 - Digital Control Systems

ECG 770 - Linear Systems Theory

ECG 771 - Optimal and Modern Controls

ECG 772 - Nonlinear Systems I

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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

ECG 750 - Optical Electronics I

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 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 - Advanced Digital Communications

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 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 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

Control Systems Theory
ECG 770 - Linear Systems Theory

ECG 771 - Optimal and Modern Controls

ECG 772 - Nonlinear Systems I

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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

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 Track 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- will 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 program 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 will 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 Track

Total Credits Required: 60-66

Course Requirements

Major Field Courses – Credits: 6-15

Complete 6-15 credits of coursework in an approved major in a single area in Electrical and Computer Engineering with a minimum overall GPA of 3.33.

Communications

ECG 662 - Advanced Digital Communications

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 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

Control Systems Theory
ECG 672 - Digital Control Systems

ECG 770 - Linear Systems Theory

ECG 771 - Optimal and Modern Controls

ECG 772 - Nonlinear Systems I

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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

ECG 750 - Optical Electronics I

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 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 - Advanced Digital Communications

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 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 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

Control Systems Theory
ECG 770 - Linear Systems Theory

ECG 771 - Optimal and Modern Controls

ECG 772 - Nonlinear Systems I

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

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ECG 680 - Discrete-Time Signal Processing

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ECG 762 - Detection and Estimation of Signals in Noise

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ECG 782 - Multidimensional Digital Signal Processing

ECG 783 - Adaptive Signal Processing with Neural Networks

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ECG 651 - Electronic and Magnetic Materials and Devices

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ECG 653 - Introduction to Nanotechnology

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- 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.
11. All regular status graduate students must file an approved program 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 will 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.
3. 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.
4. 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.
   a. 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.
   b. 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.
   c. The Qualifying Exam is a four and one-half hour exam covering questions in the following undergraduate electrical and computer engineering fields:
      i. Communications
      ii. Control System Theory
      iii. Electromagnetics and Optics
      iv. Electronics
      v. Power
      vi. Signal Processing
      vii. Solid State
      viii. Digital Logic Design
      ix. Computer Architectures and Organization
      x. Digital Electronics and VLSI Design
      xi. Computer Communication Networks
   d. 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.

e. 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.

5. In all Post-Bachelor's Tracks, 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 Materials and Devices as major fields. Specific courses that can be applied to specific fields are listed in detail in the Electrical Engineering Graduate Program Document.
   a. 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).
   b. 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.
6. After passing the Qualifying Exam, successfully completing all courses for a major field, and successfully completing all courses for the ECE minor field, students are eligible to take the Comprehensive Exam. All students must have passed the Comprehensive Exam within two semesters after successfully completing all required course work except for the 18 credits Dissertation. [NOTE: Up to 6 credits of Dissertation taken prior to the successful completion of the Preliminary Exam may count towards the degree program.] The Comprehensive Exam cannot be taken more than once per semester and cannot be taken more than twice.
   a. The Comprehensive Exam tests the candidate's depth of knowledge in the candidate's chosen ECE major field and chosen ECE minor (primary minor) field. All students must have passed the Comprehensive Exam within two semesters after successfully completing all required course work (except for the 18 credits of Dissertation). The Comprehensive Exam is offered once every fall semester and once every spring semester. The Comprehensive Exam cannot be taken more than twice. Candidates who have not passed the Comprehensive Exam within this time frame (two consecutive sittings) will be terminated from the Ph.D. program. Candidates who have not passed the Comprehensive Exam following their second attempt will be terminated from the Ph.D. program.
   b. Before a student is eligible to register for the Comprehensive Exam, the candidate must have obtained regular (full graduate standing) admission status, passed the Qualifying Exam, and must have successfully completed all of the course requirements for the ECE major field and the ECE minor (primary minor) field. The student must have acquired a minimum GPA of 3.33 in both the major and minor fields separately. If the minor field GPA is less than 3.33 and/or the major field GPA is less than 3.33, then the minor and/or minor field requirement has not been successfully completed. The candidate will not be allowed to take the Comprehensive Exam until both the major and minor 3.33 GPA requirements are fulfilled. Further, the student must have a minimum overall GPA of 3.2 and must have satisfied all other Ph.D. degree program admission requirements. If a student takes the Comprehensive Exam before any one of these requirements has been satisfied, the student will automatically receive a FAIL grade for the exam. At their discretion, the Graduate Committee may also count this failing grade as one of the student's attempts for the Comprehensive Exam. To register for the Comprehensive Exam, eligible students must notify the graduate coordinator no later than one month prior to the examination date.
   c. To pass the Comprehensive Exam, a student must pass a five-hour exam covering courses in his/her ECE major field and ECE minor (primary minor) field. A pass or fail grade will be given for the exam. The graduate committee will notify students of the results of the exam. The major and minor area exam will emphasize graduate coursework taken in the ECE major and ECE minor (primary minor; minor 1) fields. The exam will evaluate the student's ability to apply his/her theoretical and analytical abilities to problems in his/her ECE major and ECE minor (primary minor) field. However, the exam may require knowledge of undergraduate material related to the student's major and minor fields. Students should expect problems that require advanced thinking. Specific problems need not be familiar textbook problems nor may the student be necessarily familiar with the problem. A pass or fail grade will be given for the exam. The graduate committee will notify students of the exam results.

d. For more details on course specifics, exam logistics, appeal rights and procedure, and protocols regarding the comprehensive exam, refer to the ECE department's Electrical Engineering Graduate Program Document.

7. After successfully completing all required course work and passing the Comprehensive Exam, the candidate must pass the Preliminary Exam. The Preliminary Exam cannot be taken more than once per semester but may be repeated until passed.
   a. 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.
   b. To be eligible for the Preliminary Exam, a student must have passed the Comprehensive Exam, and have successfully completed all required course work except for the 18 credits of Dissertation.
   c. Before the Preliminary Exam, a student must prepare a 10 to 20-page prospectus of his/her 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.
   d. 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.
   e. During the Preliminary Exam, the student presents his/her prospectus to his 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.
8. 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 his/her dissertation. The Final Exam is the culminating experience of the PhD program.
   a. 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 his/her advisory committee of the date, time, and location of his/her Final Exam at least two weeks prior to the Final Exam. During the Final Exam, the Ph.D. candidate will present his/her 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.
9. 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.
10. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
11. The student must submit and successfully defend his/her dissertation by the posted deadline. The defense must be advertised and is open to the public.
12. Student must submit his/her approved, properly formatted hard-copy dissertation to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Dual Degree: Doctor of Philosophy - Electrical Engineering & Master of Science - Mathematical Sciences

Plan Description
The dual Ph.D. EE and M.S. MAT program of study is designed for those who want to pursue a Ph.D. degree in Electrical Engineering or a career in Electrical Engineering with emphasis in applied mathematics. The program prepares graduate students with complementing educational components covering electrical engineering and mathematics, which is the basis of all engineering.

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.

For more information about your program, including your graduate program handbook and learning outcomes, please visit the Degree Directory.

Learning outcomes for each degree can be found below:
- Doctor of Philosophy - Electrical Engineering
- Master of Science - Mathematical Sciences

Plan Admission Requirements
Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

Applicants are considered on an individual basis. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

Applicants must satisfy the minimum requirements of the Ph.D. – Electrical Engineering program, and the M.S. – Mathematics program. If denied by one program, the applicant will have the option of proceeding with a single degree program with departmental approval.

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 Requirements: Post-Master's Track
Total Credits Required: 69-72
Course Requirements
Total Credits Required for the Mathematical Sciences M.S.: 30-33
Required Courses – Credits: 6
Complete two of the following courses:

MAT 707 - Real Analysis I

MAT 709 - Complex Function Theory I

MAT 765 - Advanced Numerical Analysis

Elective Courses – Credits: 21-24
Students completing the exam option must complete a minimum of 24 credits of MAT or STA elective courses (excluding MAT 711 & 712), and students completing the thesis option must complete a minimum of 21 credits of MAT or STA elective courses (excluding MAT 711 & 712). Other graduate-level courses may be taken with advisor-approval.

Thesis – Credits: 6 (Optional)
Complete 6 credits from one of the following courses:

MAT 791 - Thesis

STA 791 - Thesis

Total Credits Required for the Electrical Engineering Ph.D.: 45

Major Field Courses – Credits: 6-15
Complete 6-15 credits of coursework in an approved major in a single area in Electrical and Computer Engineering with a minimum overall average GPA of 3.33.

Communications
ECG 662 - Advanced Digital Communications

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 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

Control Systems Theory
ECG 672 - Digital Control Systems

ECG 770 - Linear Systems Theory

ECG 771 - Optimal and Modern Controls

ECG 772 - Nonlinear Systems I

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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

ECG 750 - Optical Electronics I

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 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 - Advanced Digital Communications

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 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 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

Control Systems Theory
ECG 770 - Linear Systems Theory

ECG 771 - Optimal and Modern Controls

ECG 772 - Nonlinear Systems I

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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

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: 0-12
Complete 0-12 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

Total Credits Shared: 6
Two courses can be double counted between Electrical Engineering Ph.D. and Mathematical Sciences M.S. degrees. Non-ECG courses must be applied towards non-ECG elective credits in the electrical engineering degree program pursued.

Degree Requirements
1. A minimum 69 or 72 credits (including thesis and dissertation credits) is required for the Dual Electrical Engineering Ph.D. and Mathematical Sciences M.S. which corresponds to the choice of completing a Mathematics comprehensive exam or thesis.
2. Two of the courses included in the degree program can be double counted in the Electrical Engineering Ph.D. and Mathematical Sciences M.S. degrees. Non-ECG courses must be applied towards non-ECG elective credits in the electrical engineering degree program pursued.

Mathematical Sciences M.S
1. Students completing a thesis must complete a minimum of 33 credit hours with a minimum GPA of 3.00.
2. Students completing the comprehensive exam must complete a minimum of 30 credit hours with a minimum GPA of 3.00.
3. For the master's degree 21 credits of mathematics course work must be at the 700-level (excluding thesis).
4. A student will be placed on academic probation if a minimum of 3.00 GPA is not maintained in all work taken in the degree program. A grade of C or less in one graduate-level course will cause a student to be placed on academic probation and will elicit a critical review of the student's program by the Graduate Studies Committee.
5. The Graduate College requires a minimum of 50 percent of the total credits required to complete the graduate degree, exclusive of transferred credits and/or the thesis, must be earned at UNLV after admission to a graduate degree program.
6. Students must complete a final examination. This will be either an examination to defend the thesis or a written comprehensive examination based on requirements 1 and 2.
7. If the thesis option is chosen: In consultation with his/her advisor, a student will organize a dissertation 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.

Electrical Engineering Ph.D.

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- will 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 program 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 will 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 Track
Total Credits Required: 93-96
Course Requirements
Total Credits Required for the Mathematical Sciences M.S.: 30-33
Required Courses – Credits: 6
Complete two of the following courses:
MAT 707 - Real Analysis I

MAT 709 - Complex Function Theory I

MAT 765 - Advanced Numerical Analysis

Elective Courses – Credits: 21-24
Students completing the exam option must complete a minimum of 24 credits of MAT or STA elective courses (excluding MAT 711 & 712), and students completing the thesis option must complete a minimum of 21 credits of MAT or STA elective courses (excluding MAT 711 & 712). Other graduate-level courses may be taken with advisor-approval.

Thesis – Credits: 6 (Optional)
Complete 6 credits from one of the following courses:
MAT 791 - Thesis

STA 791 - Thesis

Total Credits Required for the Electrical Engineering Ph.D.: 69

Major Field Courses – Credits: 15
Complete 15 credits of coursework in an approved major in a single area in Electrical and Computer Engineering with a minimum overall GPA of 3.33. A minimum of 9 credits must be in 700-level courses.

Communications
ECG 662 - Advanced Digital Communications

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 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

Control Systems Theory
ECG 672 - Digital Control Systems

ECG 770 - Linear Systems Theory

ECG 771 - Optimal and Modern Controls

ECG 772 - Nonlinear Systems I

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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

ECG 750 - Optical Electronics I

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 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 - Advanced Digital Communications

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 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 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

Control Systems Theory
ECG 770 - Linear Systems Theory

ECG 771 - Optimal and Modern Controls

ECG 772 - Nonlinear Systems I

ECG 774 - Stochastic Control

ECG 776 - Adaptive Control

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ECG 731 - Theoretical Techniques in Electromagnetics

ECG 732 - Advanced Engineering Electromagnetics II

ECG 733 - Plasma I

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ECG 620 - Analog Integrated Circuit Design

ECG 621 - Digital Integrated Circuit Design

ECG 720 - Advanced Analog IC Design

ECG 721 - Memory Circuit Design

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ECG 743 - Smart Electrical Power Grid

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ECG 781 - Digital Filters

ECG 782 - Multidimensional Digital Signal Processing

ECG 783 - Adaptive Signal Processing with Neural Networks

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ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

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

Total Credits Shared: 6

Two courses can be double counted between Electrical Engineering Ph.D. and Mathematical Sciences M.S. degrees. Non-ECG courses must be applied towards non-ECG elective credits in the electrical engineering degree program pursued.

Degree Requirements
1. A minimum 93 or 96 credits (including thesis and dissertation credits) is required for the Dual Electrical Engineering Ph.D. and Mathematical Sciences M.S. which corresponds to the choice of completing a Mathematics comprehensive exam or thesis.
2. Two of the courses included in the degree program can be double counted Electrical Engineering M.S.E and Mathematical Sciences M.S. degrees. Non-ECG courses must be applied towards non-ECG elective credits in the electrical engineering degree program pursued.

Mathematical Sciences M.S

1. Students completing a thesis must complete a minimum of 33 credit hours with a minimum GPA of 3.00.
2. Students completing the comprehensive exam must complete a minimum of 30 credit hours with a minimum GPA of 3.00.
3. 21 credits of mathematics course work must be at the 700-level (excluding thesis).
4. A student will be placed on academic probation if a minimum of 3.00 GPA is not maintained in all work taken in the degree program. A grade of C or less in one graduate-level course will cause a student to be placed on academic probation and will elicit a critical review of the student's program by the Graduate Studies Committee.
5. The Graduate College requires a minimum of 50 percent of the total credits required to complete the graduate degree, exclusive of transferred credits and/or the thesis, must be earned at UNLV after admission to a graduate degree program.
6. Students must complete a final examination. This will be either an examination to defend the thesis or a written comprehensive examination based on requirements 1 and 2.
7. If the thesis option is chosen: In consultation with his/her advisor, a student will organize a dissertation 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.

Electrical Engineering Ph.D.

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 Track 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- will 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 program 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 will 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 Track
Total Credits Required: 84-93
Course Requirements
Total Credits Required for the Mathematical Sciences M.S.: 30-33
Required Courses – Credits: 6
Complete two of the following courses:
MAT 707 - Real Analysis I

MAT 709 - Complex Function Theory I

MAT 765 - Advanced Numerical Analysis

Elective Courses – Credits: 21-24
Students completing the exam option must complete a minimum of 24 credits of MAT or STA elective courses (excluding MAT 711 & 712), and students completing the thesis option must complete a minimum of 21 credits of MAT or STA elective courses (excluding MAT 711 & 712). Other graduate-level courses may be taken with advisor-approval.

Thesis – Credits: 6 (Optional)
Complete 6 credits from one of the following courses:
MAT 791 - Thesis

STA 791 - Thesis

Total Credits Required for the Electrical Engineering Ph.D.: 60-66

Major Field Courses – Credits: 6-15
Complete 6-15 credits of coursework in an approved major in a single area in Electrical and Computer Engineering with a minimum overall GPA of 3.33.

Communications
ECG 662 - Advanced Digital Communications

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 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

Control Systems Theory
ECG 672 - Digital Control Systems

ECG 770 - Linear Systems Theory

ECG 771 - Optimal and Modern Controls

ECG 772 - Nonlinear Systems I

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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

ECG 750 - Optical Electronics I

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 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 - Advanced Digital Communications

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 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 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

Control Systems Theory
ECG 770 - Linear Systems Theory

ECG 771 - Optimal and Modern Controls

ECG 772 - Nonlinear Systems I

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

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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

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ECG 743 - Smart Electrical Power Grid

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ECG 680 - Discrete-Time Signal Processing

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ECG 653 - Introduction to Nanotechnology

ECG 750 - Photonics

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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

Total Credits Shared: 6
Two courses can be double counted between Electrical Engineering Ph.D. and Mathematical Sciences M.S. degrees. Non-ECG courses must be applied towards non-ECG elective credits in the electrical engineering degree program pursued.

Degree Requirements
1. A minimum of 84, 87, 90, or 93 credits (including thesis and dissertation credits) of graduate work is required for the Dual Electrical Engineering Ph.D. and Mathematical Sciences M.S. which corresponds to the choice of completing a Mathematics comprehensive exam or thesis, and the number of credits of formally approved graduate level courses applied toward the B.S. degree and used in the Electrical Engineering Integrated BS-PHD Track.
2. Two of the courses included in the degree program can be double counted Electrical Engineering M.S.E and Mathematical Sciences M.S. degrees. Non-ECG courses must be applied towards non-ECG elective credits in the electrical engineering degree program pursued.

Mathematical Sciences M.S

1. Students completing a thesis must complete a minimum of 33 credit hours with a minimum GPA of 3.00.
2. Students completing the comprehensive exam must complete a minimum of 30 credit hours with a minimum GPA of 3.00.
3. 21 credits of mathematics course work must be at the 700-level (excluding thesis).
4. A student will be placed on academic probation if a minimum of 3.00 GPA is not maintained in all work taken in the degree program. A grade of C or less in one graduate-level course will cause a student to be placed on academic probation and will elicit a critical review of the student's program by the Graduate Studies Committee.
5. The Graduate College requires a minimum of 50 percent of the total credits required to complete the graduate degree, exclusive of transferred credits and/or the thesis, must be earned at UNLV after admission to a graduate degree program.
6. Students must complete a final examination. This will be either an examination to defend the thesis or a written comprehensive examination based on requirements 1 and 2.
7. If the thesis option is chosen: In consultation with his/her advisor, a student will organize a dissertation 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.

Electrical Engineering Ph.D.

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 69 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- 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.

11. All regular status graduate students must file an approved program 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 will 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. Students cannot graduate from one portion of the dual degree until the requirements for both are met. Students must apply to graduate from both programs for the same semester.
2. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.

Mathematical Sciences M.S

1. The student must successfully complete a culminating experience.
2. If the exam option is chosen, the student must successfully pass a final comprehensive examination.
3. If the thesis option is chosen, the student must:
   a. Submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
   b. Submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Electrical Engineering Ph.D.

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.
3. 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.
4. 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.
   a. 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.
   b. 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 timeframe 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 timeframe may elect to pursue a M.S. Degree by completing all of the requirements listed for that degree.
   c. The Qualifying Exam is a four and one-half hour exam covering questions in the following undergraduate electrical and computer engineering fields:
      i. Communications
      ii. Control System Theory
      iii. Electromagnetics and Optics
      iv. Electronics
      v. Power
      vi. Signal Processing
      vii. Solid State
      viii. Digital Logic Design
      ix. Computer Architectures and Organization
      x. Digital Electronics and VLSI Design
      xi. Computer Communication Networks
   d. 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.

e. 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.

5. In all Post-Bachelor's Tracks, 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 Materials and Devices as major fields. Specific courses that can be applied to specific fields are listed in detail in the Electrical Engineering Graduate Program Document.
   a. 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).
   b. 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.
6. After passing the Qualifying Exam, successfully completing all courses for a major field, and successfully completing all courses for the ECE minor field, students are eligible to take the Comprehensive Exam. All students must have passed the Comprehensive Exam within two semesters after successfully completing all required course work except for the 18 credits Dissertation. [NOTE: Up to 6 credits of Dissertation taken prior to the successful completion of the Preliminary Exam may count towards the degree program.] The Comprehensive Exam cannot be taken more than once per semester and cannot be taken more than twice.
   a. The Comprehensive Exam tests the candidate's depth of knowledge in the candidate's chosen ECE major field and chosen ECE minor (primary minor) field. All students must have passed the Comprehensive Exam within two semesters after successfully completing all required course work (except for the 18 credits of Dissertation). The Comprehensive Exam is offered once every fall semester and once every spring semester. The Comprehensive Exam cannot be taken more than twice. Candidates who have not passed the Comprehensive Exam within this timeframe (two consecutive sittings) will be terminated from the Ph.D. program. Candidates who have not passed the Comprehensive Exam following their second attempt will be terminated from the Ph.D. program.
   b. Before a student is eligible to register for the Comprehensive Exam, the candidate must have obtained regular (full graduate standing) admission status, passed the Qualifying Exam, and must have successfully completed all of the course requirements for the ECE major field and the ECE minor (primary minor) field. The student must have acquired a minimum GPA of 3.33 in both the major and minor fields separately. If the minor field GPA is less than 3.33 and/or the major field GPA is less than 3.33, then the minor and/or minor field requirement has not been successfully completed. The candidate will not be allowed to take the Comprehensive Exam until both the major and minor 3.33 GPA requirements are fulfilled. Further, the student must have a minimum overall GPA of 3.2 and must have satisfied all other Ph.D. degree program admission requirements. If a student takes the Comprehensive Exam before any one of these requirements has been satisfied, the student will automatically receive a FAIL grade for the exam. At their discretion, the Graduate Committee may also count this failing grade as one of the student's attempts for the Comprehensive Exam. To register for the Comprehensive Exam, eligible students must notify the graduate coordinator no later than one month prior to the examination date.
   c. To pass the Comprehensive Exam, a student must pass a five-hour exam covering courses in his/her ECE major field and ECE minor (primary minor) field. A pass or fail grade will be given for the exam. The graduate committee will notify students of the results of the exam. The major and minor area exam will emphasize graduate coursework taken in the ECE major and ECE minor (primary minor; minor 1) fields. The exam will evaluate the student's ability to apply his/her theoretical and analytical abilities to problems in his/her ECE major and ECE minor (primary minor) field. However, the exam may require knowledge of undergraduate material related to the student's major and minor fields. Students should expect problems that require advanced thinking.

Specific problems need not be familiar textbook problems nor may the student be necessarily familiar with the problem. A pass or fail grade will be given for the exam. The graduate committee will notify students of the exam results.

d. For more details on course specifics, exam logistics, appeal rights and procedure, and protocols regarding the comprehensive exam, refer to the ECE department's Electrical Engineering Graduate Program Document.

7. After successfully completing all required course work and passing the Comprehensive Exam, the candidate must pass the Preliminary Exam. The Preliminary Exam cannot be taken more than once per semester but may be repeated until passed.
   a. 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.
   b. To be eligible for the Preliminary Exam, a student must have passed the Comprehensive Exam, and have successfully completed all required course work except for the 18 credits of Dissertation.
   c. Before the Preliminary Exam, a student must prepare a 10 to 20-page prospectus of his/her 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.
   d. 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.
   e. During the Preliminary Exam, the student presents his/her prospectus to his 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.
8. 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 his/her dissertation. The Final Exam is the culminating experience of the PhD program.
   a. 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 his/her advisory committee of the date, time, and location of his/her Final Exam at least two weeks prior to the Final Exam. During the Final Exam, the Ph.D. candidate will present his/her 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.
9. 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 timeframe and indicate the extended period of time needed to complete the degree.
10. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
11. The student must submit and successfully defend his/her dissertation by the posted deadline. The defense must be advertised and is open to the public.
12. Student must submit his/her approved, properly formatted hard-copy dissertation to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Dual Degree: Master of Science in Engineering - Electrical Engineering & Master of Science - Mathematical Sciences

Plan Description

The dual M.S.E. – Electrical Engineering and the M.S. – Mathematical Sciences program is designed for those who want to pursue the M.S.E. degree in Electrical Engineering or a career in Electrical Engineering with emphasis in applied Mathematics. The program prepares graduate students with complementing educational components covering electrical engineering and mathematics, which is the basis of all engineering. The students graduating from this program will be well-prepared with a well-rounded background.

The Department of Electrical and Computer Engineering at UNLV offers a number of program options leading to the M.S.E. 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.

For more information about your program, including your graduate program handbook and learning outcomes, please visit the Degree Directory.

Learning outcomes for each degree can be found below:

- Master of Science in Engineering - Electrical Engineering
- Master of Science - Mathematical Sciences

Plan Admission Requirements

Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

Applicants must satisfy the minimum requirements of the M.S.E. – Electrical Engineering program and the MS – Mathematics program. If denied by one program, the applicant will have the option of proceeding with a single degree program with departmental approval.

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 Requirements: Standard Track
Total Credits Required: 54-57
Course Requirements
Total Credits Required for the Mathematical Sciences M.S.: 30-33
Required Courses – Credits: 6
Complete two of the following courses:
MAT 707 - Real Analysis I

MAT 709 - Complex Function Theory I

MAT 765 - Advanced Numerical Analysis

Elective Courses – Credits: 21-24

Students completing the exam option must complete a minimum of 24 credits of MAT or STA elective courses (excluding MAT 711 & 712), and students completing the thesis option must complete a minimum of 21 credits of MAT or STA elective courses (excluding MAT 711 & 712). Other graduate-level courses may be taken with advisor-approval.

Thesis – Credits: 6 (Optional)

Complete 6 credits from one of the following courses:
MAT 791 - Thesis

STA 791 - Thesis

Total Credits Required for the Electrical Engineering M.S.E.: 30

Core Courses – Credits: 9

Complete a minimum of 3 credits in at least three of the following areas. Students in the comprehensive exam track must take all courses at the 700-level.

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 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

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

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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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

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: 9-12
Complete 9-12 credits of additional core courses from the core courses in any of the areas listed above. Students in the comprehensive exam track must take all courses at the 700-level.

Students completing the comprehensive exam option must complete a minimum of 12 credits of electives, and students completing the thesis option must complete a minimum of 9 credits of electives.

Elective Courses – Credits: 6-9
Complete a minimum of 6-9 credits of 600- or 700-level MAT, PHY, AST, CEE, CEM, ECG, EGG, CS, ME, or other advisor-approved courses.

Students completing the comprehensive exam option must complete a minimum of 9 credits of electives, and students completing the thesis option must complete a minimum of 6 credits of electives.

Thesis – Credits: 6 (Optional)
ECG 797 - Electrical Engineering Thesis

Total Credits Shared: 6
Two courses can be double counted between Electrical Engineering M.S.E and Mathematical Sciences M.S. degrees. Non-ECG courses must be applied towards non-ECG elective credits in the electrical engineering degree program pursued.

Degree Requirements
1. A minimum of 54 or 57 credits (including thesis credits) of graduate work is required for the Dual Electrical Engineering M.S.E. and Mathematical Sciences M.S. which corresponds to the choice of completing a Mathematics comprehensive exam or thesis.
2. Two of the courses included in the degree program can be double counted Electrical Engineering M.S.E and Mathematical Sciences M.S. degrees. Non-ECG courses must be applied towards non-ECG electives credits in the electrical engineering degree program pursued.
3. If a thesis option is chosen: In consultation with his/her 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.

Mathematical Sciences M.S.

1. Students completing a thesis must complete a minimum of 33 credit hours with a minimum GPA of 3.00.
2. Students completing the comprehensive exam must complete a minimum of 30 credit hours with a minimum GPA of 3.00.
3. 21 credits of mathematics course work must be at the 700-level (excluding thesis).

4. A student will be placed on academic probation if a minimum of 3.00 GPA is not maintained in all work taken in the degree program. A grade of C or less in one graduate-level course will cause a student to be placed on academic probation and will elicit a critical review of the student's program by the Graduate Studies Committee.
5. The Graduate College requires a minimum of 50 percent of the total credits required to complete the graduate degree, exclusive of transferred credits and/or the thesis, must be earned at UNLV after admission to a graduate degree program.
6. Students must complete a final examination. This will be either an examination to defend the thesis or a written comprehensive examination based on requirements 1 and 2.

Electrical Engineering M.S.E.

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. 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.
7. Students completing a Thesis:
   a. A minimum of 18 core (formal) must be in core electrical engineering courses, of which 15 credits must be 700-level. This excludes Thesis, and informal courses (such as Special Topics, Graduate Seminar, and Independent Study).
   b. Students must complete at least six credits of Electrical Engineering 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.
   c. 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.
   d. The student must complete a thesis containing original research and publically defend it before his/her advisory committee at the Thesis Exam.
   e. Prior to the student's defense of the thesis before his/her advisory committee, the student must submit a complete copy of the thesis to each member of his/her 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 his/her advisory committee of the date, time and location of the oral defense of the thesis or project at least two weeks in advance.
   f. Students who plan to continue their studies beyond the M.S.E. degree program are strongly encouraged to select this option.
   g. 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 his/her 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.E. 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.
8. Students completing the Comprehensive Exam:
   a. A minimum of 21 credits must be in core (formal) electrical engineering 700-level courses excluding informal courses (such as Independent Study, Graduate Seminar, and Special Topics).
   b. Pass a comprehensive exam on graduate level coursework in the student's specialty area.
   c. The exam may be taken in the last two semesters of the student's M.S.E. program.

d. 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 his/her intention of taking the exam, the major field to be examined, and at least two courses taken in that field.
e. The Course Only Option is a final advanced professional degree option in that students who complete the Course Only Option will not be considered for admission into any of the department's Ph.D. program options.

Graduation Requirements

1. Students cannot graduate from one portion of the dual degree until the requirements for both are met. Students must apply to graduate from both programs for the same semester.
2. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.

Mathematical Sciences M.S.

1. The student must successfully complete a culminating experience.
2. If the exam option is chosen, the student must successfully pass a final comprehensive examination.
3. If the thesis option is chosen, the student must:
   a. Submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
   b. Submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Electrical Engineering M.S.E.

1. The student must successfully complete a culminating experience.
2. If the exam option is chosen, the student must pass a final comprehensive examination.
3. If the thesis option is chosen, the student must:
   a. Submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
   b. Submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Subplan 2 Requirements: Integrated BS-MS Track
Total Credits Required: 45-54
Course Requirements
Total Credits Required for the Mathematical Sciences M.S.: 30-33
Required Courses – Credits: 6
Complete two of the following courses:
MAT 707 - Real Analysis I

MAT 709 - Complex Function Theory I

MAT 765 - Advanced Numerical Analysis

Elective Courses – Credits: 21-24
Students completing the exam option must complete a minimum of 24 credits of MAT or STA elective courses (excluding MAT 711 & 712), and students completing the thesis option must complete a minimum of 21 credits of MAT or STA elective courses (excluding MAT 711 & 712). Other graduate-level courses may be taken with advisor-approval.

Thesis – Credits: 6 (Optional)
Complete 6 credits from one of the following courses:
MAT 791 - Thesis

STA 791 - Thesis

Total Credits Required for the Electrical Engineering M.S.E.: 21-27

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 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

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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

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

Total Credits Shared: 6
Two courses can be double counted between Electrical Engineering M.S.E and Mathematical Sciences M.S. degrees. Non-ECG courses must be applied towards non-ECG elective credits in the electrical engineering degree program pursued.

Degree Requirements
1. A minimum of 45, 48, 51, or 54 credits (including thesis credits) of graduate work is required for the Dual Electrical Engineering M.S.E. and Mathematical Sciences M.S. which corresponds to the choice of completing a Mathematics comprehensive exam or thesis, and the number of credits of formally approved graduate level courses applied toward the B.S. degree and used in the Electrical Engineering Integrated BS-MS Track.
2. Two of the courses included in the degree program can be double counted Electrical Engineering M.S.E and Mathematical Sciences M.S. degrees. Non-ECG courses must be applied towards non-ECG elective credits in the electrical engineering degree program pursued.

Mathematical Sciences M.S.

1. Students completing a thesis must complete a minimum of 33 credit hours with a minimum GPA of 3.00.
2. Students completing the comprehensive exam must complete a minimum of 30 credit hours with a minimum GPA of 3.00.
3. 21 credits of mathematics course work must be at the 700-level (excluding thesis)
4. A student will be placed on academic probation if a minimum of 3.00 GPA is not maintained in all work taken in the degree program. A grade of C or less in one graduate-level course will cause a student to be placed on academic probation and will elicit a critical review of the student's program by the Graduate Studies Committee.

5. The Graduate College requires a minimum of 50 percent of the total credits required to complete the graduate degree, exclusive of transferred credits and/or the thesis, must be earned at UNLV after admission to a graduate degree program.
6. Students must complete a final examination. This will be either an examination to defend the thesis or a written comprehensive examination based on requirements 1 and 2.
7. If the thesis option is chosen: In consultation with his/her advisor, a student will organize a dissertation 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.

Electrical Engineering M.S.E.

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 track 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 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 his/her 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.
    a. 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.
    b. 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.
    c. The student must complete a thesis containing original research and publically defend it before his/her advisory committee at the Thesis Exam.
    d. Prior to the student's defense of the thesis before his/her advisory committee, the student must submit a complete copy of the thesis to each member of his/her 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 his/her advisory committee of the date, time and location of the oral defense of the thesis or project at least two weeks in advance.
    e. 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 his/her 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

1. Students cannot graduate from one portion of the dual degree until the requirements for both are met. Students must apply to graduate from both programs for the same semester.
2. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.

Mathematical Sciences M.S.

1. The student must successfully complete a culminating experience.
2. If the exam option is chosen, the student must successfully pass a final comprehensive examination.
3. If the thesis option is chosen, the student must:
   a. Submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
   b. Submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Electrical Engineering M.S.E.

1. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
2. The student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Plan Graduation Requirements

Refer to your subplan for Graduation Requirements.

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 Materials and Devices. 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 track 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 track 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.

Plan Admission Requirements

Application deadlines available on the UNLV Graduate College website.

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 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 his 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 written statement of purpose indicating the applicant's research interests, motivations, and objectives.
      i. In the statement of purpose, the applicant must explicitly identify his/her 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. Before international applicants can be considered for admission, the Graduate College requires that all international applicants take the Test of English as a Foreign Language (TOEFL) and obtain a minimum score of 550 or 85 on the Michigan Test. Students whose first language is not English may be required to take and pass the English as a Second Language Placement Test upon arrival at UNLV. If necessary, they will be required to take English as a Second Language (ESL) courses at UNLV.
6. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

The Integrated BS-MS Track 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 Track. Students admitted to the Integrated BS-MS Track program are required to write a thesis.

To be considered for admission to the Integrated BS-MS Track, 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 Requirements: Comprehensive Exam Track
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 617 - Internet of Things Systems

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

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 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
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.
   a. The exam may be taken in the last two semesters of the student's M.S.E. program.
   b. 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 his/her intention of taking the exam, the major field to be examined, and at least two courses taken in that field.
9. The Comprehensive Exam Track is a final advanced professional degree option in that students who complete this track will not be considered for admission into any of the department's Ph.D. program options.

Graduation Requirements

1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must pass a final comprehensive exam.

Subplan 2 Requirements: Thesis Track
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 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

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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

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 his/her 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.
   a. 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.
   b. 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.

c. The student must complete a thesis containing original research and publically defend it before his/her advisory committee at the Thesis Exam.
d. Prior to the student's defense of the thesis before his/her advisory committee, the student must submit a complete copy of the thesis to each member of his/her 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 his/her advisory committee of the date, time and location of the oral defense of the thesis or project at least two weeks in advance.
e. 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 his/her 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

1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Subplan 3 Requirements: Integrated BS-MS Track
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 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

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 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
ECG 651 - Electronic and Magnetic Materials and Devices

ECG 652 - Optoelectronics

ECG 653 - Introduction to Nanotechnology

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 track 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 his/her 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.
    a. 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.
    b. 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.

c. The student must complete a thesis containing original research and publically defend it before his/her advisory committee at the Thesis Exam.
d. Prior to the student's defense of the thesis before his/her advisory committee, the student must submit a complete copy of the thesis to each member of his/her 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 his/her advisory committee of the date, time and location of the oral defense of the thesis or project at least two weeks in advance.
e. 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 his/her 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

1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. Student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Plan Graduation Requirements

Refer to your subplan for Graduation Requirements.

ECG 600 - Computer Communication Networks **Credits 3**
Computer network architecture; the OSI Model: network protocols; local area networks; fiber optics communication; ISDN; elements of Queueing Theory, with emphasis on hardware design issues.

ECG 603 - Embedded Systems Design **Credits 3**
Embedded Systems Design.

ECG 604 - Modern Processor Architecture **Credits 3**
Instruction level parallel processing. Processor performance evaluation and optimization. Scalar and superscalar pipelines. Instruction, register data and memory data flow techniques. Cache organization and performance analysis. Comparison of RESC, CISC and VLIW architecture. Survey of modern processors. Introduction to multithreading.

ECG 605 - Data Compression Systems **Credits 3**
Source modeling. Foundations of lossy and lossless compression, code properties. Huffman and arithmetic coding, predictive coding, dictionary techniques, compression techniques and standards for facsimile, audio, video and still image coding. Hardware design specifics, coding and watermarking.

ECG 607 - Biometrics **Credits 3**
Taxonomics of devices and applications, probability and statistical testing methods, one and tow dimensional transform techniques, finger printing, voice recognition., facial recognition, and iris scanning, large scale identification applications, multibiometrics, social, legal, and ethical concerns. Note(s): This course is crosslisted with CPE 407. Credit at the 600 level requires additional work.

ECG 608 - Digital Design Verification and Testing **Credits 3**
A study of complete digital design testing during all design flow stages - from writing code to testing chips after manufacturing, creating and implementing effective test scenarios and assertion techniques, designing self-testing devices. Students will get hands-on experience with various EDA tools for design testing, verification, logic and fault simulation.

ECG 609 - Embedded Digital Signal Processing **Credits 3**
Hardware implementation of DSP operations, filters, interpolation and decimation, linear and non-linear transforms. Embedded audio and video processing, error control and coding. DSP processors.

ECG 617 - Internet of Things Systems **Credits 3**
The elements of IoT, detailed analysis of IoT sensors, IoT networking and sensor-system communications. The analysis of the process of designing the IoT systems, design of the data management / databases and security requirements. Class is project-based. Note(s): This course is crosslisted with CpE 417. Coursework at the 600-level requires additional work.

ECG 620 - Analog Integrated Circuit Design **Credits 3**
An introduction to the design, layout, and simulation of analog integrated circuits including current mirrors, voltage and current references, amplifiers, and op-amps. Prerequisite(s): EE 320.

ECG 621 - Digital Integrated Circuit Design **Credits 3**
An introduction to the design, layout, and simulation of digital integrated circuits. MOSFET operation and parasitics. Digital design fundamentals including the design of digital logic blocks. Prerequisite(s): CpE 100 and EE 320.

ECG 630 - Transmission Lines **Credits 3**
Telegraphist's equations; transient response—steady state response; reflection diagrams; Smith chart; matching techniques and designs; narrow and broadband impedance matching techniques; scattering matrix; introduction to stripline and microstrip devices.

ECG 631 - Engineering Optics **Credits 3**
Fundamentals of antennas and antenna design; linear wire, loop, and antenna arrays; antenna measurements.

ECG 632 - Antenna Engineering **Credits 3**
Fundamentals of antennas and antenna design; linear wire, loop, and antenna arrays; antenna measurements.

ECG 633 - Active and Passive Microwave Engineering **Credits 3**
This 600-level course has been approved by the Graduate College for possible inclusion in graduate programs. A full description of this course may be found in the Undergraduate Catalog under the corresponding 400 number.

ECG 642 - Power Electronics **Credits 3**
Topics include: diode circuits and rectifiers, power semiconductor diodes and transistors, thyristors and static switches, controlled rectifiers, AC voltage controllers, DC choppers, inverters, AC and DC drives, power supplies and protection of devices and circuits.

ECG 646 - Photovoltaic Devices and Systems **Credits 3**
This course covers solar resource characteristics, solar cell physics and technologies, cell electrical characteristics, PV module design, DC-AC inverters, battery energy storage and charge controllers, design of stand-alone and grid-connected PV systems, and economic considerations. Prerequisite(s): Enrollment in the Solar and Renewable Energy Graduate Certificate Program, or graduate standing for engineering students.

ECG 651 - Electronic and Magnetic Materials and Devices **Credits 3**
Semiconductors, dielectrics, ferroelectrics, antiferromagnetics, ferromagnetics, ferrimagnetics, crystal structure, structure-property relations, device applications.

ECG 652 - Optoelectronics **Credits 3**
Topics include: modulation of light, display devices, lasers, photodetectors, fiber optics, engineering applications, and systems.

ECG 653 - Introduction to Nanotechnology **Credits 3**
Overview of Nanotechnology. Physics of the Solid State, Properties of Individual Nanostructures. Bulk Nanostrutured materials, magnetic nanoparticles, Quantum Wells, Wires and Dots, Self-Assembly and Catalysis, nanoscale Biological materials.

ECG 662 - Digital Communication Systems **Credits 3**
Information theory and fundamental limits on performance, digital coding of waveforms, pulse shaping for baseband transmission, digital bandpass modulations, channel coding.

ECG 666 - Wireless and Mobile Communication Systems **Credits 3**
Study of wireless systems including cellular telephone systems, wireless local area networks and other wireless data services. Topics include digital modulation techniques, frequency reuse, diversity techniques, multiple access schemes and channel modeling including path loss, shadowing, fading and multipath interference. Note(s): This course is crosslisted with EE 466. Credit at the 600-level requires additional work. Prerequisite(s): EE 460 or equivalent.

ECG 672 - Digital Control Systems **Credits 3**
Introduction to discrete time of control. State space representation of linear systems; stability; the concepts of controllability and observability. Sample data control system design techniques, including pole placement, observer design.

ECG 674 - Recent Topics in Control **Credits 3**
This 600-level course has been approved by the Graduate College for possible inclusion in graduate programs. A full description of this course may be found in the Undergraduate Catalog under the corresponding 400 number.

ECG 680 - Discrete-Time Signal Processing **Credits 3**
Review of discrete linear system theory including the z-transformers, the Fourier transform, discrete and fast Fourier transform. Sampling, reconstruction multirate systems and quantization noise. IIR and FIR digital filter design including digital filter structures and finite word length effects.

ECG 680L - Digital Signal Processing Laboratory **Credits 1**
Laboratory projects and exercises in digital signal processing including the design and implementation of FIR, IIR, and multirate systems.

ECG 682 - Introduction to Biomedical Signals and Systems **Credits 3**
Introduction to biomedical signals, transduction devices, bioelectric potentials and sensors. Application of electrical signal and system principles to biosignals, such as cardiovascular electrical signals, neural electrical communication, and diagnostic ultrasound. Includes current biomedical engineering topics.

ECG 695 - Special Topics **Credits 1-4**
Covers experimental and other topics which may be of current interest. Topics and credits to be announced. Note(s): May be repeated once under a different topic. May have a laboratory.

ECG 700 - Advanced Computer System Architecture **Credits 3**
High performance computer architecture including pipelining techniques, high speed memory systems, vector processors, parallel processing, and interconnection networks. Prerequisite(s): ECG 300 or consent of instructor.

ECG 701 - Reliable Design of Digital Systems **Credits 3**
D-algorithm, Boolean difference, test generation for combinational and sequential circuits, self checking circuits, fault tolerant design, design for testability, and topics in reliability and maintainability. Prerequisite(s): ECG 300 or consent of instructor.

ECG 702 - Interconnection Networks for Parallel Processing Applications **Credits 3**
Interconnection networks models, comparison of single-stage networks: PM2I, HYPERCUBE Illiac and suffle-exchange, partitioning single-state networks, multistage networks, survey and comparison of fault-tolerant multistage networks. Prerequisite(s): ECG 300 or consent of instructor.

ECG 703 - Machine Learning and Applications **Credits 3**
Linear Regression, Curve Fitting, Bayesian Inference, Supervised and Unsupervised Learning, Support Vector Machine, K-nearest Neighbor, Dimensionality Reduction, Learning Theory, Reinforcement Learning. Applications to Security, Robotics, Autonomous Navigation, Weather forecasting, Bioinformatics, Finance, Healthcare. Prerequisite(s): Consent of Instructor.

ECG 704 - Coding with Applications in Computers and Communication Media **Credits 3**
Error correcting codes, design and analysis of encoder/decoder circuitry, applications to reliable communication and fault tolerant computing, compression encoding schemes. Prerequisite(s): ECG 300 , MATH 453, or consent of instructor.

ECG 706 - Analysis of Telecommunication and Data Networks **Credits 3**
Probability-based treatment of telecommunication and data networks. Delay, throughput, buffer management in layers of ISO Open Systems Interconnection Model. Performance analysis, flow and congestion control, routing function, polling and random access, CSMA/CD and Ethernet. Prerequisite(s): ECG 300 and MATH 462

ECG 707 - Logic Synthesis Engineering **Credits 3**
Theory and application of Boolean Minimization, functional decomposition and logic synthesis for FPGAs, serial and parallel decomposition strategies, and design implementation using FPGAs. Design entry, introduction to VHDL, BDD, FSM, and BLIF. Placement and routing in Xilinx and Aleira. Prerequisite(s): Graduate standing in computer engineering or consent of instructor.

ECG 709 - Synthesis and Optimization of Digital Systems **Credits 3**
Study of the high-level synthesis and optimization algorithms for designing SOCs and MPSOCs. Topics including algorithms for high-level synthesis, scheduling, resource binding, real-time systems, application specific instruction processors, embedded systems and hardware/software codesigns. Simulate and synthesize algorithms using HDL languages (Verilog and SystemC). Use of simulators and emulators. Prerequisite(s): CPE 300 and C/C++ knowledge or Instructor permission

ECG 720 - Advanced Analog IC Design **Credits 3**
Advanced analog design considerations including: noise, common-mode feedback, high-speed design, and design for analog signal processing. Prerequisite(s): EE 420 or ECG 620.

ECG 721 - Memory Circuit Design **Credits 3**
A practical introduction to the transistor-level design of memory circuits. Memory technologies including DRAM, Flash, MRAM, Glass-based, and SRAM will be discussed. Prerequisite(s): EE 421 or ECG 621.

ECG 722 - Mixed-Signal Circuit Design **Credits 3**
Design of data converters using sigma-delta techniques. Operation and design of custom digital filters for decimating and interpolating in analog-to-digital interfaces. Prerequisite(s): EE 320 and EE 360.

ECG 730 - Advanced Engineering Electromagnetics I **Credits 3**
Conformal transformation with application to static field problems in engineering; wave harmonics with engineering applications; theorems of waves and media; Special Theory of Relativity with engineering applications; wave propagation in various media; engineering application of scattering. Prerequisite(s): ECG 330 or consent of instructor.

ECG 731 - Theoretical Techniques in Electromagnetics **Credits 3**
Review and introduce mathematical techniques basic to the study of engineering electromagnetics, including coupled mode theory; complex analysis; and Green's function. Prerequisite(s): ECG 330 or consent of instructor.

ECG 732 - Advanced Engineering Electromagnetics II **Credits 3**
Scattering; particle and beam radiation; selected topics in advanced antenna and microwave engineering. Prerequisite(s): ECG 330 or consent of instructor.

ECG 733 - Plasma I **Credits 3**
Single particle motion; adiabatic invariants; plasmas as fluids; waves in plasmas; diffusion; resistivity; introduction to kinetic theory; Landau damping. Prerequisite(s): ECG 330

ECG 740 - Computer Analysis Methods for Power Systems **Credits 3**
Power system matrices, programming considerations, conventional power flow studies, approximate and fast power flow studies, optimal dispatch, fault studies, power system stability, stochastic methods in power systems analysis. Prerequisite(s): ECG 440, ECG 440L or consent of instructor.

ECG 741 - Electric Power Distribution System Engineering **Credits 3**
Electric load characteristics, distribution transformers, design of subtransmission lines and distribution substations, design of primary and secondary systems, voltage drop and power loss calculation, capacitor applications, voltage regulation, distribution system protection and reliability. Prerequisite(s): ECG 440, ECG 440L or consent of instructor.

ECG 742 - Power System Stability and Control **Credits 3**
Power equipment dynamic characteristics and modeling, control of active and reactive power, small-signal stability, transient stability, voltage stability, sub-synchronous oscillations, mid- and long-term stability, methods of improving stability. Prerequisite(s): ECG 440, ECG 440L or consent of instructor.

ECG 743 - Smart Electrical Power Grid **Credits 3**
Modeling and operation of conventional power systems, microgrid power systems, renewable energy systems with battery storage, smart grid concepts, smart power devices, smart grid communication, cyber security, advanced metering infrastructure, dynamic home area networks, demand response.

ECG 750 - Photonics **Credits 3**
Review of Electromagnetic theory of light, optical wave propagation in vacuum and media, waveguides, fiber optics, quantum dots, lasers, LEDs, semiconductor lasers, optical detectors, electro-optic and acousto-optic modulations, nonlinear optics, harmonic generation, parametric process, Q-switching, mode locking, frequency combs, laser amplification, quantum mechanical aspects of light. Prerequisite(s): MATH 432, EE 330, EE 452/ECG 652 or consent of instructor.

ECG 752 - Physical Electronics **Credits 3**
Quantum Theory, electron in potential well, harmonic oscillator. Hydrogen atom, Band Theory of Solids, Kronig-Penny model, theory of metallic state, diffraction by crystals, electronic structure of solids. Prerequisite(s): ECG 320 or consent of instructor.

ECG 753 - Advanced Topics in Semiconductor Devices I **Credits 3**
Topics of current interest in solid state electronic devices: physics of semiconductors, thermal and optical and electronic properties of semiconductors, bipolar junction devices, field effect devices, surface related effects, optoelectronic devices, semiconductor lasers. Applications and the design of circuits using these devices. Intended for electrical and electronic engineers, physicists and qualified senior students in engineering and physics. Prerequisite(s): PHYS 411 and 483 or ECG 421, ECG 420 and consent of instructor.

ECG 755 - Monolithic Integrated Circuit Fabrication **Credits 3**
Fabrication of integrated silicon and gas circuits, thermal oxidation, solid state diffusion, epitaxial growth, ion implantation, photo and electron lithography, design considerations, surface effect. Prerequisite(s): Graduate standing or consent of instructor.

ECG 756 - Advanced Topics in Semiconductor Devices II **Credits 3**
Topics of current interest in solid state electronic devices: ultrafast electronics, high electron mobility transistors, superlattices, heteroface devices, transfer electron devices and III-V and II-VI compounds, novel device structures. Novel approaches to device modeling such as Monte Carlo simulations, self-consistent solution of Schroedinger and Poisson and other approaches. Prerequisite(s): ECG 753

ECG 757 - Electron Transport Phenomena in Solid State Devices **Credits 3**
Phenomenological transport equations, Boltzmann transport equation, relaxation time approximation, low field and high electron transport in Si and GaAs, moments of BTE, Monte Carlo simulation, spatial and temporal transients, device analysis, Quantum transport. Prerequisite(s): ECG 450 or ECG 753.

ECG 758 - Numerical Methods in Engineering Credits 3
Computational course with emphasis on both the numerical analysis and the programming aspects of computer-aided design using simulation methods. Coverage includes understanding and use of CAD programs such as ECAP, CIRCUS, ICECREM, SUPREM, etc. Prerequisite(s): Graduate standing or consent of instructor.

ECG 758R - Optical Sensing Credits 3
Quick review of fiber optics, lasers, and detectors. Fiber responses to disturbances, interferometry, displacement sensors, laser stabilization, atomic clocks, precision time and frequency transfer, multiplexing in time, spatial, wavelength domains, rotation and angular sensors, acoustic sensors, deformation sensors, photonic Doppler velocimetry, remote sensing, biosensors, quantum enhancement. Prerequisite(s): Consent of instructor. It is recommended but not required for students to have completed ECG 652 Optical Electronics and ECG 750 Photonics.

ECG 760 - Random Processes in Engineering Problems Credits 3
Basic probability theory, random variables, probability and densities, expectation, static estimation, random processes, power spectral density, mean square calculus, Wiener integrals. Prerequisite(s): ECG 460, MATH 461 or consent of instructor.

ECG 762 - Detection and Estimation of Signals in Noise Credits 3
Hypothesis testing, matched filters, estimation theory, Kalman and Wiener filters, applications to communication systems. Prerequisite(s): ECG 460, ECG 760 or consent of instructor.

ECG 763 - Advanced Digital Communication Systems Credits 3
Digital communication systems with emphasis in digital modulation schemes, optimal detectors, inter symbol interference, channel equalization and multi-carrier communications. Prerequisite(s): EE 460

ECG 770 - Linear Systems Credits 3
Mathematical systems theory, state space concepts, canonical forms, time and frequency domains, controllability and observability, state feedback, compensator design, and algebraic systems theory. Prerequisite(s): ECG 470, MATH 431 or consent of instructor.

ECG 771 - Optimal and Modern Control Credits 3
Students will participate in one of the following activities: research; clinical activity; community outreach under the supervision of a dentist/mentor; may also participate in clinical externship activities with prior approval. Note(s): Topics selected according to the interests of the class. Prerequisite(s): ECG 770

ECG 772 - Nonlinear Systems Credits 3
Introduction, differential equations, approximate analysis methods, Lyapunov stability, input-output stability. Prerequisite(s): ECG 770 or consent of instructor.

ECG 774 - Stochastic Control Credits 3
Introduction, stochastic processor, state estimation, Kalman Filter, nonlinear estimation, stochastic control. Prerequisite(s): ECG 770 or consent of instructor.

ECG 776 - Adaptive Control Credits 3
Introduction, model reference control, hyperstability, Popov criterion, parameter identification, adaptive control of discrete systems, adaptive predictor, adaptive state estimation. Prerequisite(s): ECG 770 (formerly EEG 760) or consent of instructor.

ECG 780 - Digital Signal Processing Credits 3
Introduction to the theory and applications of digital signal processing. Discrete-time signals, linear systems and difference equations. Sampling and multirate systems. One sided and two sided z-transforms. Finite impulse response (FIR) and infinite impulse response (IIR) systems. The discrete and fast Fourier transforms (FFT). Prerequisite(s): ECG 460, MATH 431 or consent of instructor.

ECG 781 - Digital Filters Credits 3
Theory and applications of digital filters. Structures for discrete time systems. Finite precision numerical effects in digital systems. Finite impulse response (FIR) and infinite impulse response (IIR) digital filters designs including windowing techniques, optimization techniques, analog to discrete time transformation techniques and wave digital filters. Prerequisite(s): ECG 780

ECG 782 - Multidimensional Digital Signal Processing Credits 3
Theory and applications of multidimensional (M-D) digital signal processing. M-D signals and systems. M-D z-transform. M-D DFT and FFT. Design and implementation of M-D FIR and IIR filters. Applications to image processing such as image enhancement and restoration. Advanced topics chosen according to class interests. Prerequisite(s): ECG 780

ECG 783 - Adaptive Signal Processing with Neural Networks Credits 3
Theory and application of adaptive signal processing with neural networks. Theory of adaptation and performance surfaces. Adaptive algorithms. Fundamental concepts and models of artificial neural systems. Single layer perception classifiers. Multi layer feed forward networks. Single layer feedback networks applications. Prerequisite(s): ECG 780 or equivalent.

ECG 791 - Independent Study in Electrical Engineering Credits 1 – 3
Supervised independent work in a topic of electrical engineering. Note(s): May be repeated to a maximum of six credits with consent of electrical engineering faculty. Prerequisite(s): Graduate standing in electrical engineering or related field and consent of instructor.

ECG 793 - Engineering Science Seminars Credits 1-3
The seminar series emphasizes national security related topics, which are broadly applicable to all sciences and technology disciplines. Leaders and experts from government, national laboratories, and universities present the latest progress in national security, defense experiments, applied physics, electrical engineering, photonics, and scientific computing. Note(s): May be repeated to a maximum of six credits.

ECG 795 - Advanced Special Topics in Electrical Engineering Credits 1 – 3
Advanced special topics in modern electrical engineering as defined in the announcement of the course. Note(s): May be repeated to a maximum of six credits. Prerequisite(s): Graduate standing in electrical engineering or related field and consent of instructor.

ECG 797 - Electrical Engineering Thesis Credits 3 – 6
Research, analysis, and writing towards completion of thesis and subsequent defense. Note(s): May be repeated, but only six credits will be applied to a student's program. Grading: S/F grading only. Prerequisite(s): Graduate standing in electrical engineering or related field and consent of instructor.

ECG 799 - Dissertation Credits 1 – 6
Research analysis and writing toward completion of dissertation and subsequent defense. Note(s): May be repeated to a maximum of 18 credits allowed toward the degree. Grading: S/F grading only. Prerequisite(s): Graduate standing in electrical engineering or related field and consent of instructor.

Mechanical Engineering

Graduate students in the mechanical engineering program join highly active research teams. They learn advanced engineering concepts and develop research skills allowing them to investigate and solve critical and relevant technological problems. Many of our graduate students present results of their work at prestigious international conferences and publish in high quality journals. Our graduate student alumni have gone on to careers as researchers in government or industry laboratories, faculty at academic institutions or engineers at a wide range of companies.

Courses and research projects focus on: active (smart) materials, aerospace, vibrations and acoustics, heat transfer, fluid flow (and computational fluid dynamics), environmental transport processes, multiphase flow, energy conservation and conversion technologies, alternative energy including solar power, automatic control, robotics, unmanned aerial systems, biomedical engineering, nuclear engineering and materials, structural properties of engineering materials, composite materials, and computational simulation of structures under extreme dynamic loading.

Graduate students have access to all departmental laboratories and equipment as well as the facilities of the National Supercomputing Center for Energy and the Environment. The department supports numerous networked workstations.

The laboratories of the department include the Drones and Autonomous Systems Lab, Active Materials and Smart Living Laboratory, a full range of solar and renewable energy facilities, extensive acoustics and vibrations facility, thermal-fluids capability, full array of mechanical testing machines, measurement and control laboratory, and nuclear sensors and devices laboratory. A unique laboratory also exists for full-scale testing of ducts and diffusers, including indoor air quality and HVAC equipment.

Brendan O'Toole, Ph.D., Chair
Hui Zhao, Ph.D., Graduate Coordinator

Mechanical Engineering Faculty

Chair

O'Toole, Brendan J. - Full Graduate Faculty Professor; B.S., M.S., Ph.D., University of Delaware. Rebel since 1992.

Graduate Coordinator

Zhao, Hui - Full Graduate Faculty Associate Professor; B.S., M.S., Peking University, China; Ph.D., University of Pennsylvania. Rebel since 2009.

Graduate Faculty

Bansal, Shubhra - Full Graduate Faculty Assistant Professor; B.S., Indian Institute of Technology, M.S., Ph.D., Georgia Institute of Technology. Rebel since 2015.

Barzilov, Alexander P. - Full Graduate Faculty Associate Professor; M.S. Institute of Nuclear Power Engineering (INPE), Obninsk, Russia; Ph.D. Institute of Physics and Power Engineering (IPPE), Obninsk, Russia. Rebel since 2012.

Boehm, Robert F. - Full Graduate Faculty Professor; B.S., M.S., Washington State University; Ph.D., University of California, Berkeley; P.E., California. Rebel since 1990.

Chen, Yi Tung - Full Graduate Faculty Professor; B.S, Feng Chia University; M.S., Ph.D., University of Utah. Rebel since 1993.

Culbreth, William G. - Full Graduate Faculty Associate Professor; B.S., California State Polytechnic University, Pomona; M.S., Ph.D., University of California, Santa Barbara. Rebel since 1985.

Hartmann, Thomas - Full Graduate Faculty Associate Professor; Diploma in Mineralogy, University Heidelberg, Ph.D., University Heidelberg / Karlsruhe Institute of Technology

Kim, Kwang J. - Full Graduate Faculty Professor; B.S., Yonsei University, S. Korea; M.S., Ph.D., Arizona State University. Rebel since 2012.

Mauer, Georg F. - Full Graduate Faculty Professor; Diploma-Ingenieur; Ph.D., Technical University of Berlin. Rebel since 1986.

Moon, Jaeyun - Full Graduate Faculty Assistant Professor; B.S., M.S., Hanyang University; Ph.D., University of California, San Diego. Rebel since 2014.

Moujaes, Samir F. - Full Graduate Faculty Professor; B.S., M.S., American University of Beirut; Ph.D., University of Pittsburgh; P.E., Nevada. Rebel since 1984.

Oh, Paul - Full Graduate Faculty Professor; B.S., McGill University; M.S., Seoul National University; Ph.D., Columbia University. Rebel since 2014.

Pepper, Darrell W. - Full Graduate Faculty Professor; B.S., M.S., Ph.D., University of Missouri-Rolla. Rebel since 1992.

Reynolds, Douglas D. - Full Graduate Faculty Professor; B.S., Michigan State University; M.S., Ph.D., Purdue University. Rebel since 1983.

Rice, Stephen - Full Graduate Faculty Professor; B.S., M.Engr., Ph.D., University of California, Berkeley. Rebel since 1966.

Trabia, Mohamed - Full Graduate Faculty Professor; B.S., M.S., Alexandria University; Ph.D., Arizona State University. Rebel since 1987.

Wang, Zhiyoung - Full Graduate Faculty Associate Professor; B.S., M.S., Ph.D., Harbin University of Science and Technology. Rebel since 1998.

Yim, Woosoon - Full Graduate Faculty Professor; B.S., Hanyang University, S. Korea; M.S., Ph.D. University of Wisconsin-Madison. Rebel since 1987.

Graduate Certificate in Nuclear Criticality Safety

Plan Description
The graduate, distance education Nuclear Criticality Safety (NCS) Certificate program will provide the graduate MSMNE student a diverse education and the practicing NCS engineer (and their employer) with components that will help train and maintain a well-qualified workforce. The UNLV NCS Certificate will provide evidence that the graduate has the appropriate education to become a certified NCS Engineer in NRC-licensed facilities, US DOE's national laboratories, and the Navy Reactors program. The NCS Certificate program consists of four nuclear engineering courses (twelve credits total) that include three required courses and a related/approved elective course. In addition, many of the proposed topic areas, e.g., Introduction to Nuclear Criticality Safety, are also appropriate subjects for general nuclear engineering graduate students (i.e., not NCS engineers), while other certificate program courses, e.g., Monte Carlo Methods are appropriate for both UNLV's NE students as well as health and medical physics students.

For more information about your program, including your graduate program handbook and learning outcomes, please visit the Degree Directory.

Plan Admission Requirements
Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

Admission to the NCS Certificate program requires both a BS degree in an engineering discipline and ME 455/655 Fundamentals of Nuclear Engineering (or equivalent).

If an applicant can demonstrate equivalent knowledge from relevant work experience (e.g. Navy nuclear reactor program or extensive training and experience at an NRC-licensed or DOE process facility), the Director of the NCS Certificate Program can waive both requirements with the concurrence of the Chair of the Department of Mechanical Engineering based upon review by nuclear engineering faculty.

All applicants must review and follow the Graduate College Admission and Registration Requirements.

Students are accepted into a certificate 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
Total Credits Required: 12
Course Requirements
Required Courses – Credits: 9
ME 754 - Introduction to Nuclear Criticality Safety

ME 755 - Nuclear Criticality Safety Engineering

ME 756 - Monte Carlo Methods in Nuclear Engineering

Elective – Credits: 3
Complete an advisor-approved graduate-level nuclear engineering or health physics course.

Certificate Requirements
Completion of a minimum of 12 credit hours with a minimum GPA of 3.00.

Plan Certificate Completion Requirements
The student must submit all required forms to the Graduate College and then apply for graduation in MyUNLV by the appropriate deadline.

Graduate Certificate in Nuclear Safeguards and Security

Plan Description
The graduate Nuclear Safeguards and Security (NSS) Certificate program will provide graduate students and practicing engineers (and their employers) a diverse education with components that will help train and maintain a well-qualified workforce. The UNLV NSS Certificate will provide evidence that the graduate has the appropriate education to become a nuclear safeguards and security engineer in NRC-licensed facilities and US DOE's national laboratories.

For more information about your program, including your graduate program handbook and learning outcomes, please visit the Degree Directory.

Plan Admission Requirements
Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

Admission to the NSS Certificate program, either as a MSMNE student or as a non-admitted student, requires both a BS degree in an engineering or related discipline and ME 455/655 Fundamentals of Nuclear Engineering or HPS 701 Applied Nuclear Physics (or an equivalent course). If an applicant can demonstrate equivalent knowledge from relevant work experience (e.g. Navy nuclear reactor program or extensive training and experience at an NRC-licensed or DOE process facility), the Director of the NSS Certificate Program can waive the prerequisite course requirement with the concurrence of the Chair of the Department of Mechanical Engineering based upon review by nuclear engineering faculty.

All applicants must review and follow the Graduate College Admission and Registration Requirements.

Students are accepted into a certificate 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
Total Credits Required: 12
Course Requirements
Required Courses – Credits: 9
ME 757 - Radiation Monitoring and Safeguards Systems

ME 758 - Accelerator Applications in Nuclear Engineering

ME 765 - Neutron Detection and Production

Elective Course – Credits: 3
Complete one of the following courses, or another advisor approved NSS-relevant Mechanical Engineering, Radiochemistry or Health Physics graduate course.

ME 756 - Monte Carlo Methods in Nuclear Engineering

ME 760 - Waste Management And The Nuclear Fuel Cycle

Certificate Requirements
1. Completion of a minimum of 12 credit hours.
2. A grade point average of at least 3.00 for course work required for the certificate.
3. No grade lower than B is acceptable.

Plan Certificate Completion Requirements
The student must submit all required forms to the Graduate College and then apply for graduation in MyUNLV by the appropriate deadline.

Doctor of Philosophy - Mechanical Engineering

Plan Description

The Department of Mechanical Engineering offers a program leading to the Ph.D. degree in Engineering in the field of Mechanical Engineering. The program also offers the Ph.D. degree with a concentration in the field of Nuclear Engineering.

For more information about your program, including your graduate program handbook and learning outcomes, please visit the Degree Directory.

Plan Admission Requirements

Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

Application for the Ph.D. program can be completed by one of two mechanisms. The Post-Master's Track requires the student to complete an M.S. degree in Engineering or equivalent with a major in mechanical engineering or closely related fields (nuclear engineering or health physics for the Nuclear concentration track). The Post-Bachelor's Track allows those undergraduates with outstanding undergraduate backgrounds to enter the Ph.D. program without having to complete an M.S. degree. The degree requirements for both options are the same beyond the B.S. degree excluding the completion of a master's thesis.

In order to be admitted to the Ph.D. program in Engineering in the field of Mechanical Engineering, a student must complete the following requirements:

1. Applicants must complete the on-line process in the Grad Rebel Gateway system.
2. Mechanical Engineering applicants must provide two additional items while completing the process in the Grad Rebel Gateway system:
    1. Submit a written statement of purpose indicating interests and objectives in working toward a Ph.D. degree. This is a 1-2 page essay describing the applicant's reasons for considering graduate study, goals after completion of the graduate degree, and the applicant's specific areas of interest.
    2. Submit three letters of recommendation using the online recommendation system. There is no specified format. Each letter should detail the potential of the applicant for success in a Mechanical Engineering Ph.D. program.
    3. Candidates who do not meet all the requirements may be admitted with conditional or provisional status. Details of the conditions or provisions required will be provided with the notification of admittance.
    4. Before acceptance into the Ph.D. program, potential students may take courses as a non-degree seeking student. Up to 15 credits can be applied to the degree program if they meet curriculum requirements.
    5. The applicant must submit an official copy of the Graduate Record Examination (GRE) test scores. The GRE university code for UNLV is 4861. The Mechanical Engineering Department code is 1502. The minimum required score is at or above 75 percentile range in the quantitative reasoning section. The Graduate Program Committee can modify this requirement if necessary. The GRE requirement is waived for students participating in the Integrated BS-PhD track.
    6. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.
    7. Admitted students with non-engineering backgrounds will be required to complete a set of courses that will assure successful completion of the Ph.D. specialization and qualify the student to sit for the Fundamentals of Engineering (FE) exam. The Graduate Program Committee or Graduate Coordinator will specify a list of required undergraduate courses that must be completed within the first year. These courses are in addition to those required for the graduate degree.

Post-Master's Track

1. The applicant must have a Master of Science in Engineering degree or equivalent with a major in mechanical engineering or a closely allied field.
2. A minimum post-baccalaureate GPA of 3.30 (on a 4.00 scale) is required for graduates from accredited U.S. institutions. The Graduate College is responsible for international GPA interpretation.

Post-Bachelor's Track

1. The applicant must have a bachelor's degree in engineering or a closely related discipline.
2. A minimum GPA of 3.50 (on a 4.00 scale) is required for graduates from accredited U.S. institutions. The Graduate College is responsible for international GPA interpretation.

Integrated BS-PhD Track

The Integrated BS-PhD degree program is designed to provide high-achieving UNLV Mechanical Engineering undergraduate students with the opportunity to take graduate courses that can count toward both the B.S. and Ph.D. ME degree programs at UNLV. This will hopefully encourage them to continue with a graduate degree by reducing the time needed for degree completion. Up to nine credit hours of approved graduate-level course work can be taken as technical electives for the grade of B or better during the senior year and those credit hours will be waived for the graduate degree. The GRE requirement is waived for students participating in the Integrated BS-PhD track. The following conditions are needed to enroll in the Integrated BS-PhD program:

1. A minimum of two semesters of full-time enrollment in B.S. of Mechanical Engineering program is required.
2. Applications are normally submitted with two semesters remaining in the senior year.
3. A minimum of 90 credit hours of course work applicable to the B.S. of Mechanical Engineering degree with a cumulative GPA of 3.50 or higher must be completed before beginning the joint degree program.
4. Student must submit three letters of recommendation to the Mechanical Engineering Graduate Program Coordinator.

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 Requirements: Post-Master's Track
Total Credits Required: 39
Course Requirements
Required Courses – Credits: 9
Complete 9 credits from any Mechanical Engineering 600- or 700-level courses.

Elective Courses – Credits: 12
Complete 12 credits of 600- or 700-level coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Dissertation – Credits: 18
ME 799 - Dissertation

Degree Requirements
1. Complete a minimum of 21 credit hours of course work beyond the degree of Master of Science in Engineering (M.S.) or equivalent with an overall minimum GPA of 3.20 and a minimum GPA of 2.70 (B-) in each class. Ph.D. candidates who do not maintain this GPA requirement will be placed on probation.
2. Out of the 21 credit hours of course work a minimum of 18 of these credits must be 700-level courses, and no more than 6 credits can be from ME 791 Graduate Independent Study. In addition to these course requirements, a minimum of 18 credits of Dissertation is required.
3. The student's Doctoral Advisory Committee may add other requirements in accordance with the individual's background and area of study. No more than 15 non-matriculated credits including transfer credits are allowed.
4. The student must identify a Dissertation Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Doctoral Advisory Committee that includes at least five members:
    1. One Dissertation Advisor. A student may have two co-Advisors but they count as one committee member.
    2. Three Mechanical Engineering Department faculty members. At the discretion of the Dissertation Advisor and student, one of these three can be from a relevant supporting field outside of the department or university.
    3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.
    5. The program of study must be submitted by the second semester of study. The program of study is to be prepared by the student and his/her doctoral advisor, and must be approved by the student's Doctoral Advisory Committee and the GPC.
    6. The student must pass a written Qualifying Exam consisting of two sections, Mathematics and a Major subject area chosen from the following list:
        1. Dynamics and Control
        2. Fluid Mechanics
        3. Material Science
        4. Solid Mechanics and Mechanical Design
        5. Thermal Sciences
        6. Nuclear Engineering

        These examinations are prepared by a department committee and based on undergraduate senior level courses. Qualifying exams are held every semester. The first attempt at taking the qualifying exam must be scheduled during the first year of study. They can be taken a maximum of two times. Failure to take the exam within the first year or failure to pass the exam in the second attempt will automatically result in terminating the student from the program.
7. Students must submit a written report to their Doctoral Advisory Committee consisting of a relevant literature review, dissertation research objectives, and outline of planned work to meet those objectives. The student must also present this proposal to their committee and be prepared to discuss and defend their objectives and plan. This report and presentation is known as the "Preliminary Exam".
    1. The Preliminary Exam must be scheduled within one semester of passing the Qualifying Exam.
    2. The Preliminary Exam can be taken only once per semester but may be repeated until passed.
8. The student is advanced to candidacy for the Ph.D. upon completion of all course work, the Qualifying Exam and the Preliminary Exam.

Plan Graduation Requirements
See Plan Graduation Requirements below.

Subplan 2 Requirements: Post-Master's Nuclear Engineering Track
Total Credits Required: 39
Course Requirements
Required Courses – Credits: 9
Students in the Nuclear Engineering concentration must take three courses (9 credits) from the following list:
ME 655 - Fundamentals of Nuclear Engineering

ME 700 - Advanced Fluid Mechanics I

ME 701 - Advanced Fluid Mechanics II

ME 702 - Computational Fluid Dynamics

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 707 - Radiation Heat Transfer

ME 708 - Convective Boiling and Condensation

ME 711 - Advanced Thermodynamics

ME 754 - Introduction to Nuclear Criticality Safety

ME 755 - Nuclear Criticality Safety Engineering

ME 756 - Monte Carlo Methods in Nuclear Engineering

ME 757 - Radiation Monitoring and Safeguards Systems

ME 758 - Accelerator Applications in Nuclear Engineering

ME 760 - Waste Management And The Nuclear Fuel Cycle

ME 762 - Nuclear Power Engineering

ME 763 - Nuclear Reactor Analysis

HPS 602 - Radiation Detection

HPS 603 - Radiation Physics and Instrumentation Laboratory

HPS 701 - Applied Nuclear Physics

HPS 703 - Radiation Interactions and Transport

HPS 719 - Introduction to Radioanalytical Chemistry

HPS 720 - Radiation Dosimetry

HPS 730 - Advanced Radiation Biology

Elective Courses – Credits: 12
Complete 12 credits of 600- or 700-level coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Dissertation – Credits: 18
ME 799 - Dissertation

Degree Requirements
1. Complete a minimum of 21 credit hours of course work beyond the degree of Master of Science in Engineering (M.S.) or equivalent with an overall minimum GPA of 3.20 and a minimum GPA of 2.70 (B-) in each class. Ph.D. candidates who do not maintain this GPA requirement will be placed on probation.
2. Out of the 21 credit hours of course work a minimum of 18 of these credits must be 700-level courses, and no more than 6 credits can be from ME 791 Graduate Independent Study. In addition to these course requirements, a minimum of 18 credits of Dissertation is required.
3. The student's Doctoral Advisory Committee may add other requirements in accordance with the individual's background and area of study. No more than 15 non-matriculated credits including transfer credits are allowed.
4. The student must identify a Dissertation Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Doctoral Advisory Committee that includes at least five members:
    1. One Dissertation Advisor. A student may have two co-Advisors but they count as one committee member.
    2. Three Mechanical Engineering Department faculty members. At the discretion of the Dissertation Advisor and student, one of these three can be from a relevant supporting field outside of the department or university.
    3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.
5. The program of study must be submitted by the second semester of study. The program of study is to be prepared by the student and his/her doctoral advisor, and must be approved by the student's Doctoral Advisory Committee and the GPC.
6. The student must pass a written Qualifying Exam consisting of two sections, Mathematics and a Major subject area chosen from the following list:
    1. Dynamics and Control
    2. Fluid Mechanics
    3. Material Science
    4. Solid Mechanics and Mechanical Design
    5. Thermal Sciences
    6. Nuclear Engineering

    These examinations are prepared by a department committee and based on undergraduate senior level courses. Qualifying exams are held every semester. The first attempt at taking the qualifying exam must be scheduled during the first year of study. They can be taken a maximum of two times. Failure to take the exam within the first year or failure to pass the exam in the second attempt will automatically result in terminating the student from the program.
7. Students must submit a written report to their Doctoral Advisory Committee consisting of a relevant literature review, dissertation research objectives, and outline of planned work to meet those objectives. The student must also present this proposal to their committee and be prepared to discuss and defend their objectives and plan. This report and presentation is known as the "Preliminary Exam".
    1. The Preliminary Exam must be scheduled within one semester of passing the Qualifying Exam.
    2. The Preliminary Exam can be taken only once per semester but may be repeated until passed.
8. The student is advanced to candidacy for the Ph.D. upon completion of all course work, the Qualifying Exam and the Preliminary Exam.

Plan Graduation Requirements
See Plan Graduation Requirements below.

Subplan 3 Requirements: Post-Bachelor's Track
Total Credits Required: 63
Course Requirements
Required Courses – Credits: 18
Complete 18 credits from any Mechanical Engineering 600- or 700-level courses.

Elective Courses – Credits: 27
Complete 27 credits of 600- or 700-level coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Dissertation – Credits: 18
ME 799 - Dissertation

Degree Requirements
1. Complete a minimum of 45 credit hours of course work beyond the degree of Bachelor of Science in Engineering (B.S.) or equivalent with an overall minimum GPA of 3.20 and a minimum GPA of 2.70 (B-) in each class. Ph.D. candidates who do not maintain this GPA requirement will be placed on probation. Students on academic probation may be transferred to the M.S.M.E. Program depending on the student's academic record.

2. Out of the 45 credit hours of course work, a minimum of 33 credits must be in 700-level courses, and no more than 9 credits can be from ME 791 Graduate Independent Study. In addition to these course requirements, a minimum of 18 credits of Dissertation is required.
3. The student's doctoral advisory committee may add more requirements in accordance with the individual's background and field of study. No more than 15 non matriculated credits including transfer credits is allowed.
4. The student must identify a Dissertation Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Doctoral Advisory Committee that includes at least five members:
   1. One Dissertation Advisor. A student may have two co-Advisors but they count as one committee member.
   2. Three Mechanical Engineering Department faculty members. At the discretion of the Dissertation Advisor and student, one of these three can be from a relevant supporting field outside of the department or university.
   3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.
5. The program of study must be submitted by the second semester of study. The program of study is to be prepared by the student and his/her doctoral advisor, and must be approved by the student's Doctoral Advisory Committee and the GPC.
6. The student must pass a written Qualifying Exam consisting of two sections, Mathematics and a Major subject area chosen from the following list:
   1. Dynamics and Control
   2. Fluid Mechanics
   3. Material Science
   4. Solid Mechanics and Mechanical Design
   5. Thermal Sciences
   6. Nuclear Engineering

   These examinations are prepared by a department committee and based on undergraduate senior level courses. Qualifying exams are held every semester. The qualifying exams must be scheduled during the first year of study. They can be taken a maximum of two times. Failure to take the exam within the first year or failure to pass the exam in the second attempt will automatically result in terminating the student from the program.
7. Students must submit a written report to their Doctoral Advisory Committee consisting of a relevant literature review, dissertation research objectives, and outline of planned work to meet those objectives. The student must also present this proposal to their committee and be prepared to discuss and defend their objectives and plan. This report and presentation is known as the "Preliminary Exam".
   1. The Preliminary Exam must be scheduled within one semester of passing the Qualifying Exam.
   2. The Preliminary Exam can be taken only once per semester but may be repeated until passed.
8. The student is advanced to candidacy for the Ph.D. upon completion of all course work, the Qualifying Exam and the Preliminary Exam.

Plan Graduation Requirements
See Plan Graduation Requirements below.

Subplan 4 Requirements: Post-Bachelor's Nuclear Engineering Track
Total Credits Required: 63
Course Requirements
Required Courses – Credits: 18
Students in the Nuclear Engineering concentration must take three courses (9 credits) from the following list:

ME 655 - Fundamentals of Nuclear Engineering

ME 700 - Advanced Fluid Mechanics I

ME 701 - Advanced Fluid Mechanics II

ME 702 - Computational Fluid Dynamics

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 707 - Radiation Heat Transfer

ME 708 - Convective Boiling and Condensation

ME 711 - Advanced Thermodynamics

ME 754 - Introduction to Nuclear Criticality Safety

ME 755 - Nuclear Criticality Safety Engineering

ME 756 - Monte Carlo Methods in Nuclear Engineering

ME 760 - Waste Management And The Nuclear Fuel Cycle

ME 762 - Nuclear Power Engineering

ME 763 - Nuclear Reactor Analysis

HPS 602 - Radiation Detection

HPS 603 - Radiation Physics and Instrumentation Laboratory

HPS 701 - Applied Nuclear Physics

HPS 703 - Radiation Interactions and Transport

HPS 719 - Introduction to Radioanalytical Chemistry

HPS 720 - Radiation Dosimetry

HPS 730 - Advanced Radiation Biology

Elective Courses – Credits: 27
Complete 27 credits of 600- or 700-level coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Dissertation – Credits: 18
ME 799 - Dissertation

Degree Requirements
1. Complete a minimum of 45 credit hours of course work beyond the degree of Bachelor of Science in Engineering (B.S.) or equivalent with an overall minimum GPA of 3.20 and a minimum GPA of 2.70 (B-) in each class. Ph.D. candidates who do not maintain this GPA requirement will

be placed on probation. Students on academic probation may be transferred to the M.S.M.E. Program depending on the student's academic record.
2. Out of the 45 credit hours of course work, a minimum of 33 credits must be in 700-level courses, and no more than 9 credits can be from ME 791 Graduate Independent Study. In addition to these course requirements, a minimum of 18 credits of Dissertation is required.
3. The student's doctoral advisory committee may add more requirements in accordance with the individual's background and field of study. No more than 15 non-matriculated credits including transfer credits is allowed.
4. The student must identify a Dissertation Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Doctoral Advisory Committee that includes at least five members:
   1. One Dissertation Advisor. A student may have two co-Advisors but they count as one committee member.
   2. Three Mechanical Engineering Department faculty members. At the discretion of the Dissertation Advisor and student, one of these three can be from a relevant supporting field outside of the department or university.
   3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.
5. The program of study must be submitted by the second semester of study. The program of study is to be prepared by the student and his/her doctoral advisor, and must be approved by the student's Doctoral Advisory Committee and the GPC.
6. The student must pass a written Qualifying Exam consisting of two sections, Mathematics and a Major subject area chosen from the following list:
   1. Dynamics and Control
   2. Fluid Mechanics
   3. Material Science
   4. Solid Mechanics and Mechanical Design
   5. Thermal Sciences
   6. Nuclear Engineering

   These examinations are prepared by a department committee and based on undergraduate senior level courses. Qualifying exams are held every semester. The qualifying exams must be scheduled during the first year of study. They can be taken a maximum of two times. Failure to take the exam within the first year or failure to pass the exam in the second attempt will automatically result in terminating the student from the program.
7. Students must submit a written report to their Doctoral Advisory Committee consisting of a relevant literature review, dissertation research objectives, and outline of planned work to meet those objectives. The student must also present this proposal to their committee and be prepared to discuss and defend their objectives and plan. This report and presentation is known as the "Preliminary Exam".
   1. The Preliminary Exam must be scheduled within one semester of passing the Qualifying Exam.
   2. The Preliminary Exam can be taken only once per semester but may be repeated until passed.
8. The student is advanced to candidacy for the Ph.D. upon completion of all course work, the Qualifying Exam and the Preliminary Exam.

Plan Graduation Requirements
See Plan Graduation Requirements below.

Subplan 5 Requirements: Integrated BS-PhD Track
Total Credits Required: 54-60
Students admitted into this track have taken 3, 6 or 9 credits of graduate level courses that were applied toward their B.S. degree in Mechanical Engineering at UNLV. These credits reduce the total needed to complete the Ph.D. degree.

Course Requirements
Required Courses – Credits: 18
Complete 18 credits from any Mechanical Engineering 600- or 700-level courses.

Elective Courses – Credits: 18-24
Complete 18-24 credits of 600- or 700-level coursework from within the College of Engineering. The total number of credits depends on the number of graduate credits taken toward the student's B.S. degree. Courses from outside the College of Engineering may be taken with advisor approval.

Dissertation – Credits: 18
ME 799 - Dissertation

Degree Requirements
1. Complete a minimum of 36-42 credit hours of course work beyond the degree of Bachelor of Science in Engineering (B.S.) or equivalent with an overall minimum GPA of 3.20 and a minimum GPA of 2.70 (B-) in each class. The exact number of credits needed depends on the number of graduate credits applied toward the students' B.S. degree. Ph.D. candidates who do not maintain this GPA requirement will be placed on probation. Students on academic probation may be transferred to the M.S.M.E. Program depending on the student's academic record.
2. Out of the 36-42 credit hours of course work, a minimum of 33 credits must be in 700-level courses, and no more than 9 credits can be from ME 791 Graduate Independent Study. Students who took 700-level courses toward their B.S. degree can count these credits toward the required total of 33 700-level credits. In addition to these course requirements, a minimum of 18 credits of Dissertation is required.
3. The student's doctoral advisory committee may add more requirements in accordance with the individual's background and field of study. No more than 15 non-matriculated credits including transfer credits is allowed.
4. The student must identify a Dissertation Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Doctoral Advisory Committee that includes at least five members:
   1. One Dissertation Advisor. A student may have two co-Advisors but they count as one committee member.
   2. Three Mechanical Engineering Department faculty members. At the discretion of the Dissertation Advisor and student, one of these three can be from a relevant supporting field outside of the department or university.

3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.

5. The program of study must be submitted by the second semester of study. The program of study is to be prepared by the student and his/her doctoral advisor, and must be approved by the student's Doctoral Advisory Committee and the GPC.
6. The student must pass a written Qualifying Exam consisting of two sections, Mathematics and a Major subject area chosen from the following list:
   1. Dynamics and Control
   2. Fluid Mechanics
   3. Material Science
   4. Solid Mechanics and Mechanical Design
   5. Thermal Sciences
   6. Nuclear Engineering

   These examinations are prepared by a department committee and based on undergraduate senior level courses. Qualifying exams are held every semester. The qualifying exams must be scheduled during the first year of study. They can be taken a maximum of two times. Failure to take the exam within the first year or failure to pass the exam in the second attempt will automatically result in terminating the student from the program.
7. Students must submit a written report to their Doctoral Advisory Committee consisting of a relevant literature review, dissertation research objectives, and outline of planned work to meet those objectives. The student must also present this proposal to their committee and be prepared to discuss and defend their objectives and plan. This report and presentation is known as the "Preliminary Exam".
   1. The Preliminary Exam must be scheduled within one semester of passing the Qualifying Exam.
   2. The Preliminary Exam can be taken only once per semester but may be repeated until passed.
8. The student is advanced to candidacy for the Ph.D. upon completion of all course work, the Qualifying Exam and the Preliminary Exam.

Plan Graduation Requirements
See Plan Graduation Requirements below.

Subplan 6 Requirements: Integrated BS-PhD Nuclear Engineering Track
Total Credits Required: 54-60
Students admitted into this track have taken 3, 6 or 9 credits of graduate level courses that were applied toward their B.S. degree in Mechanical Engineering at UNLV. These credits reduce the total needed to complete the Ph.D. degree.

Course Requirements
Required Courses – Credits: 18
Complete 9 credits from any Mechanical Engineering 600- or 700-level courses and an additional 9 credits from the following list of courses:
ME 655 - Fundamentals of Nuclear Engineering

ME 700 - Advanced Fluid Mechanics I

ME 701 - Advanced Fluid Mechanics II

ME 702 - Computational Fluid Dynamics

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 707 - Radiation Heat Transfer

ME 708 - Convective Boiling and Condensation

ME 711 - Advanced Thermodynamics

ME 754 - Introduction to Nuclear Criticality Safety

ME 755 - Nuclear Criticality Safety Engineering

ME 756 - Monte Carlo Methods in Nuclear Engineering

ME 760 - Waste Management And The Nuclear Fuel Cycle

ME 762 - Nuclear Power Engineering

ME 763 - Nuclear Reactor Analysis

HPS 602 - Radiation Detection

HPS 603 - Radiation Physics and Instrumentation Laboratory

HPS 701 - Applied Nuclear Physics

HPS 703 - Radiation Interactions and Transport

HPS 719 - Introduction to Radioanalytical Chemistry

HPS 720 - Radiation Dosimetry

HPS 730 - Advanced Radiation Biology

Elective Courses – Credits: 18-24
Complete 18-24 credits of 600- or 700-level coursework from within the College of Engineering. The total number of credits depends on the number of graduate credits taken toward the student's B.S. degree. Courses from outside the College of Engineering may be taken with advisor approval.

Dissertation – Credits: 18
ME 799 - Dissertation

Degree Requirements

1. Complete a minimum of 36-42 credit hours of course work beyond the degree of Bachelor of Science in Engineering (B.S.) or equivalent with an overall minimum GPA of 3.20 and a minimum GPA of 2.70 (B-) in each class. The exact number of credits needed depends on the number of graduate credits applied toward the students' B.S. degree. Ph.D. candidates who do not maintain this GPA requirement will be placed on probation. Students on academic probation may be transferred to the M.S.M.E. Program depending on the student's academic record.
2. Out of the 36-42 credit hours of course work, a minimum of 33 credits must be in 700-level courses, and no more than 9 credits can be from ME 791 Graduate Independent Study. Students who took 700-level courses toward their B.S. degree can count these credits toward the required total of 33 700-level credits. In addition to these course requirements, a minimum of 18 credits of Dissertation is required.
3. The student's doctoral advisory committee may add more requirements in accordance with the individual's background and field of study. No more than 15 non-matriculated credits including transfer credits is allowed.
4. The student must identify a Dissertation Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Doctoral Advisory Committee that includes at least five members:
    1. One Dissertation Advisor. A student may have two co-Advisors but they count as one committee member.
    2. Three Mechanical Engineering Department faculty members. At the discretion of the Dissertation Advisor and student, one of these three can be from a relevant supporting field outside of the department or university.
    3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.
5. The program of study must be submitted by the second semester of study. The program of study is to be prepared by the student and his/her doctoral advisor, and must be approved by the student's Doctoral Advisory Committee and the GPC.
6. The student must pass a written Qualifying Exam consisting of two sections, Mathematics and a Major subject area chosen from the following list:
    1. Dynamics and Control
    2. Fluid Mechanics
    3. Material Science
    4. Solid Mechanics and Mechanical Design
    5. Thermal Sciences
    6. Nuclear Engineering

    These examinations are prepared by a department committee and based on undergraduate senior level courses. Qualifying exams are held every semester. The qualifying exams must be scheduled during the first year of study. They can be taken a maximum of two times. Failure to take the exam within the first year or failure to pass the exam in the second attempt will automatically result in terminating the student from the program.
7. Students must submit a written report to their Doctoral Advisory Committee consisting of a relevant literature review, dissertation research objectives, and outline of planned work to meet those objectives. The student must also present this proposal to their committee and be prepared to discuss and defend their objectives and plan. This report and presentation is known as the "Preliminary Exam".
    1. The Preliminary Exam must be scheduled within one semester of passing the Qualifying Exam.
    2. The Preliminary Exam can be taken only once per semester but may be repeated until passed.
8. The student is advanced to candidacy for the Ph.D. upon completion of all course work, the Qualifying Exam and the Preliminary Exam.

Plan Graduation Requirements

See Plan Graduation Requirements below.

Plan Graduation Requirements

1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her dissertation by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy dissertation to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Master of Science - Biomedical Engineering

Plan Description

The objective of the M.S.B.E. degree program is to provide a graduate-level educational experience that will prepare individuals to undertake design and research in the area of biomedical engineering. The program is multidisciplinary and integrates knowledge from the traditional engineering sciences, the life sciences, and medicine.

Specific goals of the program include development of:

1. A thorough grounding in the life sciences;
2. Mastery of engineering tools and approaches;
3. Familiarity with the problems of making and interpreting quantitative measurements of living systems;
4. The ability to use modeling techniques; and
5. The ability to formulate and solve problems with medical relevance, including the design of devices, systems, and processes to improve human health.

For more information about your program, including your graduate program handbook and learning outcomes please visit the Degree Directory.

Plan Admission Requirements

Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

In addition to the general requirements for admission to the Graduate College, an applicant for the M.S. program must complete the following requirements:

1. Applicants must complete the on-line process in the Grad Rebel Gateway system.
2. Mechanical Engineering applicants must provide two additional items while completing the process in the Grad Rebel Gateway system:
    1. A written statement of purpose indicating interests and objectives in working toward a M.S. degree.
    2. Two letters of recommendation using the online recommendation system. There is no specified format. Each letter should detail the potential of the applicant for success in a Mechanical Engineering M.S. program.
    3. The applicant must have a bachelor's degree in engineering or a closely related discipline. Admitted students with non-engineering backgrounds will be required to complete a set of course work requirements that will assure successful completion of the M.S. specialization and qualify the student to sit for the Fundamentals of Engineering (FE) exam. The Graduate Program Committee or Graduate Coordinator will specify a list of required undergraduate courses that must be completed within the first year. These courses are in addition to those required for the graduate degree.
    4. The applicant must submit an official copy of the Graduate Record Examination (GRE) test scores. The GRE university code for UNLV is 4861. The Mechanical Engineering Department code is 1502. The minimum required score is at or above 70 percentile range in the quantitative reasoning section. The Graduate Program Committee can modify this requirement if necessary. The GRE requirement is waived for students participating in the Integrated BS-MS track.
    5. The GPC will examine the applicant's academic record and will make the final determination of the applicant's admissibility to the M.S. program. In general, a minimum post baccalaureate GPA of 3.00 on a 4.00 scale or equivalent is required for admission in addition to a GPA of 3.00 on a 4.00 scale or equivalent in all engineering courses.
    6. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

Students who have not taken at least three of the courses listed below (or their equivalent), will be required to do so in addition to course requirements listed below.

BIO 209 – Introduction to Cell Biology

BIO 360 – Mammalian Physiology

CHE 225 – Organic Chemistry I

BIOL 209 – Introduction to Cell Biology

BIOL 223 – Human Anatomy and Physiology I

BIOL 480 – Introduction to Biological Modeling

CHEM 220 – Introductory Organic Chemistry

CHEM 474 – Biochemistry I

CHEM 478 – Endocrinology

MATH 283 – Calculus III

MATH 427 – Differential Equations I

MATH 431 – Mathematics for Engineers and Scientists I

STAT 463 – Applied Statistics for Engineers

ME 301 – Structure and Properties of Solids

ME 302 – Material Mechanics

ME 311 – Engineering Thermodynamics

ME 314 – Introduction to Heat Transfer

ME 380 – Fluid Dynamics for Mechanical Engineers

ME 402 – Computational Methods for Engineers

ME 421 – Automatic Controls

ME 425 – Robotics

The Integrated BS-MS degree program is designed to provide high-achieving UNLV Mechanical Engineering undergraduate students with the opportunity to take graduate courses that can count toward both the B.S. and M.S. ME degree programs at UNLV. This will hopefully encourage them to continue with a graduate degree by reducing the time needed for degree completion. Up to nine credit hours of approved graduate-level course work can be taken as technical electives for the grade of B or better during the senior year and those credit hours will be waived for the graduate degree. The GRE requirement is waived for students participating in the Integrated BS-MS track. The following conditions are needed to enroll in the Integrated BS-MS program:

1. A minimum of two semesters of full-time enrollment in B.S. of Mechanical Engineering program is required.
2. Applications are normally submitted with two semesters remaining in the senior year.
3. A minimum of 90 credit hours of course work applicable to the B.S. of Mechanical Engineering degree with a cumulative GPA of 3.3 or higher must be completed before beginning the joint degree program.
4. Student has to choose the thesis option.

All applicants must review and follow the Graduate College Admission and Registration Requirements.

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 Requirements: Non-Thesis Track
Total Credits Required: 30
Course Requirements
Required Courses – Credits: 27
Complete 27 credits of advisor-approved common core introductory biomedical engineering and health science courses.

Design Project – Credits: 3
ME 796 - Design Project in Mechanical Engineering

Degree Requirements
1. Requires 30 credits of approved graduate courses. At least 18 credits must be earned from 700-level courses, and 15 credits must be in engineering.
2. Students must make satisfactory progress toward degree completion as defined below:
   1. File an approved degree program before the completion of nine credits of coursework.
   2. Complete at least six credits of the approved program per calendar year.
   3. Maintain a grade point average (GPA) of 3.00 on a 4.00 scale with no grades below C. Grades of C- or below are not acceptable.
   3. Students must comply with Graduate College policy. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College.
   4. Courses numbered below 600 do not count toward the hours required for the M.S. degree.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. Successfully complete a design project.

Subplan 2 Requirements: Thesis Track
Total Credits Required: 30
Course Requirements
Required Courses – Credits: 24
Complete 24 credits of advisor-approved common core introductory biomedical engineering and health science courses.

Thesis – Credits: 6
ME 797 - Thesis in Mechanical Engineering

Degree Requirements
1. Requires 24 credits of approved graduate courses plus six credits of work associated with the master's level thesis, for a total of 30 credits. At least 15 credits must be earned from 700-level courses, and at least 15 credits must be in engineering. The final examination will include a defense of thesis.
2. Students must make satisfactory progress toward degree completion as defined below:
   1. File an approved degree program before the completion of nine credits of coursework.
   2. Complete at least six credits of the approved program per calendar year.
   3. Maintain a grade point average (GPA) of 3.00 on a 4.00 scale with no grades below C. Grades of C- or below are not acceptable.
3. Students must comply with Graduate College policy. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College.
4. Courses numbered below 600 do not count toward the hours required for the M.S. degree.
5. The student must identify a Thesis Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Thesis Committee that includes at least four members:
   1. One Thesis Advisor. A student may have two co-Advisors but they count as one committee member.
   2. Two Mechanical Engineering Department faculty members.
   3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Subplan 3 Requirements: Integrated BS-MS Track
Total Credits Required: 21-27
Students admitted into this track have taken 3, 6 or 9 credits of graduate level courses that were applied toward their B.S. degree in Mechanical Engineering at UNLV. These credits reduce the total needed to complete the M.S. degree.

Course Requirements
Required Courses – Credits: 15-21
Complete 15-21 credits of advisor-approved common core introductory biomedical engineering and health science courses.

Thesis – Credits: 6
ME 797 - Thesis in Mechanical Engineering

Degree Requirements
1. 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.
2. Requires 15-21 credits of approved graduate courses plus six credits of work associated with the master's level thesis, for a total of 21-27 credits. At least 15 credits must be earned from 700-level courses, and at least 15 credits must be in engineering. The final examination will include a defense of thesis.
3. Students must make satisfactory progress toward degree completion as defined below:
    1. File an approved degree program before the completion of nine credits of coursework.
    2. Complete at least six credits of the approved program per calendar year.
    3. Maintain a grade point average (GPA) of 3.00 on a 4.00 scale with no grades below C. Grades of C- or below are not acceptable.
    4. Courses numbered below 600 do not count toward the hours required for the M.S. degree.
    5. The student must identify a Thesis Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Thesis Committee that includes at least four members:
        1. One Thesis Advisor. A student may have two co-Advisors but they count as one committee member.
        2. Two Mechanical Engineering Department faculty members.
        3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Plan Graduation Requirements
Refer to your subplan for Graduation Requirements.

Master of Science - Materials and Nuclear Engineering

Plan Description

The Master of Science degree is intended to provide the student with a solid background in either applied nuclear science and engineering, with an emphasis in used fuel management, criticality, or radiation detection, or material science and engineering, with an emphasis in materials performance. The program consists of two master's degree tracks: Materials Engineering and Nuclear Engineering. The materials engineering track consists of a core curriculum in material science, metallurgy, and materials performance, which is to be augmented by advanced level classes in corrosion engineering, physical metallurgy, mechanical metallurgy, mechanics of materials, and nuclear materials. The nuclear engineering track consists of a core curriculum in applied nuclear science and engineering, coupled with advanced classes in the student's sub discipline.

For more information about your program including your graduate program handbook and learning outcomes please visit the Degree Directory.

Plan Admission Requirements

Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

In addition to the general requirements for admission to the Graduate College, an applicant for the M.S. program must complete the following requirements:

1. Applicants must complete the on-line process in the Grad Rebel Gateway system.
2. Mechanical Engineering applicants must provide two additional items while completing the process in the Grad Rebel Gateway system:
    1. A written statement of purpose indicating interests and objectives in working toward a M.S. degree.
    2. Two letters of recommendation using the online recommendation system. There is no specified format. Each letter should detail the potential of the applicant for success in this M.S. program.
    3. The applicant must have a bachelor's degree in engineering or a closely related discipline. Admitted students with non-engineering backgrounds will be required to complete a set of courses that will assure successful completion of the M.S. specialization and qualify the student to sit for the Fundamentals of Engineering (FE) exam. The Graduate Program Committee or Graduate Coordinator will specify a list of required undergraduate courses that must be completed within the first year. These courses are in addition to those required for the graduate degree.
    4. The applicant must submit an official copy of the Graduate Record Examination (GRE) test scores. The GRE university code for UNLV is 4861. The Mechanical Engineering Department code is 1502. The minimum required score is at or above 70 percentile range in the quantitative reasoning section. The Graduate Program Committee can modify this requirement if necessary. The GRE requirement is waived for students participating in the Integrated BS-MS track.
    5. The GPC will examine the applicant's academic record and will make the final determination of the applicant's admissibility to the M.S. program. In general, a minimum post baccalaureate GPA of 3.00 on a 4.00 scale or equivalent is required for admission in addition to a GPA of 3.00 on a 4.00 scale or equivalent in all engineering courses.
    6. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

The Integrated BS-MS degree program is designed to provide high-achieving UNLV Mechanical Engineering undergraduate students with the opportunity to take graduate courses that can count toward both the B.S. and M.S. ME degree programs at UNLV. This will hopefully encourage them to continue with a graduate degree by reducing the time needed for degree completion. Up to nine credit hours of approved graduate-level course work can be taken as technical electives for the grade of B or better during the senior year and those credit hours will be waived for the graduate degree. The GRE requirement is waived for students participating in the Integrated BS-MS track. The following conditions are needed to enroll in the Integrated BS-MS program:

1. A minimum of two semesters of full-time enrollment in B.S. of Mechanical Engineering program is required.
2. Applications are normally submitted with two semesters remaining in the senior year.
3. A minimum of 90 credit hours of course work applicable to the B.S. of Mechanical Engineering degree with a cumulative GPA of 3.3 or higher must be completed before beginning the joint degree program.
4. Student has to choose the thesis option.

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 Requirements: Non-Thesis Track
Total Credits Required: 30
Course Requirements
Required Courses - Credits: 9

Select one of the following specializations and complete three courses:

Materials Engineering

ME 622 - Nanomaterials for Energy Applications

ME 630 - Corrosion Engineering

ME 646 - Composite Materials

ME 695 - Special Topics in Engineering

ME 732 - Mechanical Metallurgy

ME 734 - Fracture of Engineering Materials

ME 741 - Energy and Variational Methods in Applied Mechanics I

Nuclear Engineering
ME 655 - Fundamentals of Nuclear Engineering

ME 706 - Convective Heat Transfer

ME 754 - Introduction to Nuclear Criticality Safety

ME 755 - Nuclear Criticality Safety Engineering

ME 756 - Monte Carlo Methods in Nuclear Engineering

ME 757 - Radiation Monitoring and Safeguards Systems

ME 758 - Accelerator Applications in Nuclear Engineering

ME 760 - Waste Management And The Nuclear Fuel Cycle

ME 762 - Nuclear Power Engineering

ME 763 - Nuclear Reactor Analysis

PHYS 631 - Nuclear and Elementary Particle Physics

Or

RDCH 701 - Applied Nuclear Physics

Electives - Credits: 18
Complete 18 credits of elective coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Suggested Electives for Materials Engineering Track
ME 650 - Physical Metallurgy

ME 670 - Experimental Mechanics of Materials

ME 742 - Energy and Variational Methods in Applied Mechanics II

Suggested Electives for Nuclear Engineering Track
ME 615 - Design of Thermal Systems

ME 702 - Computational Fluid Dynamics

ME 705 - Conduction Heat Transfer

ME 707 - Radiation Heat Transfer

ME 708 - Convective Boiling and Condensation

ME 711 - Advanced Thermodynamics

Design Project - Credits: 3
ME 796 - Design Project in Mechanical Engineering

Degree Requirements
1. Requires 30 credits of approved graduate courses. At least 18 credits must be earned from 700-level courses, and 15 credits must be in engineering.
2. Students must make satisfactory progress toward degree completion as defined below:
    1. File an approved degree program before the completion of nine credits of coursework.
    2. Complete at least six credits of the approved program per calendar year.
    3. Maintain a grade point average (GPA) of 3.00 on a 4.00 scale with no grades below C. Grades of C- or below are not acceptable.
3. Students must comply with Graduate College policy. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. Successfully complete a design project.

Subplan 2 Requirements: Thesis Track
Total Credits Required: 30
Course Requirements
Required Courses - Credits: 9
Select one of the following specializations and complete three courses:
Materials Engineering
ME 622 – Nanomaterials for Energy Application

ME 630 - Corrosion Engineering

ME 646 - Composite Materials

ME 695 - Special Topics in Engineering

ME 732 - Mechanical Metallurgy

ME 734 - Fracture of Engineering Materials

ME 741 - Energy and Variational Methods in Applied Mechanics I

Nuclear Engineering
ME 655 - Fundamentals of Nuclear Engineering

ME 706 - Convective Heat Transfer

ME 754 - Introduction to Nuclear Criticality Safety

ME 755 - Nuclear Criticality Safety Engineering

ME 756 - Monte Carlo Methods in Nuclear Engineering

ME 757 - Radiation Monitoring and Safeguards Systems

ME 758 - Accelerator Applications in Nuclear Engineering

ME 760 - Waste Management And The Nuclear Fuel Cycle

ME 762 - Nuclear Power Engineering

ME 763 - Nuclear Reactor Analysis

PHYS 631 - Nuclear and Elementary Particle Physics

Or

RDCH 701 - Applied Nuclear Physics

Electives - Credits: 15
Complete 15 credits of elective coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Suggested Electives for Materials Engineering Track
ME 650 - Physical Metallurgy

ME 670 - Experimental Mechanics of Materials

ME 742 - Energy and Variational Methods in Applied Mechanics II

Suggested Electives for Nuclear Engineering Track
ME 615 - Design of Thermal Systems

ME 702 - Computational Fluid Dynamics

ME 705 - Conduction Heat Transfer

ME 707 - Radiation Heat Transfer

ME 708 - Convective Boiling and Condensation

ME 711 - Advanced Thermodynamics

Thesis - Credits: 6
ME 796 - Design Project in Mechanical Engineering

Degree Requirements
1. Requires 24 credits of approved graduate courses plus six credits of work associated with the master's level thesis, for a total of 30 credits. At least 15 credits must be earned from 700-level courses, and at least 15 credits must be in engineering. The final examination will include a defense of thesis.
2. Students must make satisfactory progress toward degree completion as defined below:
    1. File an approved degree program before the completion of nine credits of coursework.
    2. Complete at least six credits of the approved program per calendar year.
    3. Maintain a grade point average (GPA) of 3.00 on a 4.00 scale with no grades below C. Grades of C- or below are not acceptable.
3. Students must comply with Graduate College policy. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College.
4. The student must identify a Thesis Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Thesis Committee that includes at least four members:
    1. One Thesis Advisor. A student may have two co-Advisors but they count as one committee member.
    2. Two Mechanical Engineering Department faculty members.
    3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Subplan 3 Requirements: Integrated BS-MS Track
Total Credits Required: 21-27
Students admitted into this track have taken 3, 6 or 9 credits of graduate level courses that were applied toward their B.S. degree in Mechanical Engineering at UNLV. These credits reduce the total needed to complete the M.S. degree.

Course Requirements
Required Courses - Credits: 9
Select one of the following specializations and complete three courses:
Materials Engineering
ME 622 - Nanomaterials for Energy Applications

ME 630 - Corrosion Engineering

ME 646 - Composite Materials

ME 695 - Special Topics in Engineering

ME 732 - Mechanical Metallurgy

ME 734 - Fracture of Engineering Materials

ME 741 - Energy and Variational Methods in Applied Mechanics I

Nuclear Engineering
ME 655 - Fundamentals of Nuclear Engineering

ME 706 - Convective Heat Transfer

ME 754 - Introduction to Nuclear Criticality Safety

ME 755 - Nuclear Criticality Safety Engineering

ME 756 - Monte Carlo Methods in Nuclear Engineering

ME 757 - Radiation Monitoring and Safeguards Systems

ME 758 - Accelerator Applications in Nuclear Engineering

ME 760 - Waste Management And The Nuclear Fuel Cycle

ME 762 - Nuclear Power Engineering

ME 763 - Nuclear Reactor Analysis

PHYS 631 - Nuclear and Elementary Particle Physics

Or

RDCH 701 - Applied Nuclear Physics

Electives - Credits: 6-12
Complete 6-12 credits of elective coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Suggested Electives for Materials Engineering Track
ME 615 - Design of Thermal Systems

ME 650 - Physical Metallurgy

ME 670 - Experimental Mechanics of Materials

ME 742 - Energy and Variational Methods in Applied Mechanics II

Suggested Electives for Nuclear Engineering Track
ME 615 - Design of Thermal Systems

ME 702 - Computational Fluid Dynamics

ME 705 - Conduction Heat Transfer

ME 707 - Radiation Heat Transfer

ME 708 - Convective Boiling and Condensation

ME 711 - Advanced Thermodynamics

Thesis - Credits: 6
ME 796 - Design Project in Mechanical Engineering

Degree Requirements
1. 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.
2. Requires 15-21 credits of approved graduate courses plus six credits of work associated with the master's level thesis, for a total of 21-27 credits. At least 15 credits must be earned from 700-level courses, and at least 15 credits must be in engineering. The final examination will include a defense of thesis.
3. Students must make satisfactory progress toward degree completion as defined below:
    1. File an approved degree program before the completion of nine credits of coursework.
    2. Complete at least six credits of the approved program per calendar year.
    3. Maintain a grade point average (GPA) of 3.00 on a 4.00 scale with no grades below C. Grades of C- or below are not acceptable.
    4. Only those courses in which a student received a grade of C or better may be used for graduate credit. Students must comply with Graduate College policy.
    5. The student must identify a Thesis Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Thesis Committee that includes at least four members:
        1. One Thesis Advisor. A student may have two co-Advisors but they count as one committee member.
        2. Two Mechanical Engineering Department faculty members.
        3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Plan Graduation Requirements
Refer to your subplan for Graduation Requirements.

Master of Science in Aerospace Engineering

Plan Description
The objectives of the M.S.A.E. degree are to provide a quality graduate educational program that will complement the existing undergraduate and graduate curricula in mechanical engineering. The aerospace graduate program will improve and enhance the capabilities of those students seeking careers in the aerospace field and supporting engineering work for the aerospace and aviation technology community. The majority of students seeking the M.S.A.E. degree will have undergraduate degrees in the fields of mechanical or aerospace engineering, or closely related fields of engineering, applied physics, or applied mathematics; some will already have graduate degrees in the more conventional areas of engineering or the sciences. Those individuals with engineering (as well as physical science) interests will use the M.S.A.E. to develop careers as well as improve their skills in the aerospace and aviation industry. Students enrolling in the program on a full-time basis will likely assist engineering faculty in obtaining sponsored project funding and performing innovative aerospace and aviation engineering research.

For more information about your program including your graduate program handbook and learning outcomes please visit the Degree Directory.

Plan Admission Requirements
Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

In addition to the general requirements for admission to the Graduate College, an applicant for the M.S. program must complete the following requirements:

1. Applicants must complete the on-line process in the Grad Rebel Gateway system.
2. Mechanical Engineering applicants must provide two additional items while completing the process in the Grad Rebel Gateway system:
    1. A written statement of purpose indicating interests and objectives in working toward a M.S. degree.
    2. Two letters of recommendation using the online recommendation system. There is no specified format. Each letter should detail the potential of the applicant for success in a Mechanical Engineering Ph.D. program.
    3. The applicant must have a bachelor's degree in engineering or a closely related discipline. Admitted students with non-engineering backgrounds will be required to complete a set of course work requirements that will assure successful completion of the M.S. specialization and qualify the student to sit for the Fundamentals of Engineering (FE) exam. The Graduate Program Committee or Graduate Coordinator will specify a list of required undergraduate courses that must be completed within the first year. These courses are in addition to those required for the graduate degree.
    4. The applicant must submit an official copy of the Graduate Record Examination (GRE) test scores. The GRE university code for UNLV is 4861. The Mechanical Engineering Department code is 1502. The minimum

required score is at or above 70 percentile range in the quantitative reasoning section. The Graduate Program Committee can modify this requirement if necessary. The GRE requirement is waived for students participating in the Integrated BS-MS track.
5. The GPC will examine the applicant's academic record and will make the final determination of the applicant's admissibility to the M.S. program. In general, a minimum post-baccalaureate GPA of 3.00 on a 4.00 scale or equivalent is required for admission in addition to a GPA of 3.00 on a 4.00 scale or equivalent in all engineering courses.
6. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

The Integrated BS-MS degree program is designed to provide high-achieving UNLV Mechanical Engineering undergraduate students with the opportunity to take graduate courses that can count toward both the B.S. and M.S. ME degree programs at UNLV. This will hopefully encourage them to continue with a graduate degree by reducing the time needed for degree completion. Up to nine credit hours of approved graduate-level course work can be taken as technical electives for the grade of B or better during the senior year and those credit hours will be waived for the graduate degree. The GRE requirement is waived for students participating in the Integrated BS-MS track. The following conditions are needed to enroll in the Integrated BS-MS program:

1. A minimum of two semesters of full-time enrollment in B.S. of Mechanical Engineering program is required.
2. Applications are normally submitted with two semesters remaining in the senior year.
3. A minimum of 90 credit hours of course work applicable to the B.S. of Mechanical Engineering degree with a cumulative GPA of 3.3 or higher must be completed before beginning the joint degree program.
4. Student has to choose the thesis option.

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 Requirements: Non-Thesis Track
Total Credits Required: 30
Course Requirements
Required Courses – Credits: 9
Complete three of the following courses:
ME 609 - Turbomachinery

ME 700 - Advanced Fluid Mechanics I

ME 701 - Advanced Fluid Mechanics II

ME 702 - Computational Fluid Dynamics

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 740 - Advanced Dynamics

ME 741 - Energy and Variational Methods in Applied Mechanics I

Core Courses – Credits: 6
Complete two of the following courses:
ME 704 - Finite Element Applications in Mechanical Engineering

ME 711 - Advanced Thermodynamics

ME 717 - Transport Phenomena

ME 720 - Acoustics I

ME 721 - Acoustics II

ME 725 - Vibrations I

ME 726 - Vibrations II

ME 729 - Advanced Robotics

ME 774 - Introduction to Theory of Elasticity and Plasticity I

ME 777 - Application of High-Performance Computing Methods in Science and Engineering

Elective Courses – Credits: 12
Complete 12 credits of elective coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Design Project – Credits: 3
ME 796 - Design Project in Mechanical Engineering

Degree Requirements
1. Requires 30 credits of approved graduate courses. At least 18 credits must be earned from 700-level courses, and 15 credits must be in engineering.
2. Students must make satisfactory progress toward degree completion as defined below:
   1. File an approved degree program before the completion of nine credits of coursework.
   2. Complete at least six credits of the approved program per calendar year.
   3. Maintain a grade point average (GPA) of 3.00 on a 4.00 scale with no grades below C. Grades of C- or below are not acceptable.
   4. Students must comply with Graduate College policy. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. Successfully complete a design project.

Subplan 2 Requirements: Thesis Track
Total Credits Required: 30
Course Requirements
Required Courses – Credits: 9
Complete three of the following courses:
ME 609 - Turbomachinery

ME 700 - Advanced Fluid Mechanics I

ME 701 - Advanced Fluid Mechanics II

ME 702 - Computational Fluid Dynamics

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 740 - Advanced Dynamics

ME 741 - Energy and Variational Methods in Applied Mechanics I

Core Courses – Credits: 6
Complete two of the following courses:
ME 704 - Finite Element Applications in Mechanical Engineering

ME 711 - Advanced Thermodynamics

ME 717 - Transport Phenomena

ME 720 - Acoustics I

ME 721 - Acoustics II

ME 725 - Vibrations I

ME 726 - Vibrations II

ME 729 - Advanced Robotics

ME 774 - Introduction to Theory of Elasticity and Plasticity I

ME 777 - Application of High-Performance Computing Methods in Science and Engineering

Elective Courses – Credits: 9
Complete 9 credits of elective coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Thesis – Credits: 6
ME 797 - Thesis in Mechanical Engineering

Degree Requirements
1. Requires 24 credits of approved graduate courses plus six credits of work associated with the master's level thesis, for a total of 30 credits. At least 15 credits must be earned from 700-level courses, and at least 15 credits must be in engineering. The final examination will include a defense of thesis.
2. Students must make satisfactory progress toward degree completion as defined below:
    1. File an approved degree program before the completion of nine credits of coursework.
    2. Complete at least six credits of the approved program per calendar year.
    3. Maintain a grade point average (GPA) of 3.00 on a 4.00 scale with no grades below C. Grades of C- or below are not acceptable.
3. Students must comply with Graduate College policy. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College.
4. The student must identify a Thesis Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Thesis Committee that includes at least four members:
    1. One Thesis Advisor. A student may have two co-Advisors but they count as one committee member.
    2. Two Mechanical Engineering Department faculty members.
    3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Subplan 3 Requirements: Integrated BS-MS Track
Total Credits Required: 21-27
Students admitted into this track have taken 3, 6 or 9 credits of graduate level courses that were applied toward their B.S. degree in Mechanical Engineering at UNLV. These credits reduce the total needed to complete the M.S. degree.

Course Requirements
Required Courses – Credits: 9
Complete three of the following courses:
ME 609 - Turbomachinery

ME 700 - Advanced Fluid Mechanics I

ME 701 - Advanced Fluid Mechanics II

ME 702 - Computational Fluid Dynamics

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 740 - Advanced Dynamics

ME 741 - Energy and Variational Methods in Applied Mechanics I

Core Courses – Credits: 6
Complete two of the following courses:
ME 704 - Finite Element Applications in Mechanical Engineering

ME 711 - Advanced Thermodynamics

ME 717 - Transport Phenomena

ME 720 - Acoustics I

ME 721 - Acoustics II

ME 725 - Vibrations I

ME 726 - Vibrations II

ME 729 - Advanced Robotics

ME 774 - Introduction to Theory of Elasticity and Plasticity I

ME 777 - Application of High-Performance Computing Methods in Science and Engineering

Electives – Credits: 0-6
Complete 0-6 credits of elective coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Thesis – Credits: 6
ME 797 - Thesis in Mechanical Engineering

Degree Requirements
1. 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.
2. Requires 15-21 credits of approved graduate courses plus six credits of work associated with the master's level thesis, for a total of 21-27 credits. At least 15 credits must be earned from 700-level courses, and at least 15 credits must be in engineering. The final examination will include a defense of thesis.
3. Students must make satisfactory progress toward degree completion as defined below:
    1. File an approved degree program before the completion of nine credits of coursework.
    2. Complete at least six credits of the approved program per calendar year.
    3. Maintain a grade point average (GPA) of 3.00 on a 4.00 scale with no grades below C. Grades of C- or below are not acceptable.
    4. The student must identify a Thesis Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Thesis Committee that includes at least four members:
        1. One Thesis Advisor. A student may have two co-Advisors but they count as one committee member.
        2. Two Mechanical Engineering Department faculty members.
        3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Plan Graduation Requirements
Refer to your subplan for Graduation Requirements.

Master of Science in Engineering - Mechanical Engineering

Plan Description
The Master of Science degree is designed to give post baccalaureate students a broad understanding of the mechanical engineering field while providing some depth in a specific option area. Option areas include Dynamic Systems and Controls, Fluid and Thermal Sciences, Materials and Mechanics, Engineering Management, Mechanical and Environmental Systems, Nuclear Engineering, and Aerospace Engineering. Applicants who choose the M.S.E. program usually have an interest in more than one aspect of Mechanical Engineering. They are interested in gaining research and/or design experience to become better prepared for the workforce or further graduate study. Graduates from the program have gone to work in a broad range of industries including automotive, aerospace, nuclear, energy, oil, entertainment, HVAC, defense, utilities, and manufacturing. Graduates have also enrolled in some of the top Ph.D. programs in the country.

For more information about your program, including your graduate program handbook and learning outcomes, please visit the Degree Directory.

Plan Admission Requirements
Application deadlines available on the UNLV Graduate College website.

Applications available on the UNLV Graduate College website.

In addition to the general requirements for admission to the Graduate College, an applicant for the M.S. program must complete the following requirements:

1. Applicants must complete the on-line process in the Grad Rebel Gateway system.
2. Mechanical Engineering applicants must provide two additional items while completing the process in the Grad Rebel Gateway system:
    1. A written statement of purpose indicating interests and objectives in working toward a M.S. degree.
    2. Two letters of recommendation using the online recommendation system. There is no specified format. Each letter should detail the potential of the applicant for success in a Mechanical Engineering M.S. program.
    3. The applicant must have a bachelor's degree in engineering or a closely related discipline. Admitted students with non-engineering backgrounds will be required to complete a set of course work requirements that will assure successful completion of the M.S. specialization and qualify the student to sit for the Fundamentals of Engineering (FE) exam. The Graduate Program Committee or Graduate Coordinator will specify a list of required undergraduate courses that

must be completed within the first year. These courses are in addition to those required for the graduate degree.
4. The applicant must submit an official copy of the Graduate Record Examination (GRE) test scores. The GRE university code for UNLV is 4861. The Mechanical Engineering Department code is 1502. The minimum required score is at or above 70 percentile range in the quantitative reasoning section. The Graduate Program Committee can modify this requirement if necessary. The GRE requirement is waived for students participating in the Integrated BS-MS track.
5. The GPC will examine the applicant's academic record and will make the final determination of the applicant's admissibility to the M.S. program. In general, a minimum post-baccalaureate GPA of 3.00 on a 4.00 scale or equivalent is required for admission in addition to a GPA of 3.00 on a 4.00 scale or equivalent in all engineering courses.
6. All domestic and international applicants must review and follow the Graduate College Admission and Registration Requirements.

The Integrated BS-MS degree program is designed to provide high-achieving UNLV Mechanical Engineering undergraduate students with the opportunity to take graduate courses that can count toward both the B.S. and M.S. ME degree programs at UNLV. This will hopefully encourage them to continue with a graduate degree by reducing the time needed for degree completion. Up to nine credit hours of approved graduate-level course work can be taken as technical electives for the grade of B or better during the senior year and those credit hours will be waived for the graduate degree. The GRE requirement is waived for students participating in the Integrated BS-MS track. The following conditions are needed to enroll in the Integrated BS-MS program:

1. A minimum of two semesters of full-time enrollment in B.S. of Mechanical Engineering program is required.
2. Applications are normally submitted with two semesters remaining in the senior year.
3. A minimum of 90 credit hours of course work applicable to the B.S. of Mechanical Engineering degree with a cumulative GPA of 3.3 or higher must be completed before beginning the joint degree program.
4. Student has to choose the thesis option.

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 Requirements: Non-Thesis Track
Total Credits Required: 30
Course Requirements
Required Courses – Credits: 9
Select one of the following specializations and complete three courses:
Dynamic Systems and Controls
ME 625 - Robotics

ME 629 - Computer Control of Machines and Processes

ME 653 - Mechanical Vibrations

ME 725 - Vibrations I

ME 726 - Vibrations II

ME 729 - Advanced Robotics

ME 740 - Advanced Dynamics

ME 741 - Energy and Variational Methods in Applied Mechanics I

ME 746 - Experimental Design and Analysis of Digital Process Control Systems

Fluid/Thermosciences
ME 700 - Advanced Fluid Mechanics I

ME 701 - Advanced Fluid Mechanics II

ME 702 - Computational Fluid Dynamics

ME 703 - Continuum Mechanics

ME 704 - Finite Element Applications in Mechanical Engineering

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 707 - Radiation Heat Transfer

ME 708 - Convective Boiling and Condensation

ME 710 - Transport Phenomena in Bioengineering

ME 711 - Advanced Thermodynamics

ME 714 - Computational Aspects of Solar Energy

ME 717 - Transport Phenomena

Materials and Mechanics
ME 641 - Advanced Mechanical Engineering Design

ME 643 - Design Techniques in Mechanical Engineering

ME 646 - Composite Materials

ME 732 - Mechanical Metallurgy

ME 734 - Fracture of Engineering Materials

ME 741 - Energy and Variational Methods in Applied Mechanics I

ME 742 - Energy and Variational Methods in Applied Mechanics II

ME 743 - Applied Dynamic Finite Element Analysis

Engineering Management
CEE 609 - Engineering Project Management

MBA 763 - Leadership, Teams, and Individuals

MBA 769 - Applied Economic Analysis

MBA 767 - Market Opportunity Analysis

MBA 771 - Law and Ethics

MBA 775 - Data Modeling and Analysis

ME 626 - Manufacturing Processes

ME 701 - Advanced Fluid Mechanics II

ME 727 - Engineering Optimization

Mechanical and Environmental Systems
ME 618 - Air Conditioning Engineering Systems

ME 634 - Noise Control

ME 653 - Mechanical Vibrations

ME 700 - Advanced Fluid Mechanics I

ME 706 - Convective Heat Transfer

ME 720 - Acoustics I

ME 721 - Acoustics II

ME 725 - Vibrations I

ME 726 - Vibrations II

Nuclear Engineering
ME 630 - Corrosion Engineering

ME 655 - Fundamentals of Nuclear Engineering

ME 656 - Radioactive Waste Management

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 707 - Radiation Heat Transfer

ME 708 - Convective Boiling and Condensation

Aerospace
ME 700 - Advanced Fluid Mechanics I

ME 701 - Advanced Fluid Mechanics II

ME 702 - Computational Fluid Dynamics

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 740 - Advanced Dynamics

ME 741 - Energy and Variational Methods in Applied Mechanics I

Electives – Credits: 18
Complete 18 credits of elective coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Design Project – Credits: 3
ME 796 - Design Project in Mechanical Engineering

Degree Requirements
1. Requires 30 credits of approved graduate courses. At least 18 credits must be earned from 700-level courses, and 15 credits must be in engineering.
2. Students must make satisfactory progress toward degree completion as defined below:
    1. File an approved degree program before the completion of nine credits of coursework.
    2. Complete at least six credits of the approved program per calendar year.
    3. Maintain a grade point average (GPA) of 3.00 on a 4.00 scale with no grades below C. Grades of C- or below are not acceptable.
3. Students must comply with Graduate College policy. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. Successfully complete a design project.

Subplan 2 Requirements: Thesis Track
Total Credits Required: 30
Course Requirements
Required Courses – Credits: 9
Select one of the following specializations and complete three courses:
Dynamic Systems and Controls
ME 625 - Robotics

ME 629 - Computer Control of Machines and Processes

ME 653 - Mechanical Vibrations

ME 725 - Vibrations I

ME 726 - Vibrations II

ME 729 - Advanced Robotics

ME 740 - Advanced Dynamics

ME 741 - Energy and Variational Methods in Applied Mechanics I

ME 746 - Experimental Design and Analysis of Digital Process Control Systems

Fluid/Thermosciences
ME 700 - Advanced Fluid Mechanics I

ME 701 - Advanced Fluid Mechanics II

ME 702 - Computational Fluid Dynamics

ME 703 - Continuum Mechanics

ME 704 - Finite Element Applications in Mechanical Engineering

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 707 - Radiation Heat Transfer

ME 708 - Convective Boiling and Condensation

ME 710 - Transport Phenomena in Bioengineering

ME 711 - Advanced Thermodynamics

ME 714 - Computational Aspects of Solar Energy

ME 717 - Transport Phenomena

Materials and Mechanics
ME 641 - Advanced Mechanical Engineering Design

ME 643 - Design Techniques in Mechanical Engineering

ME 646 - Composite Materials

ME 732 - Mechanical Metallurgy

ME 734 - Fracture of Engineering Materials

ME 741 - Energy and Variational Methods in Applied Mechanics I

ME 742 - Energy and Variational Methods in Applied Mechanics II

ME 743 - Applied Dynamic Finite Element Analysis

Engineering Management
CEE 609 - Engineering Project Management

MBA 763 - Leadership, Teams, and Individuals

MBA 769 - Applied Economic Analysis

MBA 767 - Market Opportunity Analysis

MBA 771 - Law and Ethics

MBA 775 - Data Modeling and Analysis

ME 626 - Manufacturing Processes

ME 701 - Advanced Fluid Mechanics II

ME 727 - Engineering Optimization

Mechanical and Environmental Systems
ME 618 - Air Conditioning Engineering Systems

ME 634 - Noise Control

ME 653 - Mechanical Vibrations

ME 700 - Advanced Fluid Mechanics I

ME 706 - Convective Heat Transfer

ME 720 - Acoustics I

ME 721 - Acoustics II

ME 725 - Vibrations I

ME 726 - Vibrations II

Nuclear Engineering
ME 630 - Corrosion Engineering

ME 655 - Fundamentals of Nuclear Engineering

ME 656 - Radioactive Waste Management

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 707 - Radiation Heat Transfer

ME 708 - Convective Boiling and Condensation

Aerospace
ME 700 - Advanced Fluid Mechanics I

ME 701 - Advanced Fluid Mechanics II

ME 702 - Computational Fluid Dynamics

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 740 - Advanced Dynamics

ME 741 - Energy and Variational Methods in Applied Mechanics I

Electives – Credits: 15
Complete 15 credits of elective coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Thesis – Credits: 6
ME 797 - Thesis in Mechanical Engineering

Degree Requirements
1. Requires 24 credits of approved graduate courses plus six credits of work associated with the master's level thesis, for a total of 30 credits. At least 15 credits must be earned from 700-level courses, and at least 15 credits must be in engineering. The final examination will include a defense of thesis.
2. Students must make satisfactory progress toward degree completion as defined below:
    1. File an approved degree program before the completion of nine credits of coursework.
    2. Complete at least six credits of the approved program per calendar year.
    3. Maintain a grade point average (GPA) of 3.00 on a 4.00 scale with no grades below C. Grades of C- or below are not acceptable.
3. Students must comply with Graduate College policy. If progress is not satisfactory, probation and separation may result, in accordance with the rules of the Graduate College.
4. The student must identify a Thesis Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Thesis Committee that includes at least four members:
    1. One Thesis Advisor. A student may have two co-Advisors but they count as one committee member.
    2. Two Mechanical Engineering Department faculty members.
    3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy document to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Subplan 3 Requirements: Integrated BS-MS Track
Total Credits Required: 21-27
Students admitted into this track have taken 3, 6 or 9 credits of graduate level courses that were applied toward their B.S. degree in Mechanical Engineering at UNLV. These credits reduce the total needed to complete the M.S. degree.

Course Requirements
Required Courses – Credits: 9
Select one of the following specializations and complete three courses:

Dynamic Systems and Controls
ME 625 - Robotics

ME 629 - Computer Control of Machines and Processes

ME 653 - Mechanical Vibrations

ME 725 - Vibrations I

ME 726 - Vibrations II

ME 729 - Advanced Robotics

ME 740 - Advanced Dynamics

ME 741 - Energy and Variational Methods in Applied Mechanics I

ME 746 - Experimental Design and Analysis of Digital Process Control Systems

Fluid/Thermosciences
ME 700 - Advanced Fluid Mechanics I

ME 701 - Advanced Fluid Mechanics II

ME 702 - Computational Fluid Dynamics

ME 703 - Continuum Mechanics

ME 704 - Finite Element Applications in Mechanical Engineering

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 707 - Radiation Heat Transfer

ME 708 - Convective Boiling and Condensation

ME 710 - Transport Phenomena in Bioengineering

ME 711 - Advanced Thermodynamics

ME 714 - Computational Aspects of Solar Energy

ME 717 - Transport Phenomena

Materials and Mechanics
ME 641 - Advanced Mechanical Engineering Design

ME 643 - Design Techniques in Mechanical Engineering

ME 646 - Composite Materials

ME 732 - Mechanical Metallurgy

ME 734 - Fracture of Engineering Materials

ME 741 - Energy and Variational Methods in Applied Mechanics I

ME 742 - Energy and Variational Methods in Applied Mechanics II

ME 743 - Applied Dynamic Finite Element Analysis

Engineering Management
CEE 609 - Engineering Project Management

MBA 763 - Leadership, Teams, and Individuals

MBA 769 - Applied Economic Analysis

MBA 767 - Market Opportunity Analysis

MBA 771 - Law and Ethics

MBA 775 - Data Modeling and Analysis

ME 626 - Manufacturing Processes

ME 701 - Advanced Fluid Mechanics II

ME 727 - Engineering Optimization

Mechanical and Environmental Systems
ME 618 - Air Conditioning Engineering Systems

ME 634 - Noise Control

ME 653 - Mechanical Vibrations

ME 700 - Advanced Fluid Mechanics I

ME 706 - Convective Heat Transfer

ME 720 - Acoustics I

ME 721 - Acoustics II

ME 725 - Vibrations I

ME 726 - Vibrations II

Nuclear Engineering
ME 630 - Corrosion Engineering

ME 655 - Fundamentals of Nuclear Engineering

ME 656 - Radioactive Waste Management

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 707 - Radiation Heat Transfer

ME 708 - Convective Boiling and Condensation

Aerospace
ME 700 - Advanced Fluid Mechanics I

ME 701 - Advanced Fluid Mechanics II

ME 702 - Computational Fluid Dynamics

ME 705 - Conduction Heat Transfer

ME 706 - Convective Heat Transfer

ME 740 - Advanced Dynamics

ME 741 - Energy and Variational Methods in Applied Mechanics I

Electives – Credits: 6-12
Complete 6-12 credits of elective coursework from within the College of Engineering. Courses from outside the College of Engineering may be taken with advisor approval.

Thesis – Credits: 6
ME 797 - Thesis in Mechanical Engineering

Degree Requirements
1. 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.
2. Requires 15-21 credits of approved graduate courses plus six credits of work associated with the master's level thesis, for a total of 21-27 credits. At least 15 credits must be earned from 700-level courses, and at least 15 credits must be in engineering. The final examination will include a defense of thesis.
3. Students must make satisfactory progress toward degree completion as defined below:
    1. File an approved degree program before the completion of nine credits of coursework.
    2. Complete at least six credits of the approved program per calendar year.
    3. Maintain a grade point average (GPA) of 3.00 on a 4.00 scale with no grades below C. Grades of C- or below are not acceptable.
    4. Only those courses in which a student received a grade of C or better may be used for graduate credit. Students must comply with Graduate College policy.
    5. The student must identify a Thesis Advisor within the first semester of joining the program. The student, in consultation with their Advisor, will form a Thesis Committee that includes at least four members:
        1. One Thesis Advisor. A student may have two co-Advisors but they count as one committee member.
        2. Two Mechanical Engineering Department faculty members.
        3. One Graduate College representative. The student, in consultation with their Advisor, is responsible for inviting a committee member from within the university but outside the Mechanical Engineering Department. This person is responsible for ensuring consistency and fairness throughout the UNLV graduate programs.

Graduation Requirements
1. The student must submit all required forms to the Graduate College and then apply for graduation up to two semesters prior to completing his/her degree requirements.
2. The student must submit and successfully defend his/her thesis by the posted deadline. The defense must be advertised and is open to the public.
3. The student must submit his/her approved, properly formatted hard-copy thesis to the Graduate College, and submit the approved electronic version to ProQuest by the posted deadline.

Plan Graduation Requirements
Refer to your subplan for Graduation Requirements.

ME 600 - Intermediate Fluid Mechanics Credits 3
Basic laws and equations of fluid flow; very viscous flow solutions; boundary layer flows; potential flows; wave phenomena; transport phenomena; turbulence. Note(s): This course is crosslisted with ME 400. Credit at the 600-level requires additional work.

ME 602 - Computational Methods for Engineers Credits 3
Applied numerical analysis for linear and nonlinear engineering problems. Systems of linear equations, nonlinear equations, and eigen value problems. Approximate numerical integration and differentiation. Development of numerical methods for initial and boundary value problems of ordinary differential equations. Introduction to the numerical solution of partial differential equations. Note(s): This course is crosslisted with ME 402. Credit at the 600-level requires additional work.

ME 609 - Turbomachinery Credits 3
Types of turbomachines, applications of turbomachines, and performance characteristics. Energy transfer in turbomachines. Fundamentals of turbomachinery. Applications of the principles of fluid mechanics, thermodynamics and aerodynamics to the design and analysis of pumps, fans, blowers, compressors, gas turbines, steam turbines, hydraulic turbines, and wind turbines are incorporated. Prerequisite(s): ME 311 and ME 380, or equivalent.

ME 611 - Engineering Thermodynamics II Credits 3
This advanced undergraduate course is available for graduate credit.

ME 612 - Sizing Solar Energy Systems Credits 3
Sizing and design criteria of solar thermal and photovoltaic systems using various types of software. Prerequisite(s): Graduate standing.

ME 615 - Design of Thermal Systems Credits 3
Design of thermal systems and subsystems, especially as they relate to current and new means of energy utilization and power generation; computer simulation and optimization of thermal systems based on performance and economic constraints. Note(s): This course is crosslisted with ME 415. Credit at the 600-level requires additional work.

ME 616 - Introduction to Biomechanical Engineering Credits 3
Fundamental engineering principles in several engineering areas to problems in the biological world. Discussion includes biomechanics of solids, biofluid and transport phenomena, biomaterials, cell and tissue engineering, medical imaging and electrophoresis. Note(s): This course is crosslisted with ME 416. Credit at the 600-level requires additional work.

ME 617 - Introduction to Fuel Cell Credits 3
Fuel Cell Principles, Fuel Cell Thermodynamics, Fuel Cell Reaction Kinetics, Fuel Cell Charge Transport, Fuel Cell Mass Transport, Fuel Cell Modeling, Fuel Cell Characterization, Fuel Cell Technology, Fuel Cell Types and Systems. Prerequisite(s): ME 311, ME 314, ME 380.

ME 618 - Air Conditioning Engineering Systems Credits 3
Analysis and design of air conditioning systems, load calculations, system selection, duct sizing, and controls. Relationships between internal and external environments. Development of economic, functional and energy conserving concepts in air conditioning design. Note(s): This course is crosslisted with ME 418. Credit at the 600-level requires additional work.

ME 619 - Advanced HVAC and Energy Conservation Systems Credits 3
Room air distribution. Fan and building air distribution. Mass transfer and humidity measurement. Direct contact heat and mass transfer extended surface heat exchangers. Refrigeration. Current energy conservation technologies, computer simulations of dynamic building energy demand. Note(s): This course is crosslisted with ME 419. Credit at the 600-level requires additional work.

ME 625 - Robotics **Credits 3**
Instruction to basic concept and theory behind motions generated by robot manipulators; kinematics, dynamics, and trajectory generation. Design of basic feedback position controllers and computer simulation techniques of robot dynamics and control system. Note(s): This course is crosslisted with ME 425. Credit at the 600-level requires additional work.

ME 626 - Manufacturing Processes **Credits 3**
Survey of the principal processes used to cast, form, machine, and join material. Tolerances, statistical quality control, costs, operation sequencing, and design for productivity covered. Research paper on related topic required. Note(s): This course is crosslisted with ME 426. Credit at the 600-level requires additional work.

ME 627 - Manufacturing Systems **Credits 3**
Study of the ways of organizing people and equipment so that production can be performed more efficiently. Includes production lines design, CIM, GT, FMS, production planning, inventory control and MRP, lean production, JIT, and agile manufacturing. Note(s): This course is crosslisted with ME 427. Credit at the 600-level requires additional work.

ME 629 - Computer Control of Machines and Processes **Credits 3**
Discrete control theory reduced to engineering practice through comprehensive study of discrete system modeling, system identification and digital controller design. Selected industrial processes and machines utilized as subjects on which computer control is to be implemented. Focuses on the time-domain analysis of the control theory and programming. Note(s): This course is crosslisted with ME 429. Credit at the 600-level requires additional work.

ME 630 - Corrosion Engineering **Credits 3**
Examination of the fundamental processes of metallic corrosion from the thermodynamic and kinetic points of view. Specific types of corrosion and prevention strategies discussed. Materials selection, design features, and fabrication techniques of corrosion control covered. Note(s): This course is crosslisted with ME 430. Credit at the 600-level requires additional work.

ME 634 - Noise Control **Credits 3**
Development and solution of one-dimensional wave equation for propagation of sound in air; one-dimensional plane and spherical sound waves; sound transmission phenomena; sound in enclosed spaces; sound propagation outdoors; and human responses to noise. Note(s): This course is crosslisted with ME 434. Credit at the 600-level requires additional work.

ME 640 - Mechanical Engineering Design **Credits 3**
Stress analysis; deflection of machine elements; design of machine elements for static and fatigue strength. Note(s): This course is crosslisted with ME 440. Coursework at the 600-level requires additional work.

ME 641 - Advanced Mechanical Engineering Design **Credits 3**
Use of advanced concepts in machine design. Note(s): This course is crosslisted with ME 441. Credit at the 600-level requires additional work.

ME 642 - Advanced Mechanism Design **Credits 3**
Cam design, synthesis of mechanisms, spatial mechanisms. Note(s): This course is crosslisted with ME 442. Credit at the 600-level requires additional work.

ME 643 - Design Techniques in Mechanical Engineering **Credits 3**
Computational techniques for use in mechanical engineering design. Emphasis on the use of existing commercial codes for the analysis and design of machine elements and for the study of heat transfer and fluid flow. Note(s): This course is crosslisted with ME 443. Credit at the 600-level requires additional work.

ME 646 - Composite Materials **Credits 3**
Overview of matrix and fiber systems, processing techniques, anisotropic elasticity, unidirectional lamina, multidirectional laminate theory, failure theories, and design of composite structures. Note(s): This course is crosslisted with ME 446. Credit at the 600-level requires additional work.

ME 648 - Nanomaterials for Energy Applications **Credits 3**
Fundamental information on various renewable energy applications, technologies and nanomaterials with an emphasis on understanding the relationships between material properties, structures and performance as well as current material and technology challenges. Note(s): This course is crosslisted with ME 448. Coursework at the 600-level requires additional work.

ME 650 - Physical Metallurgy **Credits 3**
This advanced undergraduate course is available for graduate credit.

ME 653 - Mechanical Vibrations **Credits 3**
Free and forced response of single-and-multi-degree-of-freedom, lumped parameter systems. Fourier series and Fourier and Laplace transforms. Introduction to vibration of continuous systems and applications. Note(s): This course is crosslisted with ME 453. Credit at the 600-level requires additional work.

ME 655 - Fundamentals of Nuclear Engineering **Credits 3**
Fundamentals of nuclear reactor design and analysis of the fission process. Basic health physics, reactor shielding, and nuclear waste management. Calculation of reactor dimensions for criticality. Reactor kinetics and control. Note(s): This course is crosslisted with ME 455. Credit at the 600-level requires additional work.

ME 656 - Radioactive Waste Management **Credits 3**
This advanced undergraduate course is available for graduate credit.

ME 660 - High School Mentoring for Engineering Design **Credits 3**
Students help high school teams design robots for the FIRST robotics competition. Weekly meetings discuss: mentoring, design, robotics, organizational skills, and teamwork. Must arrange transport to assigned local high school. Class begins with the international FIRST kick-off meeting usually scheduled for the first Saturday after New Year's Day. Note(s): This course is crosslisted with ME 460. Credit at the 600-level requires additional work. Prerequisite(s): Instructor Consent

ME 662 - Vehicle Design Projects **Credits 3**
Students design and build a vehicle for entry into a national or regional collegiate competition such as Mini-Baja or Human Powered Vehicle. Design topics my include structural analysis, composite materials, aerodynamics, engine performance, occupant safety, drive train, suspension systems, project management, team building, technical report writing, and oral presentations. Note(s): This course is crosslisted with ME 462. Credit at the 600-level requires additional work. Prerequisite(s): Instructor Consent

ME 670 - Experimental Mechanics of Materials **Credits 3**
Failure theories for isotropic and composite materials, stress concentration, fracture mechanics, combined loading, photoelasticity, composites fabrication, mold making, mechanical testing, and microstructural analysis. Note(s): This course is crosslisted with ME 470. Credit at the 600-level requires additional work.

ME 677 - Solar and Renewable Energy Utilization **Credits 3**
Introduction to renewable energy applications. Includes environmental motivations, historical perspectives, solar photovoltaic and thermal applications, implications in building designs, wind energy, biomass, alternative fuels, geothermal power utilization, utility considerations, and political and economic factors. *Formerly* EGG 650

ME 680 - Gas Dynamics I **Credits 3**
Examines the basic concepts and theories associated with compressible fluid flow. Normal and oblique shocks, 1-D analysis, and method of characteristics discussed. Note(s): This course is crosslisted with ME 480. Credit at the 600-level requires additional work.

ME 682 - Aerodynamics **Credits 3**
Presents fluid flow concepts leading to the design of flow surfaces and passages to achieve optimum performance over the widest range of significant parameters. Topics include boundary layer theory, lift, airfoil analysis, and numerical methods for fluid mechanic analyses. Note(s): This course is crosslisted with ME 482. Credit at the 600-level requires additional work.

ME 695 - Special Topics in Engineering **Credits 1-4**
Outlet for experimental and other topics which may be of current interest. Topics and credits to be announced. May have a laboratory. May be repeated once under different topic. Note(s): This course is crosslisted with ME 495. Credit at the 600-level requires additional work.

ME 700 - Advanced Fluid Mechanics I **Credits 3**
Covers area of viscous laminar fluid flow. Presents concept of shear stresses and develops Navier-Stokes equation. Applications such as boundary layer flow studied as are some solutions of viscous fluid flow. Prerequisite(s): Graduate Standing or Instructor Consent

ME 701 - Advanced Fluid Mechanics II **Credits 3**
Potential flow theory with emphasis on complex representations, conformal mapping, Shwarz Christoffel transformations, airfoils. Compressible flow, free shear layers, shock waves, compressible boundary layers, two- and three- dimensional supersonic flows. Prerequisite(s): ME 700 or consent of instructor.

ME 702 - Computational Fluid Dynamics **Credits 3**
Application of numerical methods to solve highly nonlinear equations of motion and energy associated with fluid dynamics. Among other methods, finite difference and finite element methods discussed along with use of commercial software packages. Prerequisite(s): Graduate Standing or Instructor Consent

ME 703 - Continuum Mechanics **Credits 3**
Matrices and tensors, stress deformation and flow, compatibility conditions, constitutive equations, field equations and boundary conditions in fluids and solids, applications in solid and fluid mechanics. *Formerly* (CEG 711) Prerequisite(s): Granduate Standing or Instructor Consent

ME 704 - Finite Element Applications in Mechanical Engineering **Credits 3**
Finite Element Method used historically for structurally related problems. Advances in application and development of Finite Element Method particularly useful in fluid flow and heat transfer related problems. PC, workstation, and mainframe finite element computer codes used to assist students in solving fluid and heat transfer problems. Prerequisite(s): Graduate Standing or Instructor Consent

ME 705 - Conduction Heat Transfer **Credits 3**
Designed to solve more advanced heat transfer problems by conduction. Analytical and numerical techniques in heat conduction covered. Review of elementary problems presented. Advanced analytical methods using Bessel functions, separation of variables and Laplace transforms, among others. Solutions using finite differences covered. Prerequisite(s): ME 314 and ME 445 or equivalent or consent of instructor.

ME 706 - Convective Heat Transfer **Credits 3**
Conservation principles, fluid stresses and flux laws, boundary layer equation, laminar and turbulent heat flow inside tubes. Heat transfer in laminar and turbulent boundary layers. Influence of temperature dependent fluid properties and free-convection boundary layers. Prerequisite(s): Graduate Standing or Instructor Consent

ME 707 - Radiation Heat Transfer **Credits 3**
Advanced engineering analysis of thermal radiation heat transfer. Spectral and gray-body analysis. Exchange of radiation between surfaces and through absorbing, emitting, and scattering media. Radiation combined with conduction and convection. Prerequisite(s): Graduate Standing or Instructor Consent

ME 708 - Convective Boiling and Condensation **Credits 3**
Basic models, empirical treatments of two-phase flow. Introduction to convective boiling, subcooled boiling, void fraction and pressure drop in subcooled boiling, saturated boiling heat transfer, critical heat flux, condensation. Prerequisite(s): Graduate Standing or Instructor Consent

ME 710 - Transport Phenomena in Bioengineering **Credits 3**
Transport phenomena in bioengineering at molecular, cellular and tissue levels. Topics include blood flow in large and small vessels, gas exchange in lung, biomass and heat transfer in microcirculation, ion transport across cell membrane, cell migration, renal transport, controlled drug delivery and transport in tumors. Prerequisite(s): Graduate Standing or Instructor Consent

ME 711 - Advanced Thermodynamics **Credits 3**
Advanced concepts and laws of classical equilibrium thermodynamics as applied to engineering problems. Introduction to statistical thermodynamics. Prerequisite(s): Graduate Standing or Instructor Consent

ME 714 - Computational Aspects of Solar Energy **Credits 3**
Theory and practice in the design of solar energy components and systems. Included are collectors, concentrators, receivers, storage, and power systems. Emphasis is on the simulation of transient systems. Prerequisite(s): Graduate Standing or Instructor Consent

ME 717 - Transport Phenomena **Credits 3**
Momentum, energy, and mass transport at molecular motion, microscopic levels. Momentum flux tensors, heat flux vectors, and mass flux vectors. Transport in laminar or turbulent flow. Transport in isothermal or nonisothermal systems. Transport in single or multicomponent systems. Interface transport and chemical reaction. Prerequisite(s): Graduate Standing or Instructor Consent

ME 720 - Acoustics I **Credits 3**
Introduction to wave motion and general solution techniques associated with wave equation; propagation of waves in solid media; one-dimensional acoustic waves, acoustic transmission phenomena, and propagation of sound outdoors. Prerequisite(s): Graduate Standing or Instructor Consent

ME 721 - Acoustics II **Credits 3**
Three-dimensional sound waves; experimental measurement techniques associated with acoustics; acoustic filter theory; other advanced topics in acoustics. Prerequisite(s): ME 720

ME 725 - Vibrations I **Credits 3**
Vibrations of systems with one-degree-of-freedom and more than one-degree-of-freedom. Methods for finding natural frequencies, discrete systems and continuous systems. Prerequisite(s): Graduate Standing or Instructor Consent

ME 726 - Vibrations II **Credits 3**
Virtual work, Hamilton's principles, Lagrange's equation, influence coefficients, Green's function as applied to advanced vibration problems; vibration of continuous systems; modal analysis. Prerequisite(s): Graduate standing and ME 725.

ME 727 - Engineering Optimization **Credits 3**
Introduction to optimization, univariate functions, multivariate functions, constrained optimality criteria, penalty method, constrained direct search, engineering case studies, linear programming. Prerequisite(s): Graduate Standing or Instructor Consent

ME 729 - Advanced Robotics **Credits 3**
In-depth study of advanced automation concepts and robotic manipulators. Topics including 3-D kinematics, trajectory generation, compliance analysis, dynamic control of robotics along with concept of assembly operations and machine vision. Prerequisite(s): Graduate Standing or Instructor Consent

ME 732 - Mechanical Metallurgy **Credits 3**
Behavior and response of metals to applied forces. Five areas covered: mechanical fundamentals, metallurgical fundamentals, materials testing, plastic forming of metals, and modes of failure. Prerequisite(s): Graduate Standing or Instructor Consent

ME 734 - Fracture of Engineering Materials **Credits 3**
Stress-strain relationships during elastic and plastic deformation, linear elastic and elastic-plastic fracture mechanics, Griffith's theory, stress analyses of cracks, plastic zone size, fracture toughness measurements, ductile-to-brittle transition, fatigue failure mechanisms, environmentassisted cracking and relevant test methods, metallographic evaluations using state-of-the-art techniques. Prerequisite(s): Graduate Standing or Instructor Consent

ME 736 - Diffusion in Metals **Credits 3**
Covers thermodynamics and phase diagrams, interstitial and substitutional diffusion, diffusion in binary and ternary alloys, solidification, and diffusional and diffusionless transformation in solids. Prerequisite(s): ME 301 and 302 or equivalent.

ME 740 - Advanced Dynamics **Credits 3**
Applications of Lagrangian and Newtonian mechanics to mechanical systems. Includes kinematics, moving reference frames, rigid body dynamics, oscillations and mode forms, and gyroscopic effects. Prerequisite(s): Graduate Standing or Instructor Consent

ME 741 - Energy and Variational Methods in Applied Mechanics I **Credits 3**
Governing equations of mechanics, energy and variational principles, variational methods of approximation, theory of elasticity, material laws, work and energy, beam theory, finite element method, structural systems. Prerequisite(s): Graduate Standing or Instructor Consent

ME 742 - Energy and Variational Methods in Applied Mechanics II **Credits 3**
Theoretical principles for solving solid mechanics problems. Direct continuation of ME 741. Topics covered include: computational solution methods to governing equations, free vibration and forced response of elastic systems, stability analysis, solution methods to governing equations, free vibration and forced response of elastic systems, stability analysis, solution methods for beams, plates, and structural systems. Prerequisite(s): ME 741

ME 743 - Applied Dynamic Finite Element Analysis **Credits 3**
Overview of the development of dynamic computational analysis, software description, modeling techniques, symmetry and boundary conditions, initial conditions, contact algorithms, wave propagation, material behavior, implicit analysis, damping, mass scaling, mesh adaptation, element selection, hourglassing, postprocessing, output control, restarts, parallel processing, Eulerian and ALE methods. Prerequisite(s): Graduate standing in engineering or consent of instructor.

ME 746 - Experimental Design and Analysis of Digital Process Control Systems **Credits 3**
Applications, design, and experimental practice of mechanical linear and discrete systems: hydraulic, pneumatic, elastic multibody systems, centripetal and coriolis effects, automatic model and code generation. Discrete nonlinear control systems modeling, simulation, design using state space methods. Aspects of system identification, robust and optimal control. *Same as* (EGG 746) Prerequisite(s): Graduate Standing or Instructor Consent

ME 747 - Orthopedic Biomechanics - Lower Extremities and Spine **Credits 3**
Biomechanics of the lower extremities and spine; engineering properties and physiology of bone, cartilage, and tendon; analysis of gait; effects of orthopedic impairment and injury; design and surgical implantation of prosthetic joints and fracture fixation devices; engineering of tissue regeneration and replacement. *Same as* (EGG 747) Prerequisite(s): Graduate standing in engineering or kinesiology or consent of instructor.

ME 748 - Prosthetic Systems Engineering **Credits 3**
Engineering design of prosthetic feet, ankles, knees, and prehension devices; materials and manufacturing; the biomechanics of movement using a prosthesis; residual limb morphology and surgical enhancements; socket design and tissue response; myoelectric devices; microprocessor control; psychophysical and motor control considerations; aspects of clinical science. Emphasis on R&D needs. *Same as* (EGG 748) Prerequisite(s): Graduate standing in engineering or kinesiology or consent of instructor.

ME 750 - Analysis of Human Movement **Credits 3**
Analysis of the kinematics and kinetics of human movement in two and three dimensions with emphasis on methods used in motion capture, including joint and segment position; acceleration, velocity, force and torque; work and power; and inverse solution methods. *Same as* (EGG 750) Prerequisite(s): Graduate standing in engineering or kinesiology or consent of instructor.

ME 752 - Advanced Air Pollution Control **Credits 3**
Fundamental chemical and physical principles of generation and control of air pollutants, and applications to pollution control equipment. Pollutant and particle formation during combustion. Gas adsorption and absorption fundamentals and tower/column design. Pollution control strategies. Prerequisite(s): Graduate Standing or Instructor Consent

ME 754 - Introduction to Nuclear Criticality Safety **Credits 3**
Review of criticality accidents, overview of the physics of criticality, factors that affect reactivity, experiments and the development of subcritical limits, standards and regulations, hand calculation techniques, engineering and evaluations for criticality safe processes and facilities. Prerequisite(s): ME 455, ME 655 or equivalent or consent of instructor.

ME 755 - Nuclear Criticality Safety Engineering **Credits 3**
Nuclear engineering for criticality safe processes and facilities: in-depth physics of criticality, hand calculation techniques, Monte Carlo applications, experimental development of subcritical limits; nuclear criticality accidents, anomalies and case studies; nuclear data/benchmarking, standards and regulations, etc. Practical engineering examples/case studies and the preparation of a nuclear criticality safety evaluation. Prerequisite(s): ME 754 or equivalent or consent of instructor.

ME 756 - Monte Carlo Methods in Nuclear Engineering **Credits 3**
Theory and application of the Monte Carlo method for neutron transport calculations from introductory concepts to advanced simulations of criticality in fissile materials. Computer applications in nuclear engineering; verification and validation (V&V), nuclear data files, examples of Monte Carlo calculations, case studies and applied problems. Prerequisite(s): ME 455, ME 655 or equivalent or consent of instructor.

ME 757 - Radiation Monitoring and Safeguards Systems **Credits 3**
Advanced topics in radiation measurement science, remote sensing, nondestructive assay techniques, and nuclear material safeguards. Use of radiation detection systems in process monitoring and safeguards, and in security applications. Prerequisite(s): ME 4585/655, or consent of instructor.

ME 758 - Accelerator Applications in Nuclear Engineering **Credits 3**
Fundamental concepts of particle accelerators. Radiation beams and targets. Advanced topics in accelerator applications in engineering, security, isotope production, transmutation, nondestructive assay, material analysis, biology and medicine. Prerequisite(s): ME 455/655, or consent of instructor.

ME 759 - Mass Transfer in Environmental Systems **Credits 3**
Fundamentals of mass transfer by diffusion and advection. Solutions to steady-state and transient problems in several dimensions. Note(s): Applications to natural and engineered systems. Prerequisite(s): Graduate Standing or Instructor Consent

ME 760 - Waste Management and the Nuclear Fuel Cycle **Credits 3**
Introduction to the nuclear fuel cycle and management of nuclear waste. Introduction to repository design and performance assessment. Overview of waste form performance, contaminant transport, and risk assessment as applied to nuclear waste management. Prerequisite(s): HPS 701 or consent of instructor.

ME 762 - Nuclear Power Engineering **Credits 3**
Analysis of the conversion of energy generated by fission, fusion, or radioactive decay into electrical power and propulsion. Theory of reactor heat generation and removal and new reactor concepts. Review of thermodynamic cycles used in pressurized and boiling water reactors, gas-cooled and liquid metal reactors. Prerequisite(s): ME 311 , ME 314, ME 455 or ME 655 or equivalent

ME 763 - Nuclear Reactor Analysis **Credits 3**
Development of the neutron diffusion equation with application to the design of steady state nuclear reactors. Derivation of critical core dimensions for single energy and multienergy neutron groups. Determination of group constants for thermal and fast neutrons. Unsteady reactor dynamics and criticality control. Introduction to Monte Carlo techniques. Prerequisite(s): ME 455 or ME 655

ME 765 - Neutron Detection and Production **Credits 3**
Content includes passive and active neutron detection using He3 and BF3 ionization/proportional tubes, liquid and plastic scintillators, fission chambers, and activation foils. The course includes laboratory exercises. Pulsed and continuous sources will be covered including fission reactors, accelerator production through fusion, spallation, photonuclear effects, and [alpha, n] reactions. Prerequisite(s): ME 455/655 or equivalent.

ME 774 - Introduction to Theory of Elasticity and Plasticity I **Credits 3**
Introduction to theoretical and applied elasticity and plasticity theory-solutions to engineering problems in structural mechanics and geotechnical engineering. Response of isotropic, orthotropic and layered media to applied stresses and strains. Prerequisite(s): Graduate Standing or Instructor Consent

ME 777 - Application of High-Performance Computing Methods in Science and Engineering **Credits 3**
Application of high performance computing systems to science and engineering, models for numerically intensive problem solving, high performance numerical algorithms, FORTRAN 90 and high-performance FORTRAN. *Same as* (MAT 777) Prerequisite(s): Knowledge of UNIX, FORTRAN, and previous course on numerical methods. Graduate standing.

ME 791 - Independent Study in Mechanical Engineering **Credits 1 – 3**
Independent study of a selected mechanical engineering topic. Note(s): May be repeated to a maximum of three credits. Prerequisite(s): Graduate standing in mechanical engineering and consent of instructor.

ME 795 - Advanced Topics in Mechanical Engineering **Credits 1 – 6**
Outlet for experimental and other advanced topics which may be of current interest. Note(s): Topics and credits to be announced. May have a laboratory. May be repeated to a maximum of six credits.

ME 796 - Design Project in Mechanical Engineering **Credits 1 – 3**
Synthesis course involving students in the design process from analysis and proposal to solution. Note(s): May be repeated to a maximum of three credits. Prerequisite(s): Graduate standing in mechanical engineering and consent of instructor.

ME 797 - Thesis in Mechanical Engineering **Credits 3 – 6**
Research, analysis, and writing towards completion of thesis and subsequent defense. Note(s): May be repeated but only six credits will be applied to the program. Grading: S/F grading only. Prerequisite(s): Graduate standing in mechanical engineering.

ME 799 - Dissertation **Credits 1 – 6**
Research analysis and writing towards completion of dissertation and subsequent defense. Note(s): May be repeated to a maximum of 18 credits allowed toward the degree. Grading: S/F grading only. Prerequisite(s): Graduate standing in Ph.D. program and consent of advisor.