College of Engineering

New Mexico State University
Klipsch School of Electrical & Computer Engineering

Report Title: AY 2008 – 2009 Graduate Program Handbook

Authors(s): ECE Graduate Studies Committee

Date: August 2008

ECE Graduate Program Handbook for Academic Year 2008-09
The Klipsch School of Electrical and Computer Engineering
New Mexico State University

The faculty members of the Klipsch School of Electrical and Computer Engineering offer graduate work leading to the Master of Science and Doctor of Philosophy degrees. Areas of specialization for master's students and doctoral candidates are digital signal processing, communications, microelectronics/VLSI, control systems, electromagnetics, electro-optics, electric power systems, and computer engineering. Research in the above areas currently being conducted by the faculty ensures that the present and new doctoral candidates will work on the frontier of knowledge in these areas.

In addition to giving students the opportunity to perform in-depth research in one of these eight specialty areas, the graduate program is intended to provide broad graduate-level training. For example, appropriate courses in computer science, mathematics, physics, or business management may be integrated into a graduate student's program.

Students desiring to work toward an advanced degree in electrical engineering must have completed undergraduate preparation substantially equivalent to that required for the Bachelor of Science in Electrical Engineering degree at this institution. For students with undergraduate degrees in other disciplines, see the section on undergraduate deficiencies.

For further information on the Klipsch School of Electrical and Computer Engineering, please consult the Web page http://www.ece.nmsu.edu/ .

NOTE: The primary purpose of the *ECE Graduate School Handbook* is to educate faculty and students about the opportunities and requirements for graduate school in the Klipsch School. The information contained in this handbook is subject to change. The most up-to-date information can be found (1) on the Graduate School Web site, (2) the current Graduate School catalog, and (3) the ECE Web Site.

Contact Information:

Klipsch School of Electrical and Computer Engineering
Box 30001, MSC 3-O,
Thomas & Brown Hall Rm 106
Las Cruces, NM 88003-8001 USA
ecegraduate@nmsu.edu
Office: (505) 646-3115 FAX: (505) 646-1435

Contents

1 Graduate Faculty

S. J. Horan, department head, Ph.D. (New Mexico State)- communications and telemetering;

D. K. Borah, Ph.D. (Australian National)-digital communication systems;

S. Brahma, PhD (Clemson) – energy systems

S. P. Castillo, Dean of Engineering, Ph.D. (Illinois)-electromagnetics;

S-Y Cho, PhD (Georgia Institute of Technology) -- photonics

J. Cook, Ph.D. (New Mexico State)-computer architecture;

C. D. Creusere, Ph.D. (California-Santa Barbara)-digital image and signal processing;

M. Dawood, Ph.D.(University of Nebraska-Lincoln)-Radar/Electromagnetics

P. L. DeLeon, Ph.D. (Colorado)-digital signal processing;

P. M. Furth, Ph.D. (Johns Hopkins)-analog VLSI systems;

H. Huang, Ph.D. (Georgia Institute of Technology)-communication networks;

E. E. Johnson,* Ph.D. (New Mexico State)-computer systems;

J Kliewer, PhD (Kiel - Germany) – information and coding

K. T. Ng, Ph.D. (Ohio State)-bio-electromagnetics;

R. A. Paz, Ph.D. (Illinois)-robust control theory;

N. R. Prasad, Ph.D. (New Mexico State)-expert systems;

J. Ramirez-Angulo, D.Sc. (Stuttgart-Germany)-analog/mixed-signal VLSI;

S. Ranade, Ph.D. (Florida)-power systems;

S. Stochaj, Ph.D. (Maryland)-real-time computer systems;

D. Voelz, Ph.D. (Illinois)-image sensing/interferometry

*Registered Professional Engineer

2 Research Facilities and Headings

There are extensive computer and research facilities available in the Klipsch School of Electrical and Computer Engineering. The school has numerous PC workstations contained within three different open computing labs and several research laboratories. Research requiring larger computational resources have access to the departmental 16 processor HP rp 8400 supercomputer, 4 quad-processor Itanium 2 HP servers, and a 128-processor "Beowulf" distributed memory parallel computer. The internal network consists of a one Gbit/sec fiber optic backbone with 100 Mbit/sec Ethernet connections to all desktop machines. The Electrical Engineering building is linked to a large number of remote computers on campus via NMSUnet and to computers at other universities and research laboratories via the VBNS and the Internet.
The Center for Telemetry and Telemetering hosts the Manuel Lujan, Jr . Space Tele-Engineering Program and the Frank Carden Chair for Telemetry and Telemetering. Faculty and staff in the Center are involved in education and research programs focusing on telecommunications, communication theory, coding and information theory, wireless networks, digital signal processing, optical and radio frequency communications, and digital image processing. The Center has several major research sponsors including NASA, AFOSR, ONR, and the National Science Foundation. The director of the Center and holder of the Frank Carden Chair is Dr. Stephen Horan.
The Advanced Speech and Audio Processing Laboratory is used for both teaching and research in digital signal processing (DSP). Current research areas include audio coding, embedded DSP, signal enhancement, speaker recognition, and subjective speech and audio evaluation. Research sponsors for the laboratory include Air Force Research Laboratories, Freescale Semiconductor, IBM, Motorola, National Science Foundation, and Texas Instruments. The director of the laboratory is Dr. Phillip L. De Leon.
The New Mexico State University R.L. Golden Particle Astrophysics Lab (PAL) is dedicated to measuring and interpreting cosmic ray spectra in an effort to better understand the origin, structure, and workings of our universe. PAL also serves as the center of a large scientific collaboration including scientists from Italy, Germany, Sweden, Russia, France, and India. For the past 20 years, giant helium-filled balloons have carried PAL’s research instrument on 24-hour flights to the top of the earth’s atmosphere. This method of research allows the collaboration to make scientific observations comparable to those possible using satellites but

at a small fraction of the cost. PAL's major sponsor is NASA. The director of PAL is Dr. Steven Stochaj.

The Electromagnetics and Microwave Laboratory is used for both teaching and research in electromagnetic fields. Current research areas include antenna analysis, synthesis, and design, bio-electromagnetics, brain mapping, computational physics, electromagnetic interference and compatibility, high performance computing, nondestructive evaluation, radar system analysis and design, and radar cross-section analysis. Research sponsors for the laboratory include American Heart Association, Department of Defense, Los Alamos National Laboratory, NASA, National Institutes of Health, Sandia National Laboratories, and White Sands Missile Range. The Director of the Electromagnetics and Microwave Laboratory is Dr. Kwong T. Ng.

The New Mexico State University program in Electric Utility Management (EUMP) is sponsored by a group of public and private electric utility companies and industrial organizations and hosts the PNM Professor for Utility Management. The program leads to the degree of Master of Science in Electrical Engineering and is designed to prepare the student for a future engineering management position in the electric utility industry. An industry advisory committee provides the vital connecting link between the electric utility industry and the university, so that a coordinated effort may be achieved in realizing the following program objectives: (1) to provide a program of study at the graduate level in the planning, operation, and management of electric power generation, transmission, distribution, and utilization; (2) to supply the electric utility industry with the highest caliber of new engineering and management talent; and (3) to provide the university with the required financial and technical support to ensure a quality program. In addition, faculty members in EUMP participate in research sponsored by Sandia National Laboratories, EPRI, NSF, DOE, and the electrical utility industry. The director of the EUMP and PNM Professor for Utility Management is Dr. Satish Ranade.

Faculty and students in the VLSI Laboratory are involved in the design and analysis of analog and mixed-signal microelectronic circuits and systems. Current research areas include high-frequency analog VLSI design; digitally controlled analog VLSI signal processors; low-voltage, low-power circuits; analog speech and image processing; and CMOS image sensors. Research sponsors include the NSF, the Air Force Research Laboratories, NASA, Lockheed-Martin and Texas Instruments. The director of the VLSI Laboratory is IEEE Fellow Dr. Jaime Ramirez-Angulo.

The Electro-Optics program at NMSU offers unique opportunities to undergraduate and graduate students interested in pursuing a career in electro-optics, applied optics, photonics, or optical engineering by combining the optics resources of the Klipsch School and the Physics Department. Most of the optics classes are cross-listed in the two departments, giving the students flexibility to plan their degree programs. Excellent cooperation between the

departments provides students with different but complementary perspectives. The Klipsch School's Electro-Optics Research Laboratory (EORL) provides a variety of research opportunities in areas such as multispectral imaging, polarimetric imaging, free-space optical communications, and adaptive optics. Sponsors include the Air Force Office of Scientific Research, Sandia National Laboratories, Air Force Research Laboratory, Army Research Laboratory and the National Geospatial-Intelligence Agency. Dr. David G. Voelz is the director of the EORL and the Electro-Optics program at NMSU.

The Computer Engineering group maintains three research laboratories. Recent sponsors include DoD, USDA, Hewlett-Packard, IBM, and Intel. The Performance and Architecture Research Lab (PARL) supports cutting-edge research projects in wireless networks, network security, and computer architecture, and frequently contributes to US and international standards. PARL computer facilities include private research networks and wireless systems, extensive simulation resources, and support Internet resources such as the NMSU TraceBase, a repository of computer and network traces that is used in teaching and research worldwide. The Computer Networking Lab supports teaching and research in Internet and wireless sensor network technology. Finally, students and faculty associated with the Advanced Computer Architecture Performance and Simulation Laboratory conduct research in the areas of performance modeling and simulation techniques, low-power microarchitectures and operating systems, computer security, and performance analysis and prediction.

The Rio Grande Institute for Soft Computing (RioSoft) is a consortium of universities composed of New Mexico State University, the University of Texas at El Paso, New Mexico Highlands University, the University of New Mexico, and New Mexico Institute of Mining and Technology. The vision of RioSoft is to develop innovative bio-inspired Air, Space, Underwater, Land, and Underground autonomous systems. Soft computing which includes fuzzy logic, neural networks, and evolutionary computation are used for modeling, analysis, prototyping, manufacturing, testing, and evaluation of complex dynamical processes in various software-hardware integrated architectures. Such integrated architectures are being developed at the RioRoboLab, a NASA/Ames Research Center funded advanced robotics facility. The director of RioSoft is Dr. Nadipuram (Ram) Prasad of the Klipsch School.

3 ECE Graduate Requirements

3.1 MSEE Degree Program

3.1.1 Program Options

1. A minimum of 24 credits of graduate course work plus a minimum of 6 hours of ***EE 599 Master's Thesis*** plus oral exam.
2. A minimum of 27 credits of graduate course work plus a minimum of 3 hours of ***EE 598 Master's Technical Report*** plus oral exam.
3. A minimum of 30 credits of graduate ***course work*** plus oral exam or the graduate portion of the Ph.D. Qualifying Exam.

Students employed by the Klipsch School as a Graduate Assistant for 10 or more hours/week for two or more semesters must complete their degree under either option 1 or option 2.

3.1.2 Graduate School Requirements and Forms

The NMSU Graduate School has general requirements for graduation and time tables for submitting required paperwork during your program of study and prior to graduation. Consult the Graduate School Catalog for more detailed information. In particular, review the Graduate School Master's Degree Checklist for required paperwork and the Graduate School Academic Calendar for applicable deadlines. Many of the necessary forms can be downloaded from Graduate Students Forms.

3.1.3 Basic Requirements

1. Two graduate core courses must be taken from two different areas of specialization. In addition, either a third graduate core course OR one graduate breadth course must be taken from a third area of specialization. Students may transfer equivalent core or breadth courses taken from other ABET-accredited universities, in accordance with the transfer policy (item 6, below). The most recent NMSU instructor determines equivalency of a course taken at another university. Listed below are the core courses by area:

Table 1 - Graduate Core Courses

SPECIALIZATION	COURSE(S) / CREDITS	COURSE TITLE(S)
Microelectronics/VLSI	EE523 / 3 credits	Analog VLSI Circuit Design
Communications	EE571 / 3 credits	Random Signal Analysis
Computer Engineering	EE563 / 3 credits	Computer Performance Analysis I
Control Systems	EE551 / 3 credits	Control Systems Synthesis I
Digital Signal Processing	EE545 / 3 credits	Digital Signal Processing
Electric Energy Systems	EE543 / 3 credits	Power Systems III
Electromagnetics	EE515 / 3 credits	Electromagnetic Theory I
Electro-optics	EE577 / 3 credits EE528 / 4 credits	Fourier Methods in Electro-Optics Optical Sources, Detectors, & Radiometry

Table 2 - Graduate Breadth Courses

SPECIALIZATION	COURSE(S) / CREDITS	COURSE TITLE(S)
Microelectronics/VLSI	EE524 / 3 credits	Digital VLSI Circuit Design
Communications	EE585 / 3 credits	Telemetering Systems
Computer Engineering	EE564 / 3 credits	Advanced Computer Architecture I
Control Systems	EE555 / 3 credits	Advanced Linear Systems
Digital Signal Processing	EE555 / 3 credits	Advanced Linear Systems
Electric Energy Systems	EE537 / 3 credits	Power Electronics
Electromagnetics	EE541 / 3 credits	Antennas and Radiation
Electro-optics	N/A	

2. At least 15 credits of course work must be at or above the 500 level.
3. At least half of the graduate course work must be in the Klipsch School of Electrical and Computer Engineering.
4. At least half of the coursework credits, excluding thesis or tech report credits, must be taken with other than a single professor.
5. Any coursework more than seven years old at the time of the final examination will not be included in the Master's degree program.
6. A maximum of 12 credits of graduate course work taken at another institution may be transferred in, if those credits logically fit into the student's graduate program. The advisor decides which courses fit. Graduate School approval of transfer credit is required. Students must complete two forms: Master's Transfer of Credit and EE Transfer Checklist.
7. Credits of EE490 Selected Topics do not count toward a graduate degree. Courses CS 457/467/477/487 and BCS 472 are beginning programming classes and do not count toward a graduate degree. Credits of EE590 Selected Topics are limited to 9 total, of which at most 6 may be credits for courses that don't appear as regular classes in the printed schedule. The courses ENGL577, Advanced Technical and Professional Writing, does not count toward a graduate degree. The classes COMM485, SPCD470/SPCD 490 cannot be counted either.
8. All graduate credits must have letter grades of A, B, or C, or pass/fail grades of S (Satisfactory). At the graduate level, a pass/fail grade of S corresponds to a letter grade of A or B.
9. Up to 6 credits earned on another master's degree at NMSU may be allowed to count toward an MSEE degree, if those credits fit into a logical graduate program.
10. Submit to the Department Head an MSEE Record Check and the Application for Admission to Candidacy for the Master's Degree. The Graduate School requests that the Application for Candidacy be filed after the student has completed 12 hours of coursework. The Graduate School requires that a student's NMSU cumulative graduate grade-point average must be at least 3.0 at the time of applying for candidacy. Our department has the additional requirement that the NMSU GPA of the courses listed on the Application for Admission to Candidacy must be at least 3.0.
11. For the Final Examination, submit to the Department Head an MSEE Record Check and the Committee for Master's Final Examination form. Please note that students selecting the thesis or technical report option must submit to the Department Head a 1-page abstract which includes (a) the advisor's name, and (b) the date, time, and place of the final oral exam. PDF format for the abstract is preferred.
12. Pass an oral exam covering thesis work, technical report work, or course work, as applicable. Please note that the graduate portion of the Ph.D. Qualifying Exam may be taken in lieu of a coursework oral exam.
13. File an Application for Degree (Diploma) with the Office of the Registrar by the last day to register or add a course for the semester or summer session you plan to graduate. If you fail to complete all degree requirements by the deadline specified on the

"Application for Degree (Diploma)," you forfeit any fees paid, and you must reapply and pay all required fees for the term in which you complete all degree requirements.

14. Complete undergraduate deficiency coursework, if the student admitted has a bachelor's degree in a field other than electrical engineering, or equivalent. **Note:** it is highly recommended that all deficiencies be completed as early as possible in the program. They should be completed before the start of the last semester in the program.
15. Each area of specialization may have additional requirements.

3.1.4 Master's Minor

Graduate students enrolled in other departments who are interested in obtaining a minor in electrical engineering must complete 12 hours of graduate electrical engineering courses of which 6 hours are at the 500-level or above. A maximum of 3 credits of EE590 Selected Topics Courses that do not appear as regular classes in the printed class schedule may count toward the electrical engineering minor. These classes may have prerequisites that require additional preparation and are not included in the total credits for the minor.

3.2 Ph.D. Degree

The Doctor of Philosophy program in the Klipsch School of Electrical and Computer Engineering builds to the required doctoral dissertation. A dissertation project in the Klipsch School provides a research environment for either experimental and/or analytical investigation that has sufficient depth to allow the investigator to demonstrate independent and original work. A distinguishing feature of the doctoral research is the recognition of the state-of-the-art as well as research style in the research field. The doctoral research must establish a perspective on how the results fit into the existing body of knowledge.

The doctoral dissertation also provides evidence of independent research leading to some original results, conclusions, or applications. The dissertation must show through references to published articles that the results and conclusions are original. Original results or conclusions represent the extension of known knowledge or new methods for applying known theories.

Students may and generally do receive considerable help in selecting the direction of the dissertation project. However, each student must demonstrate the ability to perform and communicate independent research, leading to new results. The dissertation should result in one or more published papers in peer reviewed journals. Upon completion of the dissertation, the student is expected to be capable of formulating and conducting a research program in industry, federal laboratories, or academia.

3.2.1 Graduate School Requirements

The NMSU Graduate School has general requirements for graduation and time tables for submitting required paperwork during your program of study and prior to graduation. Consult the Graduate School Catalog for more detailed information. In particular, review the Graduate School Doctoral Degree Checklist for required paperwork and the Graduate School Academic Calendar for applicable deadlines. Many of the necessary forms can be downloaded from Graduate Students Forms.

3.2.2 Basic Requirements for the PH.D.

Option 1 - Ph.D. with completed MS degree

1. Complete undergraduate deficiency coursework, if the student admitted has both master's and bachelor's degrees in fields other than electrical engineering. Complete the Klipsch graduate Core classes if the student does not have a MSEE degree from NMSU.
2. Complete a minimum of 18 credits beyond the master's of graduate course work with the following restrictions:
    a. EE courses must be numbered 500 or higher. Non-EE courses must be 450 or higher.
    b. At least half of the 18 credits must be taken in the Klipsch School (EE).
    c. At most 6 credits may be research, for example, EE600, Doctoral Research, and EE590 courses that are not listed as regular courses in the schedule.
    d. Exclude credits of EE 700 Doctoral Dissertation.
    e. If the MS degree is not EE, **exclude** credits from graduate deficiency coursework.

Option 2 - Direct Ph.D. with BSEE or equivalent, but no MS degree

1. Complete three graduate core courses, listed in the Klipsch graduate Core of classes for PhD students.

2. Complete a minimum of 42 credits of graduate coursework, including the three graduate core courses with the following restrictions:
    a. At least half of the 42 credits must be numbered 500 or higher.
    b. At least half of the 42 credits must be taken in the Klipsch School (EE).
    c. At most 9 credits may be research, for example, EE600, Doctoral Research, and EE590 courses that are not listed as regular courses in the schedule.
    d. Exclude credits of EE 700 Doctoral Dissertation.
    e. Exclude credits from EE490, CS457/467/477/487, SPCD470/490, COMM485, and ENGL577.
    f. At least half of the credits must be taken with other than a single professor.

Common Requirements for all Ph.D. candidates

1. Take and pass the Ph.D. qualifying exam.
2. Submit to the Department Head a PhD EE Record Check and the Program of Study and Committee for Doctoral Students. The Graduate School requests that the Program of Study be filed after the student has completed 12 credits of coursework. Please note that the program of study requires a total of 30 graduate credits, excluding EE 700, Doctoral Dissertation. Eighteen of those credits are from item 2. The balance (12) may come from the master's degree at NMSU or elsewhere, graduate deficiency courses from item 1, or other graduate coursework.
3. Pass a comprehensive examination. The examination must be part written and part oral. The specific format of the exam is at the discretion of the examination committee. It may cover course work, include a proposal for dissertation research, and may be preceded by a written exam. Prior to taking the comprehensive exam, submit to the Department Head the Doctoral Examination Form form.
4. Complete of minimum of 18 credits of EE 700 Doctoral Dissertation. A student may not enroll in EE 700 prior to passing the Qualifying Examination. At least 9 of the 18 credits of EE 700 must be taken after completing the Comprehensive Examination.
5. Complete a doctoral dissertation within five years of taking the Comprehensive Examination.
6. Complete the research publication requirement.
7. Pass a final oral exam which defends the dissertation. The dissertation defense is open to the public and must be held in a lecture hall, such as Thomas and Brown Room 104. Prior to holding the dissertation defense, submit to the Department Head a PhD EE Record Check and the Doctoral Examination Form form. In addition, students must submit to the Department Head a 1-page abstract which includes (a) the advisor's name, and (b) the date, time, and place of the final oral exam. PDF format for the abstract is preferred.

3.2.3 Publication of Research Results

Graduate programs are intended to generate new engineering knowledge, especially within the PhD programs. The College of Engineering has the following minimum requirements for the publication of research results for PhD students who pass the Qualifying Examination after 1 July 2008. There is no corresponding requirement for MS students; however, MS thesis research is encouraged to be published as well.

- Prior to the submission of the final draft of the PhD dissertation to the committee for the final examination, the student is required to submit evidence for a **minimum** of two publications related to the dissertation research.
- One publication must have been submitted to an internationally-recognized engineering journal such as one of the IEEE Transactions. This is expected to be the significant results of the dissertation research.
- One publication can be with a professional conference such as an IEEE conference or the second publication can be a journal article to an internationally-recognized engineering journal such as one of the IEEE Transactions.

The requirement is that the journal submissions must at least be at the submission to the editor stage. Due to the lengthy review time in some journals, the paper need not be accepted by the time of the dissertation defense.

It is recommended that the conference paper/second journal publication be timed to be part of the Comprehensive Examination process. The intent here is to vet the dissertation concept and any initial results to the community for validation of the contribution. The exact timing of this is left to the discretion of the advisor and the committee.

Note: the publication requirement here is a minimum requirement. The advisor and PhD committee is free to require more publications (journal or conference) as part of the individual degree program.

3.2.4 Ph.D. Minor

Graduate students enrolled in other departments who are interested in obtaining a minor in electrical engineering must complete 12 hours of graduate electrical engineering courses of which 6 hours are at the 500-level or above. Only in special cases will joint-listed 400/500-level

courses be acceptable for PhD students wishing to earn a minor in ECE. A maximum of 3 credits of EE590 Selected Topics Courses that do not appear as regular classes in the printed class schedule may count toward the electrical engineering minor. These classes may have prerequisites that require additional preparation and are not included in the total credits for the minor.

3.3 Undergraduate Deficiencies

3.3.1 General Policy

Because of the demand for graduates with advanced degrees in electrical engineering, the number of applications from students with undergraduate and graduate degrees in fields other than electrical engineering is increasing. Listed in the table below are the undergraduate deficiency courses the graduate electrical engineering program requires of such students. This list applies to those students who:

1. are enrolled in the MSEE program and have a bachelor's degree in a field other than electrical engineering, OR
2. are enrolled in the Ph.D. (electrical) engineering program and have bachelor's and a master's degrees in fields other than electrical engineering.

For many students, some of the courses may be bypassed because of similar content in courses already taken and/or work experience. Your advisor determines what courses may be bypassed. Deficiency classes must be completed successfully with a letter grade of A, B, or C, or a pass/fail grade of S (Satisfactory). At the undergraduate level, a pass/fail grade of S corresponds to a letter grade of A, B, or C. These classes should be finished as early in the graduate program as possible.

Course Num & Credits	Title	Catalog Description
EE 111 4 credits	Introduction to Electrical and Computer Engineering	Covers electric and electronic component descriptions and equations. Kirchoff's voltage and current laws, formulation and solution of DC network equations. Applications of circuit analysis to actual circuits including

		phasors, ideal op amps, and diodes. Corequisite: MATH 191.
EE 161 4 credits	Computer-Aided Problem Solving	Evolution and application of computers, social and economic implications, introduction to programming using engineering workstations. Extensive practice in writing programs to solve engineering problems. Computer interfaces to real-world systems. Satisfies General Education computer science requirement. Corequisite: MATH 191.
EE 211 4 credits	AC Circuits	Complete solutions of RLC and switching networks. Sinusoidal steady-state analysis. Three-phase analysis. Mutual coupling. Frequency-selective networks. Prerequisites: C or better in E E 111 and MATH 192.
EE 321 4 credits	Electronics I	Design projects which demonstrate the use of a wide variety of electrical components, including opamps, capacitors, inductors, transistors, and diodes, in practical circuits. Prerequisite: C or better in E E 211, E E 261, CHEM 111, and PHYS 215.
EE 261 4 credits	Digital Design I	Design of combinational logic circuits. Introduction to state machine design. Implementation using programmable logic devices and microcontrollers. Prerequisites: C or better in E E 111 and E E 161. Corequisite: MATH 192.
EE 311 4 credits	Signals and Systems	Transform methods for solution of continuous- and discrete-time systems. Fourier and Laplace transforms. Frequency response and Bode plots. Z transform. Continuous- and discrete-time convolution. Prerequisites: C or better in E E 161 and E E 211. Corequisites: MATH 392.
EE 315 4 credits	Applied Electromagnetics	Static electric and magnetic fields. Maxwell's equations, time-varying electromagnetic fields, generalized plane wave propagation in lossless media, introduction to plane-wave polarization, and microwave transmission

		line theory. Prerequisite: C or better in E E 161, E E 211, and E E 301.
EE 341 4 credits	Control Systems I	Mathematical representations of systems, time and frequency response characteristics, stability, introduction to control system design. Prerequisite: C or better in E E 311.

For students who have a bachelor's degree from the NMSU Engineering Technology Department with the Electronics Option, we have made a table (ETEE to MSEE at NMSU) to help determine what deficiency courses are necessary.

3.3.2 Undergraduate Deficiencies for NMSU ETEE Graduates

If a student has a BS degree from NMSU in Engineering Technology, Electronics Option, he/she will need to complete deficiency course work. Listed below are the required deficiency courses for the MSEE at NMSU. For ETEE students, most of the courses may be bypassed because of similar content in courses already taken. Deficiency classes must be completed successfully with a letter grade of A, B, or C, or a pass/fail grade of S (Satisfactory). At the undergraduate level, a pass/fail grade of S corresponds to a letter grade of A, B, or C. Please note pre-requisites and co-requisites are recommended but are NOT REQUIRED for ETEE students.

Course Num & Credits	Title	Catalog Description	Similar content in:
EE 111 4 credits	Introduction to Electrical and Computer Engineering	Covers electric and electronic component descriptions and equations. Kirchoff's voltage and current laws, formulation and solution of DC network equations. Applications of circuit analysis to actual circuits including phasors, ideal op amps, and diodes. Corequisite: MATH 191.	ET 246 Electronic Devices I ET 190 Applied Circuits
EE 161 4 credits	Computer-Aided Problem Solving	Evolution and application of computers, social and economic implications, introduction to programming using engineering workstations. Extensive practice in writing programs to solve engineering problems. Computer interfaces to real-world systems. Satisfies General Education computer science requirement. Corequisite: MATH 191.	ET 262 Software Technology I

EE 211 4 credits	AC Circuits	Complete solutions of RLC and switching networks. Sinusoidal steady-state analysis. Three-phase analysis. Mutual coupling. Frequency-selective networks. Prerequisites: C or better in E E 111 and MATH 192.	ET 190 Applied Circuits
EE 321 4 credits	Electronics I	Design projects which demonstrate the use of a wide variety of electrical components, including opamps, capacitors, inductors, transistors, and diodes, in practical circuits. Prerequisite: C or better in E E 211, E E 261, CHEM 111, and PHYS 215.	ET 246 Electronic Devices I ET 272 Electronic Devices II
EE 261 4 credits	Digital Design I	Design of combinational logic circuits. Introduction to state machine design. Implementation using programmable logic devices and microcontrollers. Prerequisites: C or better in E E 111 and E E 161. Corequisite: MATH 192.	ET 282 Digital Electronics
EE 311 4 credits	Signals and Systems	Transform methods for solution of continuous- and discrete-time systems. Fourier and Laplace transforms. Frequency response and Bode plots. Z transform. Continuous- and discrete-time convolution. Prerequisites: C or better in E E 161 and E E 211. Corequisites: MATH 392.	No similar ET course
EE 315 4 credits	Applied Electromagnetics	Static electric and magnetic fields. Maxwell's equations, time-varying electromagnetic fields, generalized plane wave propagation in lossless media, introduction to plane-wave polarization, and microwave transmission line theory. Prerequisite: C or better in E E 161, E E 211, and E E 301.	No similar ET course
EE 341 4 credits	Control Systems I	Mathematical representations of systems, time and frequency response characteristics, stability, introduction to control system design. Prerequisite: C or better in E E 311.	No similar ET course

3.3.3 Klipsch Graduate Core

In order the provide adequate breadth in the programs of study for our graduate students, the Klipsch School faculty members have identified a set of classes that need to be part of each graduate student's program. These classes will also help prepare students for the PhD Qualifying Examination if needed.

Students pursuing a MSEE must achieve a C or better on two classes from the following list. PhD students who completed their MSEE at NMSU must achieve a C or better on three classes from the following list if they did not take three of these classes as part of their MSEE program at NMSU. PhD students who completed a MSEE at another university may be required to take one or more of these classes if the student's committee deems it necessary to give the student proper breadth in their program of study.

Area of Specialization	**Graduate Core Course**
Microelectronics/VLSI	EE523 Analog VLSI Design
Communications	EE571 Random Signal Analysis
Computer Engineering	EE563 Computer Performance Analysis
Control Systems	EE551 Control Systems Synthesis I
Digital Signal Processing	EE545 Digital Signal Processing
Electric Energy Systems	EE543 Power Systems III
Electromagnetics	EE515 Electromagnetic Theory I
Photonics	EE577 Fourier Methods in Electro-Optics
OR	EE528 Optical Sources, Detectors & Radiometry

MSEE students not planning to pursue a PhD may choose a third core class from either the previous list or from the following list.

Area of Specialization	**Graduate Core Course**
Microelectronics/VLSI	EE524 Digital VLSI Circuit Design
Communications	EE585 Telemetering Systems
Computer Engineering	EE564 Advanced Computer Architecture I
Control Systems	EE555 Advanced Linear Systems
Digital Signal Processing	EE555 Advanced Linear Systems
Electric Energy Systems	EE537 Power Electronics
Electromagnetics	EE541 Antennas and Radiation
Photonics	N/A

4 ECE Graduate Applications

Prospective graduate students for the Master of Science or Doctor of Philosophy in Electrical Engineering must first meet the entrance requirements of the Graduate School. The prospective graduate student should make formal application to the Graduate School. Official transcripts from all undergraduate and graduate institutions must be sent directly to the Graduate School. In addition, the student must arrange to have an official copy of the GRE (Graduate Record Examination) General Test scores sent to the Graduate School (**ETS code for NMSU is 4531; ETS code for the ECE program is 1203**). If the applicant meets the Graduate School's minimum requirements, the application is sent to the Klipsch School's Graduate Studies Committee for review. U.S. residents are given every chance of being successful in the pursuit of a graduate degree. If they do not meet the requirements of the Klipsch School, they can enter the non-degree program where they must demonstrate competence in graduate-level course work before they reapply.

Note: Admission to the graduate program does not guarantee an award of support in the form of a Teaching Assistantship or a Research Assistantship. There will be a limited number of Teaching Assistantship positions awarded with admission to new graduate students who show outstanding qualifications and meet the application deadline. At the start of each semester, students not on teaching or research assistantships will be considered for available teaching assistantship positions. Research Assistantships are awarded by the faculty with sponsored research programs. Please see the Graduate Assistantship page for more information on applying for an assistantship.

4.1 Domestic MSEE and Ph.D. Graduate Admissions

APPLICATION PROCEDURE

1. A formal application, completed in duplicate and accompanied by a $30 non-refundable application fee, is required of all prospective domestic (US) students, including graduates of New Mexico State University. The application process is on-line through the Graduate School admissions portal. If a prospective student wishes to be considered for a guaranteed Teaching Assistantship, this application must be completed along with the application for financial aid by January 15 each year.
2. Applicants, other than BSEE NMSU graduates, must arrange with each institution previously attended to have two official transcripts of all their undergraduate and graduate work sent directly to the Dean of the Graduate School.

3. Applicants who are NMSU graduates authorize the Graduate School to obtain one official transcript. If undergraduate work has not been completed at time of application, the student authorizes the Graduate School to obtain a transcript complete with degree statement as soon as the degree has been granted. Applicants having done work at another university following graduation from NMSU must provide one transcript from each of those institutions.
4. Applicants must arrange to have an official copy of their GRE (Graduate Record Examination) General Test scores sent to the Graduate School (ETS code for NMSU is 4531; ETS code for the ECE program is 1203). The Klipsch School will not consider applications without a copy of the GRE General Test scores, unless the applicant holds a BSEE degree from NMSU.
5. Please indicate the Field or Area of Advanced Study by writing in one of the Klipsch School areas of specialization. The choice of specialization helps determine an appropriate initial graduate advisor.
6. Upon satisfactory completion, the Klipsch School Graduate Studies Committee considers the application. The committee meets monthly to review all complete application folders that have been forwarded to the department from the Graduate School. Typically, students with GRE Quantitative scores below 700 are not considered for first-time admission unless there is a faculty member explicitly requesting the student's admission. Students without a BSEE may be required to take undergraduate deficiencies classes as part of their overall program.
7. The most important admission criteria for the MSEE are:
    a. Undergraduate GPA on a 4.0 scale
    b. GRE Quantitative Score (for applicants without a degree from NMSU)

    The most important admission criteria for the Ph.D. program with MS degree:

    a. Graduate GPA on a 4.0 scale
    b. GRE Quantitative Score (for applicants without a degree from NMSU)

    The most important admission criteria for the Direct Ph.D. (no MS degree) are:

    a. Undergraduate GPA on a 4.0 scale
    b. GRE Quantitative Score (for applicants without a degree from NMSU)

    Please note that an applicant who is denied admission into the direct Ph.D. program will be automatically considered for admission into the MSEE program.

8. Domestic students who are denied admission to the MSEE program may qualify for admission as non-degree students in the College of Engineering. Non-degree students interested in ECE are encouraged to take up to 9 credits of graduate-level courses. After

completing at least two master's-level EE courses numbered 501-589 with at least a 'B' in both classes, non-degree students may be considered for re-admission into the ECE Department. Non-degree students must request re-admission through the Graduate College. A maximum of 9 credits of NMSU graduate-level courses taken as a non-degree student may be applied toward the MSEE. NMSU will not transfer graduate credit for non-degree work from other institutions.

9. If a current MS student wants to be admitted into the direct Ph.D. program (no MS degree), that student must:
    a. Pass the Ph.D. qualifying exam
    b. Identify a member of the graduate faculty that wants to serve as an advisor to the student
    c. Complete a Change of Status form with the Graduate School

4.2 International MSEE and Ph.D. Graduate Admissions

International Student & Scholar Services is the entry point and point-of-contact for admission of international students at New Mexico State University. After meeting International Students' entrance requirements, your admission application will be forwarded to the Klipsch School for final admission approval. Upon successful admission, you will be assigned an advisor whom you can contact for curriculum details, etc.

There are agencies and offices in many countries that can assist with the applications process. One such agency run by the US Department of State is EducationUSA.. International students are encouraged to consider assistance from these types of agencies.

APPLICATION PROCEDURE

1. A formal application, completed in duplicate and accompanied by a $50 non-refundable application fee, is required of all prospective international students, including graduates of New Mexico State University. Application forms can be completed online or downloaded from the International Student & Scholar Services Office. If a prospective student wishes to be considered for a guaranteed Teaching Assistantship, this application must be completed along with the application for financial aid by January 15 each year.
2. To be considered for admission to NMSU, all students whose native language is not English must submit an official score of 530 or above on the Test of English as a Foreign Language (TOEFL). A TOEFL paper score of 580 or higher is normally expected for admission into the Klipsch School. A paper score of 580 corresponds to a computer score of 237. Students using the new Internet-based exams should present a score of at

least 81. Students with TOEFL scores below these levels are typically not considered for admission.

3. Applicants must arrange to have an official copy of their GRE (Graduate Record Examination) General Test scores sent to the Graduate School (ETS code for NMSU is 4531; ETS code for the ECE program is 1203). The Klipsch School will not consider applications without an official copy of the GRE General Test scores, unless the applicant already has a degree from NMSU. Typically, students with GRE Quantitative scores below 700 are not considered for first-time admission unless there is a faculty member explicitly requesting the student's admission.
4. Please indicate Field or Area of Advanced Study on the graduate application form by writing in one of the Klipsch School areas of specialization. The choice of specialization helps determine an appropriate initial graduate advisor.
5. Upon satisfactory completion, the Klipsch School Graduate Studies Committee considers the application. The committee meets monthly to review all complete application folders that have been forwarded to the department from the Graduate School and International Programs. Students without a BSEE may be required to take undergraduate deficiencies classes as part of their overall program.
6. The most important admission criteria for the MSEE are:
    a. Undergraduate GPA on a 4.0 scale
    b. GRE Quantitative Score (for applicants without a degree from NMSU)

    The most important admission criteria for the Ph.D. program with MS degree:

    a. Graduate GPA on a 4.0 scale
    b. GRE Quantitative Score (for applicants without a degree from NMSU)

    The most important admission criteria for the Direct Ph.D. (no MS degree) are:

    a. Undergraduate GPA on a 4.0 scale
    b. GRE Quantitative Score (for applicants without a degree from NMSU)

    Please note that an applicant who is denied admission into the direct Ph.D. program will be automatically considered for admission into the MSEE program.

7. If a current MS student wants to be admitted into the direct Ph.D. program (no MS degree), that student must:
    a. Pass the Ph.D. qualifying exam
    b. Identify a member of the graduate faculty that wants to serve as an advisor to the student
    c. Complete a Change of Status form with the Graduate School

4.3 Changing Majors at NMSU

Current NMSU students can request to change majors and enter a graduate program within the Klipsch School. The general process is

1. Request a change in major by making a formal request to the Graduate School using the request form.
2. The Graduate School will send the student's dossier to the Klipsch School for admission evaluation. Note: if the student's initial department did not require the Quantitative portion of the Graduate Record Exam, the Klipsch School will not process the admission request until the score is submitted.
3. Upon satisfactory completion of the dossier, the Klipsch School Graduate Studies Committee considers the application. The committee meets monthly to review all complete application folders that have been forwarded to the department from the Graduate School. Typically, students with GRE Quantitative scores below 700 are not considered for first-time admission unless there is a faculty member explicitly requesting the student's admission. Students without a BSEE may be required to take undergraduate deficiencies classes as part of their overall program.

5 Financial Support

5.1 Graduate School-Based Assistance

A limited number of Graduate Assistantships and Fellowships are directly available through the NMSU Graduate School. The listing of the available support opportunities can be found here.

5.2 Graduate Teaching Assistantships

A limited number of Graduate Teaching Assistantships are available for qualified students. Some of these Graduate Teaching Assistantships are awarded to the top incoming students based on their application material.

For a student applying for the Ph.D. program, the department can provide guaranteed financial support in the first year in the form of teaching assistantship if the applicant satisfies the following conditions

- has already obtained a MS in EE or an equivalent degree,
- has a GPA of at least 3.5 on a 4-point scale or equivalent in his/her MS program or has a GPA at least 3.0 on a 4-point scale or equivalent and having published research papers.

Financial support after the first year can be provided in the form of research assistantship or a combined teaching/research assistantship, which the student shall arrange with individual faculty members in the Klipsch School.

Additionally, Graduate Teaching Assistantships may be awarded to current students based upon a faculty member's recommendation to the Department Head. The faculty recommendation must include:

1. Name of the student, email address, degree sought (MS or Ph.D.) and anticipated graduation date.
2. How this student is contributing to the faculty member's research program research (this is only important if the faculty member is offering to at least match the teaching assistantship with a research assistantship).
3. The courses that the faculty member feels this student are best suited to cover as a laboratory instructor.

4. An assessment of the student's oral communication skills. **Note:** if the student's first language is not English, they will either have to pass the ITA screening exam or pass the ITA course COMM485 before they can be hired as a laboratory instructor. New TA's that need to be screened must arrive at the Klipsch School prior to the first week of classes so that the screening can be arranged. Generally this is done in the two weeks prior to classes starting and must be coordinated with the department. Students who cannot be screened usually do not have an assistantship opportunity for that semester.

If a student desires a teaching assistantship, they must complete an application for financial support and obtain three confidential letters of reference prior to being hired. This material should be sent directly to the Klipsch School of Electrical and Computer Engineering, not the Graduate School. For International Students, the offer of a Teaching Assistantship is contingent upon passing the screening examination given at the start of each semester by the Department of Communication Studies.

Deadline for Consideration: MSEE or PhD students wishing to be considered for guaranteed Teaching Assistantships must have their completed application for the assistantship and admission submitted to NMSU by January 15 of each year.

5.3 Graduate Teaching Assistantship Time Limits

Graduate Teaching Assistantships require that the student maintain a GPA > 3.0, and make adequate progress towards an EE degree.

1. For MS students, ECE Department teaching assistantships are limited to four semesters.
2. For Ph.D. students with MS degrees, teaching assistants are expected to conform to the following time-table:
    a. Pass the Ph.D. Qualifying Exam within 2 semesters
    b. Pass the Ph.D. Comprehensive Exam within 4 semesters
    c. Pass the Dissertation Defense within 5 semesters
3. For Ph.D. students without MS degrees, teaching assistants are expected to conform to the following time-table:
    a. Pass the Ph.D. Qualifying Exam within 3 semesters
    b. Pass the Ph.D. Comprehensive Exam within 6 semesters
    c. Pass the Dissertation Defense within 7 semesters

5.4 Graduate Research Assistantships

A limited number of Graduate Research Assistantships are available for qualified students. Generally, a RA is awarded by a faculty member who has external research funding and requires a student with specific skills or subject knowledge. Graduate Research Assistantships continue as long as the faculty sponsor has adequate funding and is satisfied with student's performance. They also require that the student maintain a GPA > 3.0 and make adequate progress towards an EE degree.

Note: Graduate Research Assistants are expected to report for work at the Klipsch School prior to the start of classes -- on the same date as faculty report (see the NMSU Academic Calendar). They are expected to perform their assigned research duties through the end of Finals Week. Any Teaching Assistant who is not present between these dates is subject to losing their Assistantship in the current and future semesters.

5.5 Graduate Scholarships

- Paul W. Klipsch Graduate Student Scholarship (open to all engineering students)
- Barry Rappaport Memorial Scholarship (open to electrical engineering and astronomy students; ECE students in academic years that start with an even number and astronomy students in academic years that start with an odd number).

6 Graduate Advising

Graduate programs are highly individualized based on the student's career goals. Because of this individualization, graduate advising is primarily handled by the student's major advisor and the student's graduate committee. The common requirements are

- maintain academic eligibility as defined by the Graduate School
- successfully complete a series of classes from the Klipsch School graduate core
- successfully complete the final examination for the program.

Other specific courses are selected based on the student's goals and research needs.

The choice of specialization on the graduate admission application form helps determine an appropriate initial graduate advisor. This advisor is assigned as part of the graduate admissions process and it is intended to be a starting point in the student's program to give the student a point of contact with the Klipsch School. A student may change their graduate advisor any time during the graduate program; however, most changes are best made in the first few semesters. Choosing a graduate advisor involves several factors, such as compatibility, specialization, and availability of research support. Because the Graduate School and the Klipsch School both need to know the current advisor, when a change of advisors is made, the Change of Advisor form must be completed and filed with the Klipsch School and the Graduate School.

The full catalog listing for the graduate program in the Klipsch School can be found on NMSU's graduate catalog page.

7 Ph.D. Qualifying Exam

Passing the Qualifying Examination is the gateway to being admitted to the doctoral program. A student may not register for dissertation credits (E E 700) until after the Qualifying Examination has been passed.

Specifics about the Electrical and Computer Engineering Qualifying Examination can be found here. The Qualifying Examination is given by the Klipsch School faculty and not the student's committee.

7.1 Dates and Times of the PH.D. Qualifying Exam

The Ph.D. Qualifying Exam is typically offered the two days prior to the beginning of the semester. The format is two half days of written exams. For the Spring semester, the exam is offered every January. For the Fall semester, the exam is offered in August provided there are a sufficient number of students who sign up for the exam.

7.2 Qualifying Exam Guidelines

Day 1: Examination of breadth at the undergraduate level

- Students will answer a total of eight questions with no more than two from any one of the eight areas (shown below). Although the number of questions may vary between specializations, there will be a minimum of three questions per area from which the student is allowed to select.
- Exam questions are based upon the undergraduate courses and topics listed below. Their difficulty is commensurate with typical homework, quiz, and/or examination problems given in the associated class.

Day 2: Examination of readiness for research at the graduate level

- Students will answer a total of six questions with two coming from each of the three areas of specialization. The areas of specialization are selected by the student when registering for the exam. Although the number of questions may vary between specializations, there will be a minimum of three questions per area from which the student is allowed to select.

- Exam questions are based upon the graduate courses and topics listed below. Their difficulty is commensurate with typical homework, quiz, and/or examination problems given in the associated class.

Additional Information

- The examination will be closed-book, closed-notes, except for a hand-held calculator and a CRC Handbook (Standard Mathematical Tables). The allowed calculators are those on the list approved by the National Council of Examiners for Engineering and Surveying which is available at http://www.ncees.org/exams/calculators/index.php#approved.
- Students must sign up and declare three areas of graduate specialization at the same time.
- Signing up is a commitment to take the examination if offered. No deletions or changes are allowed. For students who sign up but neglect to take the examination it will be considered a failed attempt.
- Students who have failed the Klipsch School PhD Qualifying Examination twice must petition the Graduate Studies Committee to be eligible for an additional attempt. The petition must be accompanied by a letter of support from the student's advisor.

7.3 Old Qualifying Exam Questions

Three recent Ph.D. Qualifying Exams are posted. Please note that only questions are available, not solutions.

- January 2008 Part 1
- January 2008 Part 2
- January 2007 Part 1
- January 2007 Part 2
- January 2006 Part 1
- January 2006 Part 2
- January 2005 Part 1
- January 2005 Part 2

7.4 Undergraduate and Graduate Courses That Form the Basis of the Qualifying Exam

The list of graduate courses corresponds to the courses in the Klipsch graduate core.

SPECIALIZATION	UNDERGRADUATE	GRADUATE
Microelectronics/VLSI	EE324 Introduction to VLSI	EE523 Analog VLSI Circuit Design
Communications	EE496/497 Intro to Communications Systems I and II	EE571 Random Signal Analysis
Computer Engineering	EE361 Digital Logic Design EE363 Computer Systems Architecture I EE464 Software Engineering I EE469 Digital Communications Networks	EE563 Computer Performance Analysis I
Control Systems	EE475/525 Control Systems II EE476/526 Computer Control Systems	EE551 Control Systems Synthesis I
Digital Signal Processing	EE395 Introduction to Digital Signal Processing	EE545 Digital Signal Processing
Electric Energy Systems	EE431 Power Systems II	EE543 Power Systems III
Electromagnetics	EE315 Applied Electromagnetics	EE515 Electromagnetic Theory I
Electro-optics	EE370 Geometrical Optics EE477 Fiber Optics I	EE528 Optical Sources, Detectors, & Radiometry EE577 Fourier Methods in Electro-Optics

8 Graduate Areas of Specialization and Faculty by Area

The available Electrical and Computer Engineering specialization areas within the Klipsch School are described below:

- **COMMUNICATIONS, TELEMETRY, AND SIGNAL PROCESSING** Students study space communication systems, wireless systems, data transmission, and audio & video signal compression, decompression, and transformation. Students working in this area could possibly work on cell phone design, satellites, sensor design and monitoring, imaging and pattern recognition (from security to medical applications), music (filtering signals, processing signals), any type of transmission (communication) from one place to another, noise reduction, analysis of signals. Department faculty members are
    - Deva Borah, Assistant Professor, PhD (Australian National University)
    - Charles Creusere, Assistant Professor, PhD (University of California at Santa Barbara)
    - Phillip DeLeon, Associate Professor, PhD (University of Colorado)
    - Sheila Horan, College Associate Professor, PhD (New Mexico State University)
    - Stephen Horan, Professor, **Frank Carden Chair for Telemetry and Telecommunications**, PhD (New Mexico State University)
    - Joerg Kliewer, Assistant Professor, PhD (Keil)
- **COMPUTERS** The Klipsch School offers a special program for students interested in computer engineering. Students wishing to become involved in this rapidly growing field will find courses in digital logic and system design, computer architecture, data networking, integrated circuits and applications, high performance computer design, digital control and instrumentation systems, digital signal processing, operating systems, and software engineering. These courses offer the student an opportunity to obtain an in-depth knowledge of digital systems and practical experience in the design, operation, programming, and applications of digital computers. Students could expect to continue on in these areas to develop better and faster computers and interfaces. Department faculty members are
    - Jeanine Cook, Associate Professor, PhD (New Mexico State University)
    - Hong Huang, Assistant Professor, PhD (Georgia Institute of Technology)
    - Eric Johnson, Professor, PhD (New Mexico State University)
    - Krist Petersen, Associate Dean of Engineering, PhD (New Mexico State University)
    - Steven Stochaj, Professor, PhD (University of Maryland)
- **CONTROL SYSTEMS** Work in the systems area provides the student with a background in modeling, analysis, design, simulation, and control of complex systems. These systems may be associated with engineering, ecology, transportation, natural resources,

environment, or other areas. Students in this area could expect to model physical systems, and work on controlling various processes. Department faculty members are:
    - Robert Paz, Associate Professor, PhD (University of Illinois)
    - Nadipuram Prasad, Associate Professor, PhD (New Mexico State University)
- **ELECTRIC ENERGY** Elective courses in power systems acquaint the student with the design, analysis, and operation of power systems. Courses are offered in high voltage transmission lines, distribution systems, rotating machines, and digital computer analysis of the steady state operation and short circuit conditions of a power system. Students in this area could expect to work in the generation, distribution and monitoring of systems which deliver power to consumers. Department faculty members are:
    - Sukumar Brahma, Assistant Professor, PhD (Clemson)
    - Satish Ranade, **PNM Chair for Utility Management**, PhD (University of Florida)
- **ELECTROMAGNETICS and Microwave Engineering** Students study electromagnetic fields, wave propagation, antennas, waveguides, transmission lines, lasers, and optics. Practical experience is available in the high-frequency and antenna laboratories and anechoic chamber. Students in this area could expect to work in the design and use of antennas, and microwaves and the sending and receiving of signals. Department faculty members are:
    - Steven Castillo, Regents Professor and Dean of Engineering, PhD (University of Illinois)
    - Muhammad Dawood, Assistant Professor, PhD (University of Nebraska-Lincoln)
    - Kwong Ng, **Paul W. and Valerie Klipsch Distinguished Professor**, PhD (Ohio State University)
- **Micro-ELECTRONICS** Students study discrete analog as well as digital and analog VLSI electronics, preparing them for design, analysis, and testing of complex circuits. During the senior year, VLSI students will design a chip to be fabricated. Students in this area could expect to design chips to be used in various devices (cars, homes, computers, almost any electrical device). Department faculty members are:
    - Paul Furth, Associate Professor, PhD (Johns Hopkins University)
    - Jaime Ramirez-Angulo, **Paul W. and Valerie Klipsch Distinguished Professor**, DSc (Stuttgart University)
- **PHOTONICS** Students may concentrate in the fields of fiber optics, lasers, optical communications, imaging, and optical signal processing. Students could expect to work with lasers and laser applications including communications, imaging systems, and optical sensors. This could include medical and astronomical applications. Department faculty members are:
    - Sang-Yeon Cho, Assistant Professor, PhD (Georgia Inst. of Tech)
    - David Voelz, Associate Professor, PhD (University of Illinois)
- **SPACE SYSTEMS ENGINEERING** Elective courses prepare the student for employment opportunities in the aerospace industry. Students are introduced to the complexities of

a space systems life cycle and the disciplines required to design, integrate, and operate large systems. Department faculty members are:

- Charles Boehmer, College Assistant Professor, MSAE (U.S. Naval Postgraduate School)
- Gary Geyer, College Assistant Professor, MSEE (University of Southern California)

9 Appendix A: ECE Graduate Forms

9.1 Application for Graduate Financial Support

9.2 Letter of Reference

9.3 MSEE Record Check

9.4 MSEE Transfer of Credit Check List

9.5 Ph.D. Record Check

Head, Klipsch School of Electrical and Computer Engineering

MSC 3-0/Box 30001

New Mexico State University

Las Cruces, New Mexico, USA 88003-8001

APPLICATION FOR GRADUATE FINANCIAL SUPPORT

(Mail completed application to Head, Klipsch School of Electrical and Computer Engineering.)

I am applying for the following in the Klipsch School of Electrical and Computer Engineering

Assistantship Graduate fellowship or traineeship Other (specify)_____

1.(Mr.)(Mrs.)(Miss)_____Soc. Sec. #_____

(Last) (First) (Middle)

2. Present Address:_____

(Until what date?)_____ Phone:(_____)_____ Email: _____

Permanent Address:_____

3. Date of Birth:_____ Place of Birth_____

No. of Children:_____ Other Dependents:_____ Married Single

4. List all post secondary (high school) educational institutions attended and degrees awarded or expected.

INSTITUTION FROM TO DEGREE DATE

_____

_____

_____

5. In which electrical engineering laboratories do you have proficiency or expertise? _____

_____

6. Honors or awards received:_____

7. Make a brief statement about your area of specialization and proposed professional career:_____

_____

_____

8. List the names and addresses of three teachers or supervisors whom you have requested to fill out the letters of reference, which should be mailed directly to Head, Klipsch School of Electrical and Computer Engineering.

_____

_____

_____

_____

Signature of the Applicant

Head, Klipsch School of Electrical and Computer Engineering
MSC 3-0/Box 30001
New Mexico State University
Las Cruces, New Mexico, USA 88003-8001

LETTER OF REFERENCE IN SUPPORT OF:

(Mail completed reference to Head, Klipsch School of Electrical and Computer Engineering.)

_____ who is applying to the
Last Name First Middle Maiden

New Mexico State University Graduate School for admission and/or financial aid to study in the Klipsch School of Electrical and Computer Engineering. (Applicant please enter your name above and transmit this form to a teacher or supervisor acquainted with your academic abilities and/or engineering work experience.)

I. **TO WRITERS OF LETTERS OF RECOMMENDATION:**

The information given in this recommendation will be considered confidential and will be used in the initial selection process only. This information will not become a part of the student's permanent academic record.

We are particularly interested in the ability of the applicant to:

— Pursue graduate study — Perform research
— Serve as a teaching assistant — Serve in a professional capacity in the chosen field.

We are also interested in the general character of the applicant.

In comparison with other graduate students you have known, rate items A through I by numeric score of 1 to 5, basing your rating on the accomplishments of the applicant. (Ratings are 1 – truly outstanding (top 10%); 2– superior; 3 – above average; 4 – average; 5 – below average; X – inadequate knowledge to rate.)

( ) A. Intellectual ability
( ) B. Mastery of fundamental knowledge in field of study
( ) C. Motivation and Drive
( ) D. Scholarship
( ) E. Ability in written expression
( ) F. Ability in oral expression
( ) G. Adequacy of ability for research
( ) H. Emotional maturity and stability
( ) I. Self-reliance and independence

II. It would be helpful if you could cite special indications bearing upon the applicant's qualifications as cited above. Please discuss in which electrical and computer laboratories the candidate will have the most proficiency or expertise. For non-U.S. citizens: Please indicate degree of English proficiency for teaching duties.

(USE OTHER SIDE OF SHEET OR ATTACH LETTER TO RESPOND)

III. How far do you think this applicant will progress? (Check one)

_____ Will probably complete the doctorate.

_____ Will probably complete the master's degree.

_____ Is not likely to complete a graduate degree without excessive help.

_____ Is not likely to complete any graduate degree.

I have been acquainted with this applicant during the period of: _____ to: _____

as: _____ (teacher / advisor / supervisor / other _____)

Name (type or print)_____Position: _____

Institution_____

Date:_____ Signature:_____

Master of Science in Electrical Engineering (MSEE) Record Check

Initial Check; submit with Application for Admission to Candidacy[1, 2]: ☐

Final Record Check; submit with Committee for Final Examination[1, 2, 3]: ☐

[1] The GPA of courses that make up the graduate degree must be 3.0 or higher.
[2] Only grades of A, B, C, or S count toward an MSEE.
[3] For thesis and technical reports, submit to the Department Head a 1-page abstract. Include the date, time, and place of the final oral exam.

Print Student Name: _____ Banner ID Num: _____

Table 1: Undergraduate Deficiencies[1]

[1] Applies only to students without BSEE degree, or equivalent.

Undergraduate Deficiency Course	Equivalent Course at Another Institution or Work Experience or Advanced Coursework	OR Grade at NMSU
EE111 Intro to Elect. Comp. Eng.		
EE161 Computer-Aided Solving		
EE211 AC Circuits		
EE321 Electronics I		
EE261 Digital Design I		
EE311 Signals and Systems		
EE315 Applied EMAG		
EE341 Control Systems I		

Table 2: Three Graduate Core Courses from Three Different Areas

Area of Specialization	Graduate Core Course	Grade
Microelectronics/VLSI	EE523 Analog VLSI Design	
Communications	EE571 Random Signal Analysis	
Computer Engineering	EE563 Computer Performance Analysis	
Control Systems	EE551 Control Systems Synthesis I	
Digital Signal Processing	EE545 Digital Signal Processing	
Electric Energy Systems	EE543 Power Systems III	
Electromagnetics	EE515 Electromagnetic Theory I	
Photonics	EE577 Fourier Methods in Electro-Optics	
OR	EE528 Optical Sources, Detectors & Radiometry	

Table 3: One Graduate Breadth Course from a Third Area may substitute for one Core Course for students not pursuing a PhD

Area of Specialization	Graduate Core Course	Grade
Microelectronics/VLSI	EE524 Digital VLSI Circuit Design	
Communications	EE585 Telemetering Systems	
Computer Engineering	EE564 Advanced Computer Architecture I	
Control Systems	EE555 Advanced Linear Systems	
Digital Signal Processing	EE555 Advanced Linear Systems	
Electric Energy Systems	EE537 Power Electronics	
Electromagnetics	EE541 Antennas and Radiation	
Photonics	N/A	

Check One Box for MSEE Option:

Thesis Option: ☐ Technical Report Option: ☐ Coursework Only: ☐

Table 4: Thesis or Technical Report Credits [1]

[1] If MS option is coursework only, skip this table entirely.
[2] If MS option is tech report, 3 credits of tech report are required.
[3] If MS option is thesis, 6 thesis credits are required.

Total Number of EE598 Tech Report Credits [2]	
Total Number of EE599 Thesis Credits [3]	

Table 5: Total Graduate Credits (**Exclude Technical Report and Thesis Credits**)

[1] If MS option is thesis, 24 graduate credits (exclude thesis credits) are required.
[2] If MS option is tech report, 27 graduate credits (exclude tech report) are required.
[3] If MS option is coursework only, 30 graduate credits are required.
[4] At least half of graduate credits must be taken in the Klipsch School (EE).
[5] At least 15 credits must be numbered 500 or above.
[6] At most 12 credits may be transferred from another institution.
[7] EE590 credits that are not listed as regular courses in the schedule are limited to 6. The total number of EE590 credits is limited to 9.
[8] Exclude credits from EE490, CS457/467/477/487, BCS472, COMM485, SPCD470/SPCD 490, and ENGL572.
[9] At least half of the coursework credits must be taken with other than a single professor.
[10] If a student began the MSEE program prior to 2003 and did not complete the core, 30 credits are required for the tech report option and 36 credits for the coursework option.

Total Number of Credits for all Courses Numbered 450 and above [1,2,3,8,9,10]	
Total Number of Credits for all EE Courses Numbered 450 and above [4,8]	
Total Number of Credits for all Courses Numbered 500 and above [5]	
Total Number of Credits transferred from Other Institutions [6]	
Total Number of Credits of EE590 [7]	

Cumulative Number of Semesters as TA[1,2] in ECE Dept: _____
Cumulative Number of Semesters as RA[1,2] in ECE Dept: _____

[1] If you were **both** a TA and RA in one semester, count semester as a TA only.
[2] Do not include summer support in the form of a TA or RA.

Student Signature: _____ Date: _____

Advisor Name (Printed): _____

Advisor Signature: _____ Date: _____

Dept. Head Signature: _____ Date: _____

Electrical Engineering Masters Transfer Credit Checklist

Student Name (Printed): _____

Student Banner ID Number: _____

Table 1: Courses to Transfer[1, 2, 3, 4, 5]

[1] A maximum of 12 coursework credits can be transferred for the MSEE degree.
[2] If more than two courses are to be transferred, please submit a second form.
[3] The minimum grade is B-, in addition to the criteria listed on the Grad School Transfer of Credit Form.
[4] For each course to be transferred, attach a copy of the course syllabus.
[5] Attach the Graduate School Transfer of Credit form to this checklist.

	First Course to Transfer		Second Course to Transfer	
Name of Institution				
Course Number, Course Name, Credits, and Grade				
Date Taken				
Catalog Description from Other Institution				
Closest Equivalent NMSU Course Number & Name[6]				
Most Recent NMSU Instructor[6]				
NMSU Instructor Signature[6]				
Count credits as (circle one):	450 – 499 level	500 or above level	450 – 499 level	500 or above level

[6] If no equivalent course can be found, use EE590, special topics, and use advisor's signature for instructor signatures.

Advisor Name (Printed): _____

Advisor Signature: _____ Date: _____

Dept. Head Signature: _____ Date: _____

Ph.D. in (Electrical) Engineering Record Check

Initial Check, submit with Program of Study: ☐

Final Record Check, submit with Committee for Final Examination[1]: ☐

[1] Please submit to the Department Head a 1-page abstract of your dissertation. Include the date, time, and place of the final oral exam.

Print Student Name: _____ Banner ID Num: _____

Bachelor's Degree Major: _____

Master's Degree Major: _____

Date Passed Ph.D. Qualifier: _____ Date Passed Comps: _____

Table 1: Undergraduate Deficiencies [1]

[1] Applies to students with neither a Bachelor's Degree nor a Master's Degree in EE

Undergraduate Deficiency Course	Equivalent Course at Another Institution or Work Experience or Advanced Coursework	OR Grade at NMSU
EE111 Intro Elect. Comp. Eng.		
EE161 Computer-Aided Solving		
EE211 AC Circuits		
EE321 Electronics I		
EE261 Digital Design I		
EE311 Signals and Systems		
EE315 Applied EMAG		
EE341 Control Systems I		

Table 2: Three Graduate Core Courses from Three Different Areas [1]

[1] Applies to students who do not have a Master's Degree in EE

Area of Specialization	Graduate Core Course	Grade
Microelectronics/VLSI	EE523 Analog VLSI Design	
Communications	EE571 Random Signal Analysis	
Computer Engineering	EE563 Computer Performance Analysis	
Control Systems	EE551 Control Systems Synthesis I	
Digital Signal Processing	EE545 Digital Signal Processing	
Electric Energy Systems	EE543 Power Systems III	
Electromagnetics	EE515 Electromagnetic Theory I	
Photonics	EE577 Fourier Methods in Electro-Optics	
OR	EE528 Optical Sources, Detectors & Radiometry	

Option 1 – MS degree completed: ☐ Option 2 – Direct Ph.D. (no MS degree): ☐

Table 3: (Option 1 only) Total Ph.D. Coursework Credits (**Exclude EE700 Credits**)

[1] At least 18 credits of graduate-level courses beyond the MSEE are required.
[2] Exclude credits for EE courses numbered below 500.
[3] At least half of the credits must be taken in the Klipsch School (EE).
[4] At most 6 credits may be research, for example, EE600, Doctoral Research, and EE590 courses that are not listed as regular courses in the schedule.
[5] If the students holds an MS degree that is not in EE, **exclude** credits for the graduate core requirement from Table 2.

Total Number of Credits for all Courses Numbered 450 and above [1,2,3,4,5]	
Total Number of Credits for all EE Courses Numbered 500 and above [2]	
Total Number of Credits of research, e.g., EE590 and EE600 [4]	

Table 4: (Option 2 only) Total Graduate Credits (**Exclude EE700 Credits**)

[1] At least 42 credits of graduate-level courses are required, including the graduate core requirement from Table 2.
[2] At least half the credits must be numbered 500 or above.
[3] At least half of the credits must be taken in the Klipsch School (EE).
[4] At most 9 credits may be research, e.g., EE600, Doctoral Research, and EE590 courses that are not listed as regular courses in the schedule.
[5] EE590 credits are limited to 9.
[6] Exclude credits from EE490, CS457/467/477/487, BCS472, COMM 485, SPCD470/490, and ENGL572.
[7] At least half of the coursework credits must be taken with other than a single professor.

Total Number of Credits for all Courses Numbered 450 and above [1,2,3,4,5,6,7]	
Total Number of Credits for all EE Courses Numbered 450 and above [3]	
Total Number of Credits for all Courses Numbered 500 and above [2]	
Total Number of Credits of research, e.g., EE590 and EE600 [4]	
Total Number of Credits of EE590 [5]	

Table 5: Dissertation Credits (Enroll in EE700 only after passing Ph.D. qualifying exam)

[1] Total number of EE700 credits must be at least 18.
[1] Nine of the 18 credits must be taken after passing the Comprehensive Exam.

Total Number of EE700 Dissertation Credits [1,2]	

Student Signature: _____ Date: _____

Advisor Name (Printed): _____

Advisor Signature: _____ Date: _____

Dept. Head Signature: _____ Date: _____

10 Appendix B: Links to Commonly Used Graduate School Forms

10.1 Masters Admission to Candidacy (Program of Study)

http://gradschool.nmsu.edu/forms/Program%20of%20Study_Masters.pdf

10.2 Masters Final Examination Form

http://gradschool.nmsu.edu/forms/ExamForm_Masters.pdf

10.3 Masters Transfer of Credit

http://gradschool.nmsu.edu/forms/Transfer%20of%20Credit%20Form.pdf

10.4 Ph.D. Program of Study

http://gradschool.nmsu.edu/forms/Program%20of%20Study_PhD.pdf

10.5 Ph.D. Examination Form (for Comprehensive and Final)

http://gradschool.nmsu.edu/forms/ExamForm_DoctorateofPhilosophy.pdf

10.6 Change of Advisor Form

http://gradschool.nmsu.edu/forms/Change%20of%20Advisor%20Form.pdf

For other Graduate School forms, visit http://gradschool.nmsu.edu/forms-index.html .