



ELECTRICAL & COMPUTER ENGINEERING

THE UNIVERSITY OF NEW MEXICO

Electrical & Computer Engineering Graduate Handbook

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Companion with UNM Catalog 2008-09



The University of New Mexico

www.ece.unm.edu

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1 Introduction

1.1 Degrees Offered

The Electrical and Computer Engineering Department offers graduate study leading to the following M.S. and Ph.D. degrees:

- Master of Science (M.S.) in Electrical Engineering
- Master of Science (M.S.) in Computer Engineering
- Master of Science (M.S.) in Optical Science and Engineering
- Doctor of Philosophy (Ph.D.) in Engineering with concentration in
 - Electrical Engineering
 - Computer Engineering
- Doctor of Philosophy (Ph.D.) in Optical Science and Engineering

The master's degree program requires 30 semester credit hours for a thesis option and 33 hours for a non-thesis option. The Ph.D. program requires that a minimum of 24 graduate credit hours beyond the Master's degree be completed at the University of New Mexico. Additional course work and research leading to the dissertation are geared to the individual student's needs and interests. As a potential candidate for the Ph.D. program, each student must pass the Ph.D. qualifying examination to establish levels and areas of scholastic capabilities.

Albuquerque, with a metropolitan population exceeding 600,000 is the largest city in New Mexico. With an unusual blend of three cultures—Native American (Indian), Spanish-American, and Western—it is able to offer a wide variety of cultural, artistic, and aesthetic events. Several of these take place on campus, others are in the city and neighboring pueblos. The All-Pueblo Indian Art Center, the Atomic Museum, and the Maxwell Museum of Anthropology on campus offer facilities of particular interest. The city lies between the lowland of the Rio Grande and the towering, 11,000-foot Sandia mountains. In this "Land of Enchantment" environment, the sun shines every day, and warm days are followed by cool nights. Hunting, fishing, ballooning, mountain climbing, and skiing are only a few of the recreational activities available.

The University of New Mexico is the largest university in the state, with more than 30,000 students. It was established in 1889 and is situated on 600 acres in the center of metropolitan Albuquerque. The resources of the University and its proximity to Sandia National Laboratories, Kirtland Air Force Base, and Los Alamos National Laboratories provide an excellent environment for advanced studies and research.

1.2 Graduate Program

The Electrical & Computer Engineering Graduate Program specializes in a broad range of state-of-the-art research emphases:

- **Computer Engineering**
 - Bioengineering
 - Computational Intelligence
 - Computer Architecture & VLSI Designs
 - Computer Networks & Systems
 - Computer Graphics & Vision
 - Image Processing
- **Electrical Engineering**
 - Applied Electromagnetics
 - Bioengineering
 - Communications
 - Image Processing
 - Microelectronics
 - Optoelectronics
 - Signal Processing
 - Systems and Controls
- **Optical Science and Engineering**

Refer to Appendix ?? for details.

ECE Graduate Office The Graduate Committee consists of the Director of Graduate Program and faculty members elected by each research area. The Director of Graduate Program who reports to the Department Chair, coordinates all activities of the Graduate Committee and is responsible for all aspects of the graduate program, including:

- Overseeing all correspondence with applicants seeking admission, including final notification of acceptance/deny,
- Interaction with the Office of Graduate Studies (OGS), Office of International Admissions (OIA), and Office of International Programs (OIP), and
- Probation/enrollment matters and exit requirements.

The UNM catalog and ECE graduate handbook. The Office of Graduate Studies (OGS) at UNM is responsible for upholding the academic standards of all graduate programs at the University of New Mexico. To this end, it establishes and enforces certain rules that must be satisfied by all graduate students and the faculty. This handbook only includes the additional policies and procedures that apply specifically to the ECE graduate program. Graduate students are ultimately responsible for understanding and meeting the requirements described in UNM Catalog and this handbook. This edition of the handbook supersedes any previous editions of the ECE Graduate Handbook. Students entering the graduate program in Spring 2009 or later must follow this edition of the handbook until further notice.

Grandfather clause. Students are required to meet the program requirements as described in the UNM Catalog and the ECE Graduate Handbook in effect at the time of admission. Should the requirements in the handbook change during their program, students may move to the new requirements with approval of their advisor.

Contact information. The contact information for the administration of the ECE Graduate Program for the year 2008–09 are provided below:

Graduate Office, Department of Electrical & Computer Engineering The University of New Mexico, Albuquerque, New Mexico 87131, USA Telephone: +1.505.277.2600, URL: www.ece.unm.edu		
Title	Name	Email
Department Chair	Prof. Chaouki Abdallah	ece-chair@ece.unm.edu
Director of Graduate Program	Prof. Wei Wennie Shu	grad-chair@ece.unm.edu
ECE Co-chair of Optical Science & Engr.	Prof. Luke Lester	ose-chair@ece.unm.edu
Graduate Program Coordinator	Ms. Elmyra Grelle	gradinfo@ece.unm.edu

2 Admissions

Admission requirements. Acceptance as a regular graduate student in the ECE Department will normally require a bachelor's degree in Computer Engineering, Computer Science, Electrical Engineering, or a related field, from an ABET accredited program in United States or its equivalent in another country. Admission into the ECE Graduate Program for both M.S. and Ph.D. degrees are decided on a case-by-case basis. Many factors are taken into account for admission decisions, including, but not limited to, previous academic degree(s) and coursework, GRE scores, letters of recommendation, etc.

Applicants	GRE Verbal	GRE Quantitative	GPA
M.S.	400	650	3.0
Ph.D.	450	690	3.5

In addition, the TOEFL (Test of English as a Foreign Language) is required of all international applicants and the minimum acceptable TOEFL score is 550 paper-based, 213 computer-based, or 79-80 internet-based. The other acceptable tests in lieu of the TOEFL include IELTS (International English Language Testing System), minimum score 7, the University of Cambridge Examination Certificate of Proficiency in English (CPE) or Certificate of Advanced English (CAE), minimum score C. Note that a student is considered a domestic student only if he/she is a US citizen or a US resident (a green card holder) under the Immigration and Naturalization Service (INS) rules.

Financial aid. The ECE graduate program has two types of assistantships: Graduate Assistantships (GA) and Research Assistantships (RA). The GAs are awarded by the ECE department for exceptional students. On the other hand, RAs are chosen and administered completely by faculty, with their own research grants. In addition to the GA and RA assistantships there are many fellowships available to graduate students. For more information on the various fellowships and financial aid, please see the web site at "<http://www.unm.edu/grad/funding/funding.html>"

Application procedures. Prospective graduate students will find UNM application materials and ECE required materials online at www.ece.unm.edu/apply/applygrad.htm The online applications are strongly encouraged. Please note that incomplete applications will not be processed by OGS or by OIA, and therefore will not make it into the ECE department.

• **The following materials should be submitted directly to ECE Graduate Office:**

1. The GRE Scores,
2. Three letters of recommendation on supplied forms,
3. ECE Addendum, including a statement of intent and an indication of the specialization,

Application deadlines. All application materials must be received by the established deadlines for timely consideration. The ECE Department reviews graduate applications twice a year, corresponding to the Fall and Spring semesters.

	Fall Semester	Spring Semester
Applicants requesting financial aid	February 15	July 15
International application	February 15	July 15
Domestic applications without financial aid	July 15	November 1

Course articulation. A student whose previous educational background is not in Computer Engineering, Computer Science, or Electrical Engineering, may have to make up certain courses at the undergraduate level. Determination of these courses will be in accordance with the UNM requirement of 12 semester hours of upper division coursework (300 level or higher) in the major field or in cognate areas and will be decided upon by an advisor and approved by the ECE Graduate Office at the time of admission. If any articulated courses at the undergraduate level are identified, the student may fulfill the requirement by taking the prescribed course at UNM, or by taking an equivalent course at another university. Normally, the student is not admitted to the graduate program until all identified articulated courses are completed with a B grade or better.

Exceptions. For students wishing to enter the graduate program who have fulfilled all other admission requirements, but whose GPA is slightly less than 3.0 for M.S. degree or 3.5 for Ph.D. degree, the ECE Graduate Office **may** recommend probationary admission, contingent upon the student completing further requirements, which usually consist of a list of 1 to 4 undergraduate courses that are important to the student's proposed graduate work and in which the student received a low grade in his/her undergraduate program. Upon successful completion of these courses (i.e. receiving at least a grade point average of 3.0 for M.S. or 3.5 for Ph.D.), the student will be placed in regular status in the M.S. or Ph.D. program.

Students who are admitted on probation, with certain course requirements, will be given a limited time (no more than 2 semesters) to complete those courses. The objective is to ensure that these courses are expeditiously completed and that they are taken before other courses that may have them as a prerequisite. If the time limit is not met, the student may be dis-enrolled.

Non-degree courses. Domestic students may enroll as non-degree status before admission (this option is unavailable for International students). A student in non-degree status who desires to receive graduate credit for an approved 400-level course must obtain signatures from the course instructor and the Office of Graduate Studies on a Graduate Credit Authorization card. Moreover, only 9 credits are acceptable for transfer from non-degree to degree status.

3 General Information

Advisement hold. Each ECE graduate student must meet with her/his advisor on a regular basis, since this is an important part of the educational process. Therefore, each student will have a HOLD placed on her/his registration. Students must obtain academic advisement each semester before the hold is removed. After advisement, the advisor will sign the advisement form so the hold can be removed.

Guidelines for courses outside ECE. All courses taken for the M.S. and Ph.D. degrees in ECE must be approved by both the ECE department, and the Office of Graduate Studies. Before selecting any course at the 400-level, check to see that graduate credit is granted by the department.

Any elective courses taken outside the department for the satisfaction of degree requirements, must be of a technical nature. Courses from the following departments are usually acceptable: Computer Science, Mathematics, Physics, or another department in the School of Engineering. Some courses from the Anderson School of Management are acceptable; however, approval should be sought from the Director of Graduate Program before registering for the course. If the course is not from one of these departments or the course might be questionable, you should first obtain the approval of the Director of Graduate Program

ECE 590 Seminar. All M.S. students are required to complete one credit hour of ECE 590 Seminar, and all Ph.D. students are required to complete two credit hours of ECE 590. The grading will be CR/NC based and the credits will not apply toward the required number of degree hours in the program.

ECE 551/651 Problems courses. The ECE Department has a policy that requires that each student taking ECE 551 or ECE 651 Problems course submit a final report for the student's record. A copy of the report should be sent to the Graduate Office for insertion into the student's file. This requirement will be checked once the student submits the Application for Candidacy or the Program of Studies, and before the student graduates. Failure to submit the report may result in a delay in graduation.

Time limit for completion of degree. All work used to meet degree requirements for an M.S. degree, including transfer credit, must be completed within a seven-year period immediately preceding the granting of the degree. Course work older than seven years cannot be used to meet requirements for the master's degree. Note that international students on student Visa must make progress towards their degree, and are therefore expected to graduate within 2 years from starting their M.S. studies.

Doctoral candidates have five (5) calendar years from the semester in which they pass their doctoral comprehensive examination to complete the degree requirements. The final requirement is generally the acceptance of the student's dissertation by the Dean of Graduate Studies.

Notification of Intent to Graduate. A student must inform the ECE Graduate Office, in writing, of the Intent to Graduate no later than 11:00am on the last day of the semester immediately preceding the semester of graduation. Degrees are awarded three times during the year, while commencement exercises are only held in May and December. Graduation is dependent upon the completion of all degree requirements for graduation by November 15 for Fall, April 15 for Spring, or July 15 for Summer. If a student does not complete all degree requirements for graduation in a particular semester, the student must submit a new Intent to Graduate form for graduation in a subsequent semester. Only students who have completed all degree requirements may participate in commencement exercises.

Graduating GPA requirements. A student may not graduate if his/her program of study includes more than 6 hours of coursework graded C, C+, or CR (ECE590 is excluded from this limitation). A student's cumulative GPA cannot be below 3.0. In addition, the GPA for courses presented in his/her program of studies cannot be below 3.0.

4 Research Emphases and Core Courses

A graduate student in ECE department is required to choose a research emphasis. Each emphasis is associated with three core courses which are required for students to take. Some emphases require up to four specific courses. Students are requested to identify his/her choice of emphases in the application to ECE department. During the initial stage of the program study, a student may reselect his/her research emphases. Any switching of research emphases after one year from the enrollment either as a MS student or as a PhD student is not encouraged. Table 1 lists all major core courses for different emphases in ECE Department.

Table 1: Emphases and Core Courses.

	Emphases	Major Core Courses	Other required
Computer Engineering	Computer Architecture	ECE537 Foundations of Computing (Fall) ECE538 Advanced Computer Architecture (Fall) ECE520 VLSI Design (Spring)	ECE5xx
	Computer Graphics & Vision	ECE537 Foundations of Computing (Fall) ECE516 Computer Vision (Spring) ECE512 Advanced Image Synthesis (Fall)	ECE533
	Computer Networks & Systems	ECE537 Foundations of Computing (Fall) ECE536 Computer Systems Software (Spring) ECE540 Advanced Networking Topics (Fall)	
	Computational Intelligence	ECE537 Foundations of Computing (Fall) ECE517 Pattern Recognition (Spring) ECE549 Information Theory & Coding (Spring)	ECE547
	Image Processing	ECE537 Foundations of Computing (Fall) ECE533 Digital Image Processing (Spring) ECE539 Digital Signal Processing (Spring)	
Electrical Engineering	Systems & Controls	ECE500 Theory of Linear Systems (Fall) ECE541 Probability Theory & Stochastic Processes (Fall) ECE546 Multivariable Control Theory (Spring)	
	Signal Processing	ECE500 Theory of Linear Systems (Fall) ECE541 Probability Theory & Stochastic Processes (Fall) ECE539 Digital Signal Processing (Spring)	ECE542
	Image Processing	ECE500 Theory of Linear Systems (Fall) ECE541 Probability Theory & Stochastic Processes (Fall) ECE533 Digital Image Processing (Spring)	ECE539
	Communications	ECE500 Theory of Linear Systems (Fall) ECE541 Probability Theory & Stochastic Processes (Fall) ECE542 Digital Communications Theory (Spring)	ECE642
	Optoelectronics	ECE561 Electrodynamics (Spring) ECE570 Optoelectronic Semiconductor Materials & Devices ECE572 Physics of Semiconductors (Spring)	ECE565
	Applied Electromagnetics	ECE561 Electrodynamics (Spring) ECE560 Intro. to Microwave Engineering (Fall) ECE534 Plasma Physics I (Fall, the Plasma Science track) or ECE569 Antennas for Wireless Communications (Spring, the Antennas track)	ECE563
	Microelectronics	ECE520 VLSI Design (Spring) ECE523 Analog Electronics (Fall) ECE576 Modern VLSI Devices (Spring)	
Bioengineering	Bioengineering with CompE	ECE510 Medical Imaging (Fall) ECE533 Digital Image Processing (Spring) ECE537 Foundations of Computing (Fall)	
	Bioengineering with Systems & Controls	ECE510 Medical Imaging (Fall) ECE533 Digital Image Processing (Spring) ECE500 Theory of Linear Systems (Fall)	
	Bioengineering with Signal Processing	ECE510 Medical Imaging (Fall) ECE533 Digital Image Processing (Spring) ECE539 Digital Signal Processing (Spring)	
	Bioengineering with AppliedEM	ECE510 Medical Imaging (Fall) ECE533 Digital Image Processing (Spring) ECE561 Electrodynamics (Spring)	

5 M.S. Program

5.1 Degree Requirement

The M.S. (in Electrical Engineering or Computer Engineering) program is offered under Plan I (Thesis) and Plan II (Non-Thesis) as shown in Table 2, Plan I requires 24 hours of coursework and 6 hours of Thesis, while Plan II requires 33 hours of coursework. Both plans require at least 12 hours of ECE core courses, among which 9 hours are required by the emphasis as 3 major core courses, and the other 3 hours are selected from another emphasis as a minor core course. Note that in addition to the three major core courses some emphases require another course as listed in Section 4. The remaining courses are free electives. The core courses are listed in Section 4, while an advisement worksheet for the M.S. program is provided as Appendix ??.

Table 2: Master Degree Requirements.

Plan I:	Plan II:
1. A minimum of 24 hours of course work (not including ECE590), with a minimum of 15 hours in ECE.	1. A minimum of 33 hours of course work (not including ECE590), with a minimum of 18 hours in ECE.
2. A maximum of 6 hours of 400-level ECE courses, and no more than 6 hours of 400-level Non-ECE courses (as long as approved for graduate credit).	2. A maximum of 6 hours of 400-level ECE courses, and no more than 6 hours of 400-level Non-ECE courses (as long as approved for graduate credit).
3. A maximum of 3 hours in “problems” courses (ECE551 or ECE651).	3. A maximum of 6 hours in “problems” courses (ECE551 or ECE651).
4. At least 50% of required course work must be completed after admission to the graduate program, unless further limited by the graduate program.	4. At least 50% of course work requirements completed after admission to the graduate program, unless further limited by the graduate program.
5. One credit hour of graduate seminar course (ECE590).	5. One credit hour of graduate seminar course (ECE590).
6. Six hours of Thesis (ECE599) credit and completion of a master’s thesis.	6. Pass the M.S. exit exam (Technical report and its presentation).

5.2 Program of Studies

An M.S. student should file a Program of Studies with the Office of Graduate Studies as soon as she/he has planned a program of studies for the degree in consultation with the major advisor

The Program of Studies must be approved by the Graduate Office and submitted to the Office of Graduate Studies by the following deadlines: October 1 for Spring, March 1 for Summer and July 1 for Fall. Each Program of Studies must be approved by the Dean of Graduate Studies before a student may take the master’s examination.

In the Program of Studies, no more than half the graduate program’s minimum required course work hours, exclusive of Thesis, may be taken with a single faculty member. After a Program of Studies has been filed, a student may switch between Plans I and II only with the approval of the ECE graduate office and the Dean of Graduate Studies and must submit a new Program of Studies;

Transfer of graduate credit. The applied or transfer of graduate credit to a program of studies is never automatic. With the approval of the ECE graduate office, a maximum of 50% of the course work requirements for the M.S. degree may consist of a combination of applied/transfer credits, assuming they meet the restrictions specified in the UNM catalog. Note that course work that has been counted toward a previous degree may not be counted again in the program of studies for a master’s degree. In addition, applied/transfer credit must meet the following criteria:

1. The course work was taken at an accredited institution and is approved by both the ECE Graduate Office and the Dean of Graduate Studies to be appropriate to the student's degree program;
2. The course work is graded at least a B and was completed within the required seven-year period; and
3. The courses are submitted to the ECE graduate office for approval. This usually requires a course syllabus and a consultation of the Director of Graduate Program with the appropriate faculty members.

5.3 Master's Examination

All M.S. students are required to pass a master's exam. The student will have at most two opportunities to pass the master's examination.

- **Thesis defense:** Plan I students will be examined over the thesis material by the thesis committee.
- **Technical report-based MS Exit Examination:** Plan II students will be examined in an emphasis area based on a technical report plus its presentation to the examination committee.

Advisor and Examination committee. Each student will be assigned an advisor on admission into the department. Upon submission of POS, a student must choose an academic advisor. The student, in cooperation with the academic advisor, will form an examination committee that includes three members, two of whom must be UNM faculty holding a tenure-track appointment. Moreover, the examination committee must be chaired by an ECE tenure-track faculty member who works in the emphasis area of the student as listed by the ECE Graduate Office (e.g., systems & controls, optoelectronics, etc.)

Technical report-based MS Plan-II Exit Examination. The exam consists of two components: i) an original technical report on a topic approved by the student's examination committee; and ii) an oral defense of the technical report in front of the examination committee. The student must work with his/her examination committee to select a topic for the report no later than the submission of the student's POS. Students may not re-use reports produced for any other UNM course (including special-topics courses) as a technical report for the MS Plan-II Exit Exam. At least three weeks before the graduation deadline, the student must sign up for the MS Plan-II Exit Exam with the ECE Graduate office. The report should be typed, using 12-point font, single space with a 1-inch margin on all sides. Its length is expected to be between 12 and 15 pages excluding references. Students are reminded that verbatim copying of text and illustrations without proper citation of the source, paraphrasing and other forms of plagiarism are unacceptable and will result in failing the exam. At least two weeks before the exam, the Plan-II MS Exam announcement form must be filled and the technical report must be submitted to the committee. The results of the MS Plan-II Exit Exam (pass or fail) must be reported to the OGS by November 15 for fall graduation and April 15 for spring graduation. If a student fails the exam, she/he may re-take the exam within one calendar year from the date of the first exam. The Plan-II MS exam may be taken only twice. A second failure will result in the student's termination from the program.

Announcement of master's examination. At least two weeks before the final examination is held, and no later than November 1 for Fall, April 1 for Spring or July 1 for summer, the Graduate Office must notify the OGS of its schedule date by submitting the appropriate announcement form.

6 Ph.D. Program

6.1 Degree Requirements

A minimum of 54 semester hours (excluding the 18 hours of dissertation hours) beyond the bachelor's degree is required, which may include a maximum of 6 hours of master's thesis. A maximum of 30 hours can be transferred from another accredited graduate school, under certain conditions (refer to the graduate program section of the UNM Catalog). A minimum of 24 hours must be completed at UNM, of which 18 hours must be at the 500 level or above. Details pertaining to the minimal coursework requirement for the Ph.D. program are summarized in Table 3 and the advisement worksheet in Appendix ??.

Table 3: Doctoral Degree Requirements.

<ol style="list-style-type: none"> 1. A minimum of 54 hours of graduate credit course work (not including ECE590). <ul style="list-style-type: none"> • At least 24 hours of graduate credit course work must be completed at the UNM. • At least 18 hours of graduate credit course work must be completed at the UNM after admission to the doctoral program. • A minimum of 18 hours of graduate credit course work earned in the UNM must be courses numbered 500 or above. 2. Two credit hours of graduate seminar course (ECE590). 3. No more than 6 credit hours of course work in which a grade of C (2.0), C+ (2.33) or CR (grading option selected by 	<p>student) was earned may be credited toward a graduate degree. ECE590 is excluded from this limitation.</p> <ol style="list-style-type: none"> 4. No more than 50% of the required course credits at the University of New Mexico may be taken with a single faculty member. (Course work that has been completed for the masters degree is included in this limit.) 5. A minimum of 18 hours of dissertation credits (ECE699) is required for the doctorate. 6. Must be enrolled in at least one hour of graduate credit in the semester in which the doctoral comprehensive examination is taken and in the semester in which they complete degree requirements, including the summer session.
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6.2 Qualifying Exam

All Ph.D. candidates are expected to take this exam. A graduate student can take the Qual exam no more than twice in his/her Ph.D. program. The passing levels will be determined by the ECE faculty, according to the recommendations of the corresponding area group and the ECE graduate committee.

Students are notified as to when they must take the Qualifying Exam in their admission acceptance letter. The exam must be attempted within one year of admission, unless otherwise determined by the academic adviser and the Director of Graduate Program. Failure to take the exam at the prescribed time will be equivalent to failing the exam. The exam date will be set so that the student will have ample time (2 semesters) to complete required course work and to study for the exam. Students will be allowed to petition, in extraordinary circumstances, for a later test date. All petitions must be approved by the ECE Graduate Office.

Qualifying exam schedule. The qualifying exam is given twice a year: In January and in August, the Friday before the first day of the Spring or Fall semesters. Students must sign up for this exam *four weeks* in advance through the ECE Graduate Office. If, after signing up, a student determines that he/she will not be able to sit for the exam, the student must submit a written request at least two weeks in advance of the scheduled exam date, with advisor approval, to withdraw from the exam.

During the two weeks following the written exam, students must be able to be physically present to attend an oral exam if necessary. Students will be notified of the need to conduct an oral exam within one week of the written exam. The results of the Qualifying Exam will be made available to students within two weeks of the written exam.

Qualifying exam information. The written exam is a 4-hour long, close book/notes test. Personal items, such as laptops, PDAs, calculators, cell phones or any other type of electronic device will not be allowed to be brought into the testing site. A basic calculator will be provided for students to use. Students are required to PASS the exam in 4 subject areas (a subject area corresponds to a core course): 3 subjects in the major emphasis and a fourth subject in another emphasis.

Four weeks before the Qualifying Exam, students are required to sign up for their major emphasis (three major core courses) and up to three minor core courses. Minor core courses can be chosen from any ECE emphasis *outside* the major emphasis. For the test, students are required to complete all questions from the three major core courses and one minor core course. Table 1 lists all major core courses for different emphases in ECE

Department. Students taking Qualifying Exam should check the latest list from the ECE Graduate Office before signing up for the exam. Students are also expected to know the material in courses prerequisite to those listed in Table 1.

Evaluation of Qualifying exam. The progressive rule allows for passing at the subject level. Students will have 2 consecutive opportunities to pass the four subject areas. Students will be evaluated as having passed or failed in the individual subject areas.

- After a Ph.D. student's 1st written exam, the outcome may be
 - passing at the PhD level, or
 - partial passing at PhD level in certain individual subject areas.
- After a PhD student's 2nd written exam, the outcome may be
 - passing at the PhD level, or
 - failing at the PhD level, or
 - failing at the PhD level, but passing at the MS level

6.3 Application to Ph.D. Candidacy

Doctoral Committee on Studies. Each Ph.D. student is required to have a Committee on Studies consisting of *at least four members*. A minimum of two members must hold regular University faculty members from the ECE Department. One of the committee members must be tenured or tenure-track faculty from outside the ECE department or at other institutions. All committee members (both internal and external to UNM) must be approved for graduate instruction (check with the Graduate Office for information). Students should form this committee early in their Ph.D. program in cooperation with their dissertation advisor who will be the Chair of this committee.

The Committee on Studies must approve all courses taken by the student via a form called the Ph.D. Candidacy form, which is a list of all courses counted toward the degree, including any transfer hours. During the semester in which the comprehensive The Application to Candidacy enables the student to formally summarize his/her program of studies. The application form will be submitted in the same semester during which the Comprehensive Exam is passed.

Comprehensive exam (Dissertation proposal). Before a student may complete this requirement, he/she must have passed the Qualifying Exam. The Comprehensive Exam must be administered and passed in the same semester the Candidacy form is submitted to the Office of Graduate Studies. Here the focus is on a dissertation topic, where the student demonstrates to the Committee On Studies that he/she is capable of carrying out the proposed research. The Chair of the Committee On Studies will advise the student on preparing for this exam, which must be scheduled through the ECE Graduate Office. The Office of Graduate Studies must be notified of the Comprehensive Exam at least two weeks before the exam through the completion of the appropriate Comprehensive Exam announcement form, available from the ECE Graduate Office.

6.4 Dissertation and the Final Examination.

Dissertation Committee. The Committee On Studies usually becomes the Dissertation Committee (with appropriate members added or deleted), after the Comprehensive Exam is passed. The composition of the dissertation committee is exactly the same as that of the Committee on Studies. The duties of the Dissertation Committee are stated in the graduate program section of the UNM Catalog. The dissertation topic and committee's membership must be recorded by completing the Appointment of Dissertation Committee form, available in the ECE Graduate Office

Outside expert as dissertation advisor. An outside expert, who has a Ph.D., may serve as a member of the Dissertation Committee, with special permission of the UNM Dean of Graduate Studies. The chair of the committee must be a regular university faculty member in the ECE Department.

Dissertation defense. All candidates must pass a final exam (dissertation defense). The Dissertation Committee conducts the defense of the dissertation. The candidate must contact the ECE Graduate Office early

enough so that all necessary arrangements can be made; see the latest UNM Catalog for pertinent deadlines. It is the responsibility of the student to meet the deadlines printed in the UNM Catalog. The examination must be scheduled through the ECE Graduate Office at least two weeks in advance of the exam. Before the exam is scheduled the student must 1) present an abstract of the dissertation to the ECE Graduate Office 2) submit a draft of the dissertation to each committee member, and 3) obtain each member's signature, acknowledging receipt of the draft, on a designated form.

Required paper submission. As part of the departmental requirement for the Ph.D. dissertation, the student must submit a paper, based on the dissertation, to the dissertation committee. This paper must have been submitted for publication in a professional journal and an acknowledgment of submission received prior to the dissertation defense. Please refer to the UNM Catalog for details on dissertation hours, format, submission, approval, and fees.

A ECE Faculty and Research Interests

- Chaouki T. Abdallah** Gardner-Zemke Professor, Department Chair, Ph.D., Georgia Institute of Technology, Interests: Control systems, communications and computing
- Ganesh Balakrishnan** Assistant Professor; PhD, University of New Mexico, Interests: Semiconductor device development including epitaxy and characterization, high power vertical external cavity surface emitting lasers and novel semiconductor material development for Mid-Infrared lasers.
- Steven R. J. Brueck** Professor; Director, Center for High Technology Materials, Ph.D., Massachusetts Institute of Technology, Interests: Laser-material interactions, electro-optic devices, laser spectroscopy
- Vince D. Calhoun** Associate Professor, Ph.D., University of Maryland, Interests: Biomedical engineering, psychiatric neuroimaging, functional and structural magnetic resonance imaging (MRI), multimodal data fusion, and medical image analysis.
- Thomas P. Caudell** Professor, Director-High Performance Computing Center Ph.D., University of Arizona, Interests: Neural networks, virtual reality, machine vision, robotics and genetic algorithms
- Jingkuang Chen** Associate Professor, Ph.D., University of Michigan, Ann Arbor, Interests: MEMS-based ultrasonic transducers, smart microfluidic systems for biomedical applications
- Christos G. Christodoulou** Professor, Ph.D., North Carolina State University, Interests: Modeling of electromagnetic systems, phased array antennas, antennas for wireless communications, microwave systems and applications of neural networks in electromagnetics
- Rafael Fierro** Associate Professor; Ph.D., University of Texas-Arlington; Interests: Hybrid and embedded systems, coordination of multiagent systems, optimization-based cooperative control of unmanned aerial and ground vehicles, mobile sensor networks, and robotics.
- Charles B. Fleddermann** Gardner-Zemke Professor; Associate Dean, School of Engineering, Ph.D., University of Illinois at Urbana-Champaign, Interests: Plasma processing, physical electronics, photovoltaics
- Nasir Ghani** Associate Professor; PhD, University of Waterloo; Interests: High-speed networking, cyber-infrastructures, protocols and architectures, traffic engineering, routing, network virtualization, optical and access networks, TCP/IP enhancements, performance evaluation, survivability, network simulation, stochastic modeling.
- Mark A. Gilmore** Assistant Professor, Ph.D., University of California at Los Angeles, Interests: Plasma physics, plasma diagnostics, magnetic confinement fusion, microwave engineering
- Majeed M. Hayat** Professor, Ph.D., University of Wisconsin at Madison, Interests: Statistical communication theory, signal and image processing, algorithms for infrared spectral sensors and imagers, novel avalanche photodiodes, optical communication, cooperative distributed sensing and computing, applied probability and stochastic processes.
- Gregory L. Heileman** Professor; Associate Chair; Director of Undergraduate Program, Ph.D., University of Central Florida, Interests: Data structures and algorithmic analysis, theory of information and computing, machine learning and pattern recognition
- Mani Hossein-Zadeh** Assistant Professor, PhD, University of Southern California-Los Angeles, Interests: Electro-optics, microwave-photonic devices and systems, ultra high-Q optical microresonators, optomechanical interaction in UH-Q optical resonators, optical communication, photonic sensors, optofluidics and plasmonics.
- Stephen D. Hersee** Professor, Ph.D., Brighton University (UK), Interests: GaN-based nanowire devices and nanostructures; advanced semiconductor materials and devices.
- Ravinder K. Jain** Professor, Ph.D., University of California at Berkeley, Interests: Quantum electronics, optoelectronics, electro-optics, experimental solid-state physics
- Sudharman K. Jayaweera** Assistant Professor, Ph.D., Princeton University, Interests: Wireless communications, statistical signal processing, information theory, wireless sensor networks, image processing, quantum information processing, distributed signal processing.

- Ramiro Jordan** Associate Professor; VP of Technology, ISTEK, Ph.D., Kansas State University, Interests: Data communications, multidimensional signal processors, software engineering
- Sanjay Krishna** Associate Professor, Ph.D., University of Michigan at Ann Arbor, Interests: Investigation of nanostructured semiconductor materials for mid-infrared lasers, detectors and thermophotovoltaic cells. The nanoscale materials consist of self-assembled quantum dots, strain layer superlattices and quantum wells grown on metamorphic buffers.
- Luke F. Lester** Professor; Associate Director, CHTM, Ph.D., Cornell University, Interests: High-speed and high-power semiconductor lasers, high-temperature electronics, microwave devices, tunable lasers, III-V semiconductor devices
- Kevin J. Malloy** Professor; Associate Dean for Research, School of Engineering, Ph.D., Stanford University, Interests: Semiconductor physics, device physics
- Yasamin Mostofi** Assistant Professor, Ph.D., Stanford University Interests: Sensor and actuator networks, collaborative information processing in intelligent mobile networks, sensing and control over wireless networks, wireless communication networks, control and dynamical systems, signal processing and optimization.
- Marek Osinski** Professor, Ph.D., Polish Academy of Sciences, Poland, Interests: Semiconductor lasers, optoelectronic devices and materials, group-III nitrides, degradation mechanisms and reliability, computer simulation
- Marios S. Pattichis** Associate Professor, Ph.D., University of Texas at Austin, Interests: Digital image and video processing and communication, medical imaging and statistical methods for image processing, reconfigurable image processing systems
- James F. Plusquellic** Associate Professor, PhD, University of Pittsburgh, Interests: IC Trust, design for manufacturability, defect-based and data-driven VLSI test, small delay faulty test model-to-hardware correlation and IC fabrication process monitors.
- L. Howard Pollard** Assistant Professor, Ph.D., University of Illinois at Urbana-Champaign, Interests: Computer architecture, digital design, fault tolerance, microprocessors
- Balu Santhanam** Associate Professor, Ph.D., Georgia Institute of Technology, Interests: Statistical signal processing, statistical communications, digital signal processing, time-frequency analysis, adaptive signal processing, and general signal processing
- Edl Schamiloglu** Gardner-Zemke Professor, Ph.D., Cornell University, Interests: Physics and technology of charged particle beam generation and propagation, high-power microwave sources and effects, pulsed power science and technologies, plasma physics and diagnostics, electromagnetics and wave propagation, infrastructure surety and complex systems
- Pradeep Sen** Assistant Professor; Ph.D., Stanford University, Interests: Computer graphics, real-time rendering, computational photography, computer vision algorithms.
- Wei Wennie Shu** Associate Professor; Associate Chair; Director of Graduate Program, Ph.D., University of Illinois at Urbana-Champaign, Interests: Distributed systems, multimedia networking, mobile ad-hoc and sensor networks, overlay network services, biomed modeling and simulation.
- Jamesina J. Simpson** Assistant Professor; PhD, Northwestern University; Interests: Computational electromagnetics theory and applications, especially finite-difference time-domain (FDTD) solutions of Maxwell's equations. Research topics range from near-DC to light, and include modeling the Earth-ionosphere waveguide and optical interactions with living tissues.
- Payman Zarkesh-Ha** Assistant Professor, Ph.D. Georgia Institute of Technology, Interests: Statistical modeling of VLSI systems, design for manufacturability, low-power and high-performance VLSI design.