

Graduate Guide to
Communications, Signal Processing, and Telemetry
Klipsch School of Electrical and Computer Engineering
New Mexico State University
Las Cruces, New Mexico

1 Introduction

This brief write-up provides guidance to students in the Communications, Signal Processing, and Telemetry Group of NMSU's Klipsch School of Electrical and Computer Engineering. Suggested courses and example programs are presented. These are meant to serve as guidelines, actual program content will be determined by the student and the advisor.

As a general guideline, the faculty in this area expect that incoming students will hold a BSEE degree (or similar technical degree). Additionally, exposure to upper-division courses in analog and digital communications, digital signal processing, and introduction to probability (equivalent to NMSU course [EE496](#), [EE497](#), [EE395](#), and [STAT371](#), respectively) is expected. For more information regarding the undergraduate specialization in communications, signal processing, and telemetry, please see

<http://telemetry.nmsu.edu/Undergrad.pdf>

Incoming graduate students lacking such exposure may be required to complete these courses (and any necessary prerequisite courses) as a deficiency. Deficiency courses do not count toward the graduate degree.

2 Masters Program Requirements

The program requirements for the MSEE degree in the area of Communications and Signal Processing are set by the Graduate School, Klipsch School, and finally the Communications, Signal Processing, and Telemetry Group.

2.1 Graduate School

For complete Graduate School [requirements](#), [deadlines](#), and [forms](#), please see

<http://www.nmsu.edu/~gradcolg>

International students need to consult with the Center for International Programs (CIP) for admissions information. CIP's home page is at

<http://www.nmsu.edu/~cip>

Requirement highlights are listed below:

- A minimum 30 semester credits for a master's degree.
- At least 15 credit hours of the course work must be from courses numbered 500 and above. (Thesis work may be included in this 15 hours.)
- At least 15 credits of the credits offered for the masters degree must be for work in the major field. Additional credits may be selected from other fields to fit into a logical, justifiable program. Courses which would normally be a part of the undergraduate preparation for the major a should not be counted as satisfying in part the requirements for the masters degree.
- A candidate for a masters degree must select a major and may select up to two minors in addition to the major. Minors need approval of that department as part of the program of study on the MS candidacy form. A minimum of 8 credits of graduate work is necessary for a minor.
- At least half of the minimum credits required for a masters degree, exclusive of thesis, must be taken with other than a single professor.
- A candidate for a masters degree must be enrolled on the campus of New Mexico State University for a minimum of two regular semesters; or one semester and two six-week summer sessions, or four six-week summer sessions.

2.2 Klipsch School

The complete requirements of the Klipsch School for the MSEE degree can be found at

<http://www.ece.nmsu.edu/academics/graduate/masters.html>

Summarized, these requirements are:

- The Electrical and Computer Engineering department normally expects incoming students to have a bachelor's degree from an [ABET](#) accredited Electrical Engineering Department. Incoming students without such degrees will usually be required to take the following undergraduate courses (if not part of the students background):
 1. Circuits Courses EE111, EE211 and EE311
 2. Electronics Course EE221
 3. Control Systems Course EE341
 4. Electromagnetics Course EE315
 5. Physics Courses PHYS213, PHYS217
 6. Computer Engineering EE161, EE261

7. Mathematics Courses MATH191, MATH192, MATH291, MATH391, MATH392

- The [GRE](#) exam is required for admission into the graduate program at the Klipsch School.
- There is no foreign language requirement. All students must show a proficiency in written and spoken English. Foreign students should consult the graduate catalog for the appropriate means of satisfying this requirement.
- Students are required to take at least three courses from the Klipsch School graduate core shown in Table 1.

Table 1: Klipsch School Graduate Core.

EE515 Emag Theory I	EE523 Analog VLSI	EE528 Optical Sources
EE543 Power Sys III	EE545 Dig Sig Proc	EE551 Control Sys I
EE561 Sequent Mach I	EE563 Comp Perf Analysis	EE571 Rand Sig Analysis
EE577 Fourier Optics		

- The masters *Admission to Candidacy* form is to be filed with the Graduate School after the completion of 12 credits of graduate work in residence and prior to the start of the final semester of the program. The student is to have a minimum grade point average of 3.0 at the time this application is submitted. Changes to the program after filing the form must be documented by a memo signed by the student's advisor and sent to the Dean of the Graduate School. All changes must be on file prior to scheduling the oral exam. The form may be found at

<http://www.nmsu.edu/~gradcolg/mast-prog.html>

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.

A student's masters program may take one of three forms

- **Course Work Only** - a minimum of 30 credits of graduate course work plus a final examination (see below) or the graduate portion of the Ph.D. qualifying exam.
- **Technical Report** - a minimum of 27 credits of graduate course work plus a minimum of 3 hours of EE 597 / EE 598 Master's Technical Report plus a final examination (see below). A technical report is generally the result of a student's project involving work with contemporary communications/signal processing/telemetry engineering.
- **Thesis** - a minimum of 24 credits of graduate course work plus a minimum of 6 hours of EE 599 Master's Thesis plus a final examination (see below). A masters thesis is greater in scope than a technical report. The thesis may involve original research and is expected to be of publishable quality in a conference proceedings or an engineering journal.

The final examination for all three master degree programs is an oral examination covering course work and research (where applicable). Consult the graduate catalog for information regarding the timing and filing of all necessary paperwork and other related requirement. **It is the students**

responsibility to make sure that all required paperwork is complete and on file with the graduate school by the graduate school deadline. If a technical report or thesis is presented, each committee member shall have a copy to read at least seven working days prior to the final examination. A complete listing of paperwork and timelines can be found at

<http://www.nmsu.edu/~gradcolg/Guidelines>

2.3 Communications, Signal Processing, and Telemetry Group

The Communications, Signal Processing, and Telemetry Group awards masters degrees with three main areas of specialization:

- **Communications Specialty Program** focuses on digital data transmission and storage, covering concepts such as signal design, receiver design, communications performance, channel coding, source coding, propagation studies, and related topics.
- **Signal Processing Specialty Program** concentrates on signaling aspects of various systems. Topics of signal filtering, detection, analysis, real-time signal processing, and algorithms are the main concentration.
- **Telemetry Specialty Program** addresses and studies issues associated with “measurements at a distance” through the processes of data measurement at sensors, transmission, and reception. Telemetry has a strong communications basis, but is slightly more diversified than the communications specialty curriculum.

A student specializing in one of the above programs is required to take specific core courses as shown in Table 2. Core courses for the specialty programs may also be used to partially satisfy the required Klipsch School graduate core. The balance of the program is decided by the student and advisor. A list of suggested, related courses are found in Table 3.

Table 2: Required Core Courses by Area of Specialization.

Communications	Signal Processing	Telemetry
EE545 Dig Sig Proc	EE545 Dig Sig Proc	EE571 Rand Sig Analysis
EE555 Adv Lin Sys	EE555 Adv Lin Sys	EE581 Dig Comm I
EE571 Rand Sig Analysis	EE571 Rand Sig Analysis	EE585 Telemetry Sys
EE581 Dig Comm I		

Some sample degree plans for each of the areas are found below; ultimately you will develop your own plan with the help of your advisor. Elective course are selected to match the student’s career goals. In some instances, EE598 Masters Technical Report or EE599 Masters Thesis may be taken over the summer term thereby shortening the Masters degree program to eighteen months.

Table 3: Suggested Courses in Elect. Eng., Industrial Eng., Mathematics, and Statistics.

Comm. /DSP Courses	Related E. E. Courses	Non-E. E. Courses
EE509 Dgtl Comm Nets	EE515 Emag Theory I	IE522 Queuing Sys
EE545 Dgtl Sig Proc	EE516 Emag Theory II	IE531 Oper Research
EE548 Intro to Radar	EE521 Microwave Eng	MATH471 Cmpx Var
EE555 Adv Lin Sys	EE527 Fiber Optics I	MATH472 Fourier Series
EE565 Pattern Recog	EE528 Opt Sources, Det	MATH480 Vec Spaces & Matx Alg
EE571 Rand Sig Analysis	EE529 Lasers & Apps	MATH481 Modern Algebra I
EE572 Channel Coding	EE541 Antennas & Rad	MATH482 Modern Algebra II
EE573 Source Coding	EE551 Control Sys I	MATH491 Real Analysis I
EE581 Dgtl Comm I	EE552 Control Sys II	MATH492 Real Analysis II
EE582 Dgtl Comm II	EE557 Fiber Optics II	MATH503 Numerical Lin Alg
EE583 Pers Comm Sys	EE578 Electro-Opt Sys	STAT581 Adv Theory Stat I
EE585 Telemetering Sys		STAT582 Adv Theory Stat II
EE592 Real Time DSP		
EE594 Adapt Sig Proc		
EE595 Appl DSP		
EE596 Image Proc		
EE671 Detect & Estim		

Example Communications Program		
	Fall	Spring
Year 1	EE545 Dig Sig Proc EE571 Rand Sig Analysis EE5xx Klipsch Core Course	EE555 Adv Lin Sys EE572 Channel Coding EE581 Dig Comm I
Year 2	EE582 Dig Comm II EE599 Masters Thesis	EE583 Pers Comm Sys EE599 Masters Thesis

Example Signal Processing Program		
	Fall	Spring
Year 1	EE545 Dig Sig Proc EE571 Rand Sig Analysis EE5xx Klipsch Core Course	EE555 Adv Lin Sys EE581 Dgtl Comm I EE596 Image Proc
Year 2	EE594 Adaptive DSP EE599 Masters Thesis	EE592 Real-Time DSP EE599 Masters Thesis

Example Telemetering Program		
	Fall	Spring
Year 1	EE545 Dig Sig Proc EE571 Rand Sig Analysis EE5xx Klipsch Core Course	EE555 Adv Lin Sys EE581 Dgtl Comm I EE585 Telemetering Sys
Year 2	EE/Math/Stat Elective EE599 Masters Thesis	EE583 Pers Comm Sys EE599 Masters Thesis

3 Doctoral Level Requirements

The doctoral degree is a research related degree of a highly specialized nature. For that reason, only communications and signal processing related doctoral programs are described here. Students wishing to be involved in the telemetering area at the doctoral level should pick an area of concentration in a telemetering sub-specialty and work in that area.

For the communications and signal processing program, the faculty normally expect that the student will hold an MSEE degree equivalent in scope to a masters degree at NMSU.

3.1 Graduate School

For complete Graduate School [requirements](#), [deadlines](#), and [forms](#), please see

<http://www.nmsu.edu/~gradcolg>

International students need to consult with the Center for International Programs (CIP) for admissions information. CIP's home page is at

<http://www.nmsu.edu/~cip>

Requirement highlights are listed below:

- There is no fixed number of student credit hours that must be taken for doctoral students other than the minimum of 18 hours of doctoral dissertation (EE700). There are three examination levels that the student must pass prior to receiving the doctoral degree:
 1. *Doctoral qualifying examination.* This two-day, written examination is periodically administered by the Klipsch School. The student will need to have taken the basic masters level courses in at least four of the departmental areas to pass this examination. If the student does not pass this examination the first time, a second opportunity is available the following year.
 2. *Doctoral comprehensive examination.* This examination is designed and administered by the student's doctoral committee and has both an oral and written component with content determined by the student's committee. The student will also be expected to present a concept of the doctoral dissertation at the oral examination. After successful completion of the comprehensive examination, the student has five years in which to complete the doctoral dissertation. For more information please see

<http://www.nmsu.edu/~gradcolg/doc-exam.html>

In general, there should be a time lapse of at least one year between the comprehensive and final oral examination. However, in some cases, such a time lapse is not always practical. In all cases there must be one semester or 16 weeks between the comprehensive and the final oral examinations.

3. *Doctoral final examination.* This oral examination covering the dissertation is conducted by the committee when the dissertation work is completed. This examination is concerned primarily with the research work of the student as embodied in the dissertation, but it may be much broader and extend over the whole field of study of the candidate. The final examination is entirely oral and open to the public. For more information please see

<http://www.nmsu.edu/~gradcolg/doc-exam.html>

- After completion of the qualifying examination and after 12 credit hours toward the doctoral program have been completed, the student should file the doctoral candidacy form. This form contains the student's program of study and the composition of the doctoral committee. A student may not register for dissertation hours prior to successful completion of the qualifying examination. For more information please see

<http://www.nmsu.edu/~gradcolg/doc-prog.html>

- The minimum residence requirement for the doctoral degree shall include at least two regular semesters at New Mexico State University, exclusive of summers, following completion of the first 30 credits of graduate work, provided the student is admitted to a doctoral program.
- The research and writing connected with the dissertation is understood to require at least one year of full-time work. Every student working toward the doctoral degree will submit a dissertation embodying the results of *original* research. The dissertation is expected to demonstrate the student's ability in independent investigation and to be a contribution to human knowledge. The dissertation preparation shall total at least 18 credits of EE700.

Typically, the student will take a minimum of 30 hours of course work beyond the masters degree.

3.2 Klipsch School

The complete requirements of the Klipsch School for the Ph.D. can be found at

<http://www.ece.nmsu.edu/academics/graduate/phd.html>

Summarized, these requirements are:

- Research Tools. Every doctoral student must be proficient in two research tools. Foreign languages may be considered as research tools. The selection of the research tools will be made by mutual understanding between the student and advisor and should reflect the overall objective of the student's program.

Foreign languages may be used in satisfying the research tools by one of two methods: translating a relevant research paper from the language into English or by successful completion (grade of C or better) in an Advanced Conversation course. The foreign language may be chosen from French, German, Russian, or Japanese.

Specialized course work to fulfill the research tool requirement may involve a minimum of 6 credit hours per research tool in a specialized area. Typical examples include,

- Industrial Engineering: [IE 467](#), [IE 567](#)
- Mathematics: [MATH471](#), [MATH481](#), [MATH482](#), [MATH483](#), [MATH491](#), [MATH492](#), [MATH581](#), [MATH591](#), [MATH592](#)
- Statistics: [STAT470](#), [STAT480](#), [STAT581](#), [STAT582](#), [EST505](#), [EST506](#)

3.3 Communications, Signal Processing, and Telemetry Group

In addition to the courses necessary to complete the masters program and to successfully pass the qualifying examination, the communications/signal processing group requires the following courses for the doctoral program:

- EE545 Digital Signal Processing
- EE555 Advanced Linear Systems
- EE581 Digital Communications I
- EE671 Detection and Estimation
- 6 credit hours from:

MATH481	MATH482
MATH491	MATH492
STAT581	STAT582

(These 6 credits may also be used to fulfill research tools component.)

3.4 Degree Planning

The planning process described here assumes that the doctoral student will be taking a minimum of 18 hours of EE700 and two research tools in addition to the courses listed below. The planning covers all post-bachelor's course work, and involves three areas: core courses by area of specialization, courses to assist in passing the doctoral qualifying examination, and elective or related courses. All but the core courses will be chosen between the student and advisor to best prepare the student for the research topic to be pursued in the doctoral dissertation.

- Communications Specialization Area
 1. Communications Core Courses

EE545	EE555	EE571	EE581	EE582	EE671
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 2. Doctoral Diversification Courses (choose at least three areas)

EE511/EE512	EE514/EE523	EE515/EE516	EE521/EE541
EE542/EE543	EE551/EE552	EE561/EE562	EE577/EE578

3. Elective or Related Areas (typically 8 courses not chosen above or as a research tool)

EE509	EE515	EE516	EE521	EE527	EE528
EE529	EE541	EE548	EE551	EE552	EE557
EE572	EE573	EE578	EE581	EE582	EE583
EE585	EE592	EE594	EE595	EE596	MATH481
MATH482	MATH483	MATH491	MATH492	MATH541	MATH581
STAT581	STAT582				

• Signal Processing Specialization Area

1. DSP Core Courses

EE545	EE555	EE571	EE594	EE596	EE671
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2. Doctoral Diversification Courses (choose at least three areas)

EE511/EE512	EE514/EE523	EE515/EE516	EE521/EE541
EE542/EE543	EE551/EE552	EE561/EE562	EE577/EE578

3. Elective or Related Areas (typically 8 courses not chosen above or as a research tool)

EE509	EE515	EE516	EE521	EE527	EE528
EE529	EE541	EE548	EE551	EE552	EE557
EE572	EE573	EE578	EE581	EE582	EE583
EE585	EE592	EE594	EE595	EE596	MATH481
MATH482	MATH483	MATH491	MATH492	MATH541	MATH581
STAT581	STAT582				