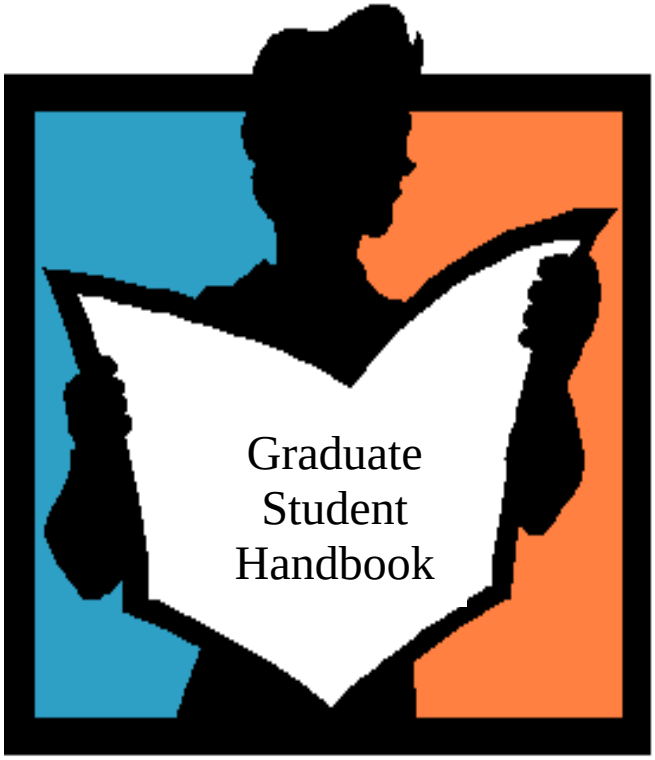
2007-2008
Electrical Engineering Graduate Program



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The purpose of this handbook is to outline the policies and procedures of the graduate program of the Charles L. Brown Department of Electrical & Computer Engineering of the University of Virginia. As such, it should be viewed as a supplement to the ***University of Virginia Graduate Record***, which summarizes the rules and regulations of the University and the School of Engineering and Applied Science (SEAS).

September 2007

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Message From the Chairman

Electrical and Computer Engineering has been, and continues to be, one of the most challenging and, at the same time, rewarding professions of modern society. Electrical engineers continue to provide both technology and technological leadership for developments in numerous fields including computers, computer-aided engineering, telecommunications, automatic control, optics, semiconductors, nanotechnology, and energy conservation. In addition, electrical engineers are being challenged to supply technical expertise to support advances in many other fields such as energy management, transportation systems, health care delivery, and public policymaking.

The Charles L. Brown Department of Electrical and Computer Engineering, at the University of Virginia, is one of the eight departments in the School of Engineering and Applied Science and offers undergraduate and graduate study programs. Fields of research include control systems, machine vision, computer engineering, VLSI systems, communications and information theory, digital signal processing, semiconductor and superconductor solid-state electronics, nano electronics, millimeter wavelength technology, pattern recognition and image processing, and network analysis and synthesis. In addition interdisciplinary programs are offered in collaboration with the departments of Systems Engineering, Applied Mathematics, Computer Science, Mechanical and Aerospace Engineering, Biomedical Engineering, and Engineering Physics.

The Electrical and Computer Engineering program has established an excellent reputation with industry as a source of outstanding engineers. The department faculty maintains this reputation by continually updating curricula to reflect current scientific and technological advances and requirements and by maintaining a vigorous research program designed to provide staff and graduate students with high level learning experiences relevant to the needs of our society.

With its excellent facilities and internationally recognized faculty, the Charles L. Brown Department of Electrical and Computer Engineering at the University of Virginia has become a major player in the development of cutting-edge technology and engineering personnel for the 21st century. We hope you like what you see, and that you will contact us with any questions or comments that you may have.

Lloyd R. Harriott
Virginia Microelectronics Consortium Professor and Chair

General Academic Policies

Administration of Graduate Programs

All graduate programs in the School of Engineering and Applied Science (SEAS) are administered through the Office of the Associate Dean for Graduate Programs. Implementation of the SEAS procedures and the management of graduate student records in the ECE Department is the responsibility of the ECE Graduate Office.

The Charles L. Brown Department of Electrical and Computer Engineering offers programs of study leading to the M.E., M.S. and Ph.D. degree. The academic requirements for higher degrees, awarded through the department are set, and periodically reviewed, by the faculty of the department. The EE Graduate Committee acts on behalf of the faculty on matters relating to programs, degree admission, implementing the graduate program procedures and directing financial aid. Graduate students, together with their advisor, are responsible for planning a course of study (meeting the SEAS requirements) that will lead to a degree. The ECE Graduate Office and SEAS Graduate Office are charged with ensuring that the appropriate degree requirements are met before a student may apply to the Registrar for the conferral of a degree.

Academic Regulations

i. Student Status and Residency Requirements

Candidates for the Master of Science degree must complete at least one semester in residence as a full-time student at the University of Virginia. Candidates for the Doctor of Philosophy degree must complete at least three sessions (or the equivalent) of graduate study beyond the baccalaureate degree, or two sessions (or the equivalent) after the master's degree. At least one session beyond the master's degree must be in full residence at the University of Virginia in Charlottesville (a session is two semesters not including the summer semester).

A student receiving financial aid from the School of Engineering and Applied Science must be registered full time, defined as at least 12 credit hours of lecture-laboratory courses and/or research per semester during the academic year, must maintain a grade point average of at least 3.0 and must maintain satisfactory progress toward a degree. Graduate research assistants must register for a minimum of 6 credit hours of research only, during the summer. Students receiving financial aid are not permitted to have other employment without prior approval of the Office of Associate Dean for Graduate Programs.

ii. Probation and Dismissal Policies

A graduate student will be considered to be on probation if his/her cumulative GPA for graduate work is less than 3.0 and will be notified of this situation by the Dean's Office. Graduate students on probation are usually ineligible for financial aid. A graduate student will be subject to dismissal if the cumulative GPA is not raised to 3.0 within one semester. Undergraduate courses and courses taken on a Pass/No Credit basis may not be used to meet requirements for a graduate degree and will not be used in computing the GPA.

iii. Time Limit for Degrees

The time limit for completion of the M.S. is five years after admission. The time limit for the M.E. is seven years, and the Ph.D. is seven years after admission into the Ph.D. program.

iv. Transfer of Credit

Master of Science candidates may transfer a maximum of 6 credits of approved graduate courses into the program. Master of Engineering candidates may transfer 12 hours of graduate credit. Students in the Cooperative Graduate Engineering Program may include up to 15 hours of credit with grades of C or better from participating institutions (an overall

GPA of 3.0 must have been maintained at the participating institution). Students not enrolled in the Cooperative Graduate Engineering Program may only transfer courses with a grade of B or better. Requests for transfer credit should be accompanied by a plan of study.
Students should discuss courses acceptable for transfer of credit with their advisor, at the same time the Plan of Study is developed. Form G112 is required for transferring courses along with a catalog statement of course level and the grading system that justifies classification of these courses as graduate-level courses. Also, an official copy of the transcript from the institution where the course(s) was taken is required.
Requests for transfer credit must be submitted with the Plan of Study (G 101-Master's, G 102-Doctoral) during the first semester as a graduate student in the department.

v. Graduate Course Drop Deadline
The last date for dropping a graduate course is determined by the Registrar's Office. Check the academic calendar for the most current list of deadlines each semester. (When deadlines are missed, students may petition the Dean's Office for a W or WP upon concurrence of their instructor and advisor).

vi. Incomplete Grades and Repeated Courses
A 10-day period past the end of the semester (end of the examination period) is automatically allowed to remove an incomplete. Maximum extension to the end of the following semester (following Fall for a Spring class, and Spring for a Fall class) may be granted by special request to the Dean's Office. If a course is repeated both grades are used in the GPA calculation.

Articulation Requirements

Graduate level electrical and computer engineering research is a broad discipline that utilizes skills from many diverse fields. Students entering the graduate ECE program from a *non-electrical or computer engineering* background are welcome within the UVA ECE department. *All* students should have completed undergraduate coursework in at least three of the following electrical and computer engineering undergraduate topic areas:

Circuit Analysis
Logic Design
Linear Systems
Communication Theory
Electronics
Signal Processing
Control Theory
Electronic Materials
Optoelectronics
Device Physics
Electromagnetics
Power
Computer Architecture
Software Engineering
Quantum Physics
Engineering Mathematics

These requirements may be satisfied in the following ways:

- Previous undergraduate course work - for example, physics course in electromagnetic fields.
- Enrollment in and successful completion of the appropriate UVA undergraduate courses (B or better

grade). Undergraduate courses may not be taken on a pass/fail basis.

- Independent-study and examination. The student may take a proficiency examination and pass with a B or better in any of the appropriate UVA undergraduate courses during the normally scheduled examination period or by special arrangement with the instructor.

Additional courses may also be required to fulfill necessary background material prerequisites needed to complete the graduate level course requirements. Many graduate level ECE courses have implicit undergraduate course prerequisites. Students are expected to have mastered the undergraduate skills necessary to provide the appropriate foundation for graduate courses they attempt.
For further details on courses see the course listing in the back of this handbook.

Responsibilities of Graduate Students

As a graduate student in the University of Virginia you have been given a unique opportunity for intellectual growth in a vibrant academic community. This opportunity comes with some responsibilities on your part as a student, researcher, and teacher.

i. The ECE Graduate Office

The ECE Graduate Office is responsible for tracking your academic progress, ensuring SEAS documentation is completed, assigning and managing department student-office space, disbursing GTA and GRA funds, assigning GTAs, graduate student admissions, and other day-to-day support issues such as room keys, room management, and database management.

You will be assigned a shared office, either by your research group or by the department. It is important that you follow some guidelines in the use of this space. Don't change offices without contacting the ECE Graduate Office first; don't move furniture in or out of your office; and remember to be considerate of the other students with whom you share the room. The Graduate Office maintains a database of graduate student information, please keep us up-to-date as to your home phone number and address.

ii. Academic Progress

The responsibility for your academic progress is largely your own. You must ensure, by carefully reading this handbook, that you are completing the necessary documentation as you progress through the program. The ECE Graduate Program Director (located in the Graduate Office) will be able to give you general guidance in meeting the academic regulations of the institution, SEAS, and the department. Your own academic advisor will assist you in preparing a plan of study that fits with the research program in which you will be engaged.

iii. Research Assistants

The award of a Graduate Research Assistantship (GRA) and the stipend and fee remission associated with it is paid out of research-group funds. A GRA is not a grant to the student but is payment for actual student services to the research program. GRA funds are awarded to the research group for the completion of a project of research, the results of which will be reported back to the funding organization. If you receive a GRA, then you are essentially an employee working on that particular project. The project may, or may not, coincide with your own research project. Your responsibility is to complete the assigned project tasks while maintaining your own academic progress. It is possible that your GRA funding will come from a research project other than the one with which your research work is connected. In this case, it is still your responsibility to maintain academic progress in both research and coursework.

iv. Teaching Assistants

The award of a Graduate Teaching Assistantship (GTA) and the stipend and fee remission associated with it is paid out of institutional funds. As a teaching assistant, a graduate student carries considerable responsibility as a representative of the University in the laboratory and the classroom.

To be appointed to a GTA position, an international graduate student must have passed the SPEAK Test. This test is administered by the Center for American English Language and Culture as part of the International Teaching Assistant Testing and Training Program. This program scores the verbal communication skills of prospective GTAs and offers further training if the score is not over the required 55-point proficiency level. This test is in addition to the TOEFL (required for admission) and the VELPT (Virginia English Language Proficiency Test) required of all international graduate students.

The ECE Graduate Office appoints GTAs for the department and for some of the SEAS core courses. Graduate students interested in a GTA position should apply to the ECE Graduate Office. A list of courses requiring GTAs for the following semester is posted on the ECE Graduate Office notice board outside room C 216.

As a GTA, your primary responsibility is to the course instructor. Once selected for a GTA position you should contact the instructor (if you haven't already done so) and become acquainted with the duties expected of you. As a GTA laboratory assistant, your most important task is to become familiar with the experiments. This involves discussing them with the instructor, reading the laboratory manual, and performing the experiments before the scheduled day of the laboratory class.

v. Scholarship

As a graduate student, the level of scholarship will be quite different from that expected of you as an undergraduate. You are required to maintain a B average in all of your coursework. You will be engaged in narrow and sophisticated fields of research, yet you will be required to know (and possibly teach) broad fundamentals. You will be expected to know detailed technical literature relevant to your project and know the fundamental concepts and milestone breakthroughs that brought your field to its current state of development. You will present your work in the form of project reports, theses, dissertations, conference proceedings, and journal publications. You will give presentations to faculty and students within the SEAS community and to wider audiences at conferences and colloquia. These expectations will place your verbal, written, and technical communication skills under the microscope. Before editors or reviewers will take your work seriously, it must be free from spelling, grammatical, typographical, and style errors. It must be readable and it must be presented according to the principles of clear technical communication. To assist you in the continuous improvement of your communication, mathematical, and scientific skills, the ECE Graduate Office strongly recommends the following:

1. Obtain a good dictionary (such as *Webster's Collegiate*) and use it. Don't rely on your spell-checker.
2. Obtain a good technical grammar reference such as *Science and Technical Writing–A Manual of Style*, ISBN 0-415-92551-7.
3. Have access to a definitive reference on issues such as units, number usage, prefixes, abbreviations, designations, and mathematical and scientific symbols. All of these items are treated in the NIST publication: *Guide for the Use of the International System of Units (SI).* This publication is available from the GPO for $7.50.
4. Have access to a definitive reference for the symbols used in your field. Comprehensive symbols and designations listings are available from the IEEE Standards Society.
5. Read at least one of the many texts available that review the procedure for writing technical reports and scientific papers. Two very good works are:

   How to Write and Publish a Scientific Paper (SCI-ENG T11.D33)

   How to Write and Publish Engineering Papers and Reports (SCI-ENG T11.M14).

6. You may often need to review mathematical topics or look up an integral or identity. A good, current, mathematical reference for engineers is:
The Handbook of Mathematical Formulas and Integrals (ISBN 0-12-382251-3).

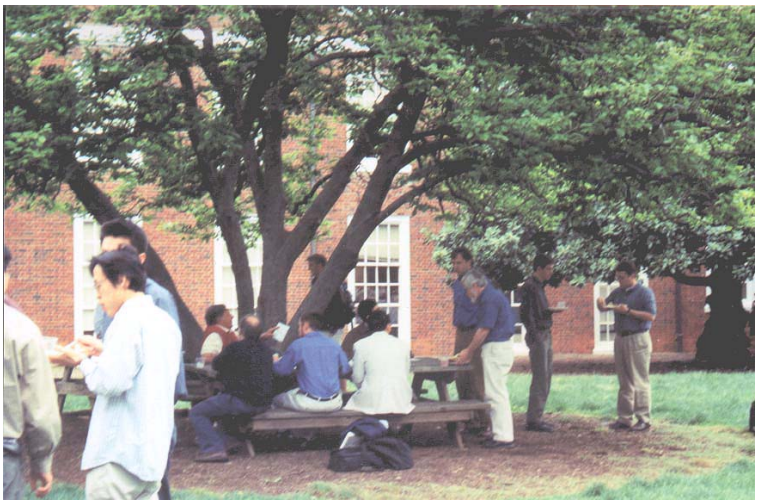
vi. Involvement

All graduate students should attend the annual graduate-student orientation activities at the beginning of fall semester. This is a good opportunity to meet with your peers, meet new graduate students, and be reminded of the academic policies and procedures.

You should also get to know the services available from the Charles L. Brown Science and Engineering Library (Clark Hall). The library contains current periodicals, and has considerable holdings of back issues of the major journals. An inter-library loan service is offered for prints and books. The library website (www.lib.virginia.edu/science) contains a wealth of information relating to databases for engineering and the electrical sciences. You should make a point of visiting the library, and its website, early in your post-graduate career. You can schedule a research tutorial (from the website) with one of the librarians, and tailor this tutorial to your research activities. A liaison person is assigned by the library to each academic department. The ECE liaison is Carol Hunter; Carol is also the Director of the Charles L. Brown Science and Engineering Library.

Graduate student membership and participation in IEEE activities is strongly encouraged. A student member may attend the Central Virginia Section monthly dinner meetings that rotate between Charlottesville, Waynesboro, and Lynchburg. There is also an active Student Chapter of IEEE, which sponsors technical talks on career choices, employment areas, plant visits, and some social events. A membership fee is required. Stop by the office of our Chapter Advisor, Professor Mircea Stan, in Thornton Hall E-209, and pick up an application form.

The Charles L. Brown Department of Electrical and Computer Engineering sponsors seminars featuring eminent speakers. All graduate students are required to attend unless they have a conflict due to classes or research travel. Talks are designed to inform the non-specialist about current research on a wide variety of science and engineering topics. Announcements of seminars will be posted on bulletin boards in the C2 and C3 lobbies.



Master's Degree Requirements

The department offers two master's degrees, a Master of Science (MS) that requires a thesis, and a Master of Engineering (ME) that does not require a thesis and is professionally oriented. Students receiving financial support from the department in the form of a GRA, GTA, or a fellowship will generally be required to take the MS (thesis) option, unless approval to do the ME is obtained from the EE Graduate Committee. Students enrolled in the MS program must obtain the agreement of an advisor to supervise a MS thesis. Degree requirements set by The Charles L. Brown Department of Electrical and Computer Engineering are in addition to SEAS requirements outlined in the Graduate Record.

Policies and Notes	***Forms and Dates***
1) Complete ECE Graduate Student Database Information form**.** 2) See the English Language Proficiency Requirements under Special Graduate Course Requirements on page 18 of this handbook.	During or prior to graduate-student orientation.
Select an academic advisor and with his/her assistance, determine a plan of study. When properly completed and approved, it represents the course curriculum for the degree. The degree plan must include 31 graduate credits: • 1 credit of ECE 696: ECE Seminar (only offered in the Fall semester). • The MS requires 24 credits of graded coursework plus 6 credits of ECE 898 – Thesis. • The ME requires 30 credits of graded coursework, which may include 3 – 6 credits of ECE 695/ECE 895–Master's Project. • Degree plans must include at least three courses, each from a different subject area. At least four courses must be within the ECE Department. • 3 credits of mathematics at, or above, 500-level are required for both MS and ME degrees, and may be taken from APMA, MATH, ECE 611, ECE 738, and SYS 605. • No more than 9 credits of 500-level courses are permitted. • No more than 6 500-level credits may be in the ECE Dept. • No more than 3 credits of Independent Study (ECE 693, ECE 793) are permitted. • For both MS and ME degrees, undergraduate articulation courses may be required of students with other than the traditional ECE background. *Note: some courses may not be offered every year.	***G104 Recommendation and Certification of Advisor for Masters/Doctoral Students*** ***G101 Master's Degree Plan of Study and accompanying assessment form (G101 A); ME students must also submit Engineering Analysis, Technical Writing and Oral Communication Assessments*** Submit to ECE Graduate Office before the end of your first semester. Resubmit G 101 if changes are made. Must Include (31 hours total): ***3*** courses, each from a different area ***4*** courses must be ECE ***3*** hours math (500-level+) ***1*** hour of ECE 696: ECE Seminar ***MS:*** 6 hours Thesis Research required ***ME:*** 3-6 Master's Project allowed Restrictions: No more than 9 hours at 500-level No more than 6 hours at 500-level in ECE No more than 3 hours Independent Study

Policies and Notes	***Forms and Dates***
If you intend substituting transfer credit for courses identified in your Plan of Study, then read Transfer of Credit under Academic Regulations above.	***G 112 Approval of Transfer Credit*** To ECE Graduate Office together with your Plan of Study.
Complete your graduate coursework within 5 years of admission (MS), and within 7 years (ME). • Receive no course grade lower than C. • You will be placed on academic probation if your cumulative GPA falls below 3.0—notified by the Dean's Office. • You will be academically dismissed if your GPA is not raised to 3.0 within one semester of being placed on academic probation. • If you repeat a course, both grades are used in the GPA calculation. • Incomplete grades must be removed within 10 days of the end of the semester in which the course was taken.	
If you intend to enter the Ph.D. program after completing the master's degree at the University of Virginia, request admission to the Ph.D. program by submitting form G 123. See also, Ph.D. Qualifying Examination under Doctor of Philosophy Degree Requirements. • Requires your academic advisor's signature and two other endorsements from ECE faculty.	***G 123 Request for Admission to the Ph.D. Program*** To ECE Graduate Office before completing your fourth academic semester of master's study.
Apply for master's degree. • If you do not complete your MS/ME coursework before the petitioned graduation date, re-apply with a new G 113.	***G 113 Application for Graduate Degree*** To ECE Graduate Office before: October 1 for January graduation February 1 for May graduation June 1 for August graduation.
Master's Thesis (ECE 898) Before beginning to write a thesis, the student should read form G 122 that outlines the approved school format and requirements. • Write thesis and receive advisor's approval for required oral defense. • The examination normally covers the research done for the thesis, but may also include questions from related coursework.	***G 122 Instructions for Thesis Preparation (Thesis Preparation Check List)*** Read this form and follow the format instructions. Consult the Associate Dean's Office if you have any questions.

Policies and Notes	***Forms and Dates***
Student and advisor select an examining committee and date for the examination. • MS thesis examination requires a minimum of three UVa faculty members, one of whom will be the thesis advisor. At least two members must be from SEAS. One research professional or faculty member from outside UVa may be a fourth voting member on the committee, provided that his/her qualifications are commensurate with that of a research faculty or equivalent rank. • Thesis advisor cannot chair the examining committee. • The committee chair must be from the ECE-Department.	***G 105 Request for Appointment of Examining Committee (MS Thesis)*** To the ECE Graduate Office. Submit at least 14 days prior to the scheduled examination date.
Prepare thesis for distribution and reserve room. • Select a conference room for your examination and check availability with the ECE Graduate Office.	
Announce the oral examination of the thesis. • Obtain an example announcement format from the ECE Graduate Office. • Send e-mail copies of your announcement to eeall@virginia.edu. • Post an announcement of the thesis defense on the department web calendar; include the title, time, and room number. • Provide the ECE Graduate Office with one copy of the announcement for inclusion in your academic file. • Post one copy of the announcement on the ECE Graduate Office notice board outside C 216.	7 days before the scheduled examination date.
Conduct master's thesis examination as scheduled. • The format of the oral defense is a presentation by the student followed by a question and answer period. The student presentation portion of the defense should not exceed 30 minutes.	***G 110 Report on Master's of Science Thesis Final Examination and accompanying assessment form*** To be brought, partially completed, to the examination. Examining committee returns it to the ECE Graduate Office.
In the event of an unsuccessful thesis examination, a two-thirds majority of the examining committee may recommend a further examination—after the student has been given time to prepare.	

Policies and Notes	***Forms and Dates***
Submit a draft copy of the final version of the thesis to the Office of the Associate Dean for Graduate Studies for format approval. Be sure you have met all of the requirements specified in the Thesis/Dissertation Approval Checklist (form G 122), available online and from the ECE Graduate Office or the Office of the Associate Dean for Graduate Studies. Once the draft has been approved or all appropriate changes have been made, deliver three copies of the final version (printed on thesis-quality bond paper) to the Office of the Associate Dean for Graduate Studies to receive the Dean's signature. Retrieve all three final copies of the thesis from Associate Dean's Office and deliver them to Printing Services, in Alderman Library, for binding. Pay the fee for binding and return the receipt to the Office of the Associate Dean for Graduate Studies.	Consult the Office of the Associate Dean for Graduate Studies in Thornton Hall, Room A108, for deadlines.

Doctor of Philosophy Degree Requirements

Policies and Notes	***Forms and Dates***
1) Complete ECE Graduate Student Database Information form**.** 2) See the English Language Proficiency Requirements under Special Graduate Course Requirements on page 19 of this handbook.	To be completed during graduate student orientation.
Select an advisor and, in consultation with the advisor, an advisory committee during the first semester of doctoral study. The advisor normally is a faculty member in the student's primary area of interest.	***G104 Recommendation and Certification of Advisor for Masters/Doctoral Students***
• The advisory committee requires a minimum of four members. At least three should be SEAS faculty, one of whom should represent minor interests and one must be from outside the ECE Department. The chair of the advisory committee must be an ECE faculty member. *Note: the purpose of the advisory committee is to provide the student with a broad base of guidance in formulating and executing a plan of study and dissertation project. Should the student's interests change, the advisory committee can be reconstituted as appropriate.*	***G103 Recommendation and Certification of Appointment of Advisory Committee*** Submit to the ECE Graduate Office within the first semester of doctoral study.
The student must meet with his/her advisory committee to determine a plan of study. Before this meeting the student should meet with his or her advisor and prepare a preliminary academic outline consisting of previous degrees, proposed Ph.D. major and minor areas of study, list of completed graduate courses, a copy of a transcript of graduate and undergraduate courses, and a list of proposed courses for the Ph.D. degree. The plan of study must include at least 24 hours of ECE 999 - Dissertation Research, and at least 12 hours of graduate-level graded coursework beyond the master's degree. The student must also complete at least three hours of graduate-level mathematics beyond the bachelor's degree, the graduate teaching requirement, and the 1 credit of ECE 696: ECE Seminar (offered in the Fall semester) (see also Special Graduate Course Requirements on page 19 of this handbook). These are the minimum course hour requirements. The student's advisory committee may require additional courses. Ph.D. students who did their master's work elsewhere must fulfill the total Ph.D. course hour requirement (as above) and the articulation requirement outlined in this handbook.	***G102 Doctoral Degree Plan of Study*** Submit to ECE Graduate Office before the end of your first semester of doctoral study. Resubmit G 102 if changes are made. Must Include (72 hours total): ***24*** hours MS coursework ***24*** hours Dissertation Research ECE 999 ***12*** hours coursework beyond MS/ME ***9*** hours of coursework and/or research ***3*** hours Teaching Experience ECE 996 ***1*** hour of ECE 696: ECE Seminar

Policies and Notes	***Forms and Dates***
While most Ph.D. students will complete a master's degree before entering the Ph.D. program, Ph.D. seeking students may be admitted directly to the Ph.D. program from a baccalaureate program with the approval of the Graduate Committee. Direct Ph.D. students must still complete the course-hour requirements of a master's degree as part of their Ph.D. program.	
See also Transfer of Credit, under Academic Regulations.	***G112 Approval of Transfer Credit*** To ECE Graduate Office together with your Plan of Study.
Prepare for the Ph.D. Qualifying Examination. Ph.D. students are required to pass a qualifying examination early in their graduate studies. The objective of the exam is to assess the student's potential to perform doctoral-level research. Students enrolled in the master's program at the University of Virginia who wish to continue on for the doctoral program must pass the qualifying examination before or within the first semester after their master's degree. Students who have obtained a master's at another university must pass the examination before completing their third academic semester in the doctoral program at the University of Virginia. The qualifying examination is not based on a specified list of topics (hence no syllabi will be involved) but rather will evolve from a short research presentation by the student. This presentation (lasting no more than 20 minutes) can be based on the student's M.S. project work and/or the student's research interests. The qualifying examination (lasting no more than 2 hours) will begin with this presentation, which will serve as a starting point for, and be followed by, questions from the qualifying examination committee. The questions can be in-depth or in-breadth, and may cover any topic logically connected to the presentation. The student should be well grounded with the fundamentals of topic areas related to the presentation.	
The qualifying examination committee requires four members. It will consist of three ECE professors chosen by the graduate committee. The examining committee chair will have interests in an area related to the student's research, a second member will also be in a	***G 105 Request for Appointment of Examining Committee (Ph.D. Qualifying)*** To the ECE Graduate Office. Submit at least 14 days prior to the scheduled examination date.

Policies and Notes	***Forms and Dates***
related area, and the third member will be from an area not closely related to the student's research topic. The student's research advisor will also be present, but may not ask questions or answer questions put to the student. The student will be informed of his/her committee membership as soon as the committee is assigned.	
The examining committee should be given a brief technical paper before the presentation. The paper should be a summary of the work described in the oral presentation, be in standard IEEE Transactions format, and is limited to three double-column single-spaced pages, including figures and references.	At least 7 days before the anticipated examination date.
Once the graduate committee has assigned the examining committee, it is the student's responsibility to schedule the examination with the committee members, arrange a room for the examination, and notify the ECE Graduate Office. The examining committee will inform the student and his/her research advisor, in writing, of the outcome within 72 hours after the qualifying examination. The result will be a clear-cut pass or fail; no remedial work will be allowed to alter the outcome. A student who fails the qualifying exam on the first try, may retake it during the following semester/summer. At least one faculty member from the first examining committee will serve on the second examining committee. A student who fails the examination twice will lose support and must leave the program at the end of that semester.	At least 7 days before the anticipated examination date. ***G 107 Report on Comprehensive (Qualifying) Examination for the Doctor of Philosophy Degree and accompanying assessment form*** Brought partially completed by the candidate and returned to the ECE Graduate Office.
Doctoral Dissertation (ECE 999) After a student has been admitted to Ph.D. study, the student should work with his/her advisor and define a dissertation topic. A dissertation proposal based on this topic must be submitted to the student's advisory committee in advance and a public oral presentation of the proposal be made within two semesters beginning with the semester following successful completion of the Ph.D. Qualifying Examination.	***G 105 Request for Appointment of Examining Committee (Dissertation Proposal/Outline)*** To the ECE Graduate Office. Submit at least 14 days prior to the scheduled examination date.
The Proposal document submitted to the examining committee should be limited to 25 pages including figures. Supplemental information should be placed in appendices to the proposal.	

Policies and Notes	***Forms and Dates***
• Obtain an example announcement format online or from the ECE Graduate Office. • Announce the presentation of the proposal by mailing the announcement to eeall@virginia.edu • Post an announcement of the presentation on the department web calendar. • Post one copy of the announcement on the ECE Graduate Office notice board outside C 216.	At least 7 days before the scheduled presentation date.
The Proposal presentation should be limited to 30 minutes and will be followed by questions from the audience and the examining committee. Successful completion of the dissertation proposal examination will result in your being admitted to candidacy for the degree. You must complete at least one semester as a candidate before the degree is awarded.	***G 108 Report on Dissertation Outline and Admission to Candidacy and accompanying assessment form*** Brought partially completed by the candidate and returned to the ECE Graduate Office.
Regular publication and presentation of scholarly work is an expected part of any graduate level research program. At a minimum, all Ph.D. candidates are required to submit an article related to their research to a refereed journal, prior to completing their dissertation defense. If the student's advisor is not a co-author of the paper, the advisor must provide the graduate committee with a note indicating the advisor's approval of the paper. (Please supply the ECE Graduate Office with a copy for your file).	***Journal Submission*** To ECE Graduate Office prior to graduation.
Apply for doctoral degree. • If you do not complete your coursework before the petitioned graduation date, re-apply with a new G 113.	***G 113 Application for Graduate Degree*** To ECE Graduate Office before: October 1 for January graduation February 1 for May graduation June 1 for August graduation.
Before beginning to write a dissertation, the student should read form G 122 that outlines the approved school format and requirements. A public oral defense is required by the department after the student has completed his/her dissertation to the satisfaction of his/her advisor.	***G 122 Instructions for Thesis Preparation (Thesis/Dissertation Preparation Check List)*** Read this form and follow the format instructions. Consult the Associate Dean's Office if you have any questions.

Policies and Notes	***Forms and Dates***
The examining committee ***will include the candidate's advisory committee*** (at least three from SEAS, four from UVa) and will have a minimum of five members total. One must be from outside the department or the student's research area. Students must furnish biographies for non-tenure track faculty members (outside of SEAS) and industry professionals to include the highest degree attained, the year and institution, and any relevant experience or research which would provide expertise needed for sitting on the committee.	***G 105 Request for Appointment of Examining Committee (Ph.D. Final)*** To the ECE Graduate Office. Submit at least 14 days prior to the scheduled examination date.
Prepare the dissertation for distribution and reserve room. • Select a conference room for your examination and check availability with the ECE Graduate Office. • The completed dissertation must be delivered to each member of the examining committee at least 14 days prior to the defense.	7 days before scheduled examination date.
Announce the final examination of the dissertation using the standard format • Obtain an example announcement format from the ECE Graduate Office. • Send e-mail copies of your announcement to eeall@virginia.edu, and to all SEAS faculty at seas-faculty@virginia.edu. • Announce the examination of your dissertation on the department web calendar. • Provide the ECE Graduate Office with one copy of the announcement for inclusion in your academic file. • Post one copy of the announcement on the ECE Graduate Office notice board outside C 216.	
Conduct doctoral dissertation final examination as scheduled. The format of the oral defense is a presentation by the student followed by a question and answer period. The student presentation portion of the defense should not exceed 45 minutes. Submit a draft copy of the final version of the dissertation to the Office of the Associate Dean of Graduate Studies for format approval.	***G 111 Report on Dissertation Final Examination and accompanying assessment form*** Brought partially completed by the candidate and returned to the ECE Graduate Office.

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Be sure you have met all of the requirements specified in the Thesis/Dissertation Approval Checklist (form G 122), available online and from the ECE Graduate Office or the Office of the Associate Dean for Graduate Studies. Once the draft has been approved or all appropriate changes have been made, deliver three copies of the final version (printed on dissertation-quality bond paper) to the Office of the Associate Dean for Graduate Studies to receive the Dean's signature.	
Retrieve all three final copies of the dissertation from Associate Dean's Office and deliver them to Printing Services, in Alderman Library, for binding. Pay the fee for binding and return the receipt to the Office of Associate Dean for Graduate Studies	Consult the Office of the Associate Dean for Graduate Studies in Thornton Hall, Room A108, for binding receipt deadlines.

Special Graduate Course Requirements

English Language Proficiency

All new graduate students whose native language is not English are tested for English proficiency near the beginning of their first semester at UVa. All non-native speakers of English take the Virginia Language Proficiency Exam (administered by the Center for American English Language and Culture) at this time. Students, in the ECE Department, who began their graduate studies during or after fall 2002, and who are non-native speakers of English, must also pass the SPEAK Test administered at UVa by CAELC. Students must pass this test before:

i. Requesting a Ph.D. Qualifying Examination.
ii. Being appointed to a Graduate Teaching Assistant position (ECE 897, 997).
iii. Commencing a doctoral-program Graduate Teaching Experience (ECE 996).
iv. Applying for a graduate degree.

If a pass grade is not achieved on the SPEAK test, CAELC offers a program of courses of instruction in preparation for a repeat test at a later date. If a student takes the SPEAK Test in the fall, portions of the Virginia Language Proficiency Exam and the SPEAK Test are merged into a single composite exam.

Independent Study (ECE 693, 793)

Any student planning to study graduate course material on an independent basis under the supervision of a faculty member, must submit a syllabus for ECE 693 or ECE 793 to the ECE Graduate Office. This syllabus may be in the form of a beginning-of-course memo and must be submitted no later than the beginning of the semester in which the student registers for Independent Study. The syllabus must include textbooks and references to be used during the study as well as a detailed outline of topics to be covered. Samples of problems solved and/or copies of any reports written during the course must be provided for the student's file along with the syllabus. All Independent Study courses must be completed within the period of the normal semester, unless extenuating circumstances prevent the student from completing the work. No more than one Independent Study course (3 credits) may be applied towards an M.S. or M.E. degree.

Master's Project (ECE 695, 895)

Subject to the approval of his/her advisor, an M.E. student may include three to six hours of project work in their degree program. MS & Ph.D students cannot use 695 or 895 to fulfill degree course requirements. A project proposal must be submitted to the student's advisor. When the project has been completed, a copy of the project report must be supplied to the ECE Graduate Office for inclusion in your academic file.

The project report should fully outline the scope of the project, indicate the methods and work accomplished including any data or measurements, and discuss and summarize the information gained. There is no required format per se, but the project report should be acceptable to the advisor. This report should be of the quality that with editorial changes it could be submitted as a letter to the editor or a short paper in a refereed journal. In writing this report, the student should make certain that the issues raised in the original proposal are adequately addressed.

Electrical and Computer Engineering Seminar (ECE 696)

This one-hour weekly seminar course features presentations given by ECE faculty members, to introduce various research areas, topics, and advances in Electrical and Computer Engineering. It is a one-credit course required for all first-year ECE graduate (ME, MS and Ph.D.) students.

This course is offered only the Fall semester.

Supervised Graduate Teaching Experience (ECE 996)

Students in the ECE Department who began their doctoral studies during or after fall 2002 must pass one semester of a guided teaching experience. The department will issue a list of possible teaching opportunities for each semester and students may apply for one of these positions. The ECE Graduate Office will select the faculty supervisor for each student in this course. The graduate student will be evaluated by the faculty supervisor and assigned a pass/fail grade as appropriate. As with all graduate-teaching positions at UVa the student must have passed the SPEAK Test in order to fulfill this graduation requirement. Students should apply to the ECE Graduate Office at least 10 days before classes begin. They will be assigned a course to teach and the student should contact the instructor of the course to get permission to register for ECE 996 – Supervised Graduate Teaching Experience.

It is the faculty's belief that this experience is valuable for the professional development of our Ph.D. students. In addition, the department and its undergraduates benefit from additional teaching support. It is expected that such an assignment will require about ten hours per week and may be a combination of laboratory support, office hours for tutoring, grading assistance, or a combination.

Note: This requirement may not be met by serving as a TA (ECE 897/ECE 997) in the department. No additional compensation is provided for this one-time experience.

Financial Support

Financial support may be provided by the department in the form of a Fellowship, Graduate Teaching Assistantship (GTA) or Graduate Research Assistantship (GRA). The student should consider such support an honor and make every effort to meet the requirements specified for such support. Financial aid may be terminated at any time if the department or the project supervisor feels the student is not performing to the professional standards expected of a graduate engineer.

A student receiving a department fellowship will typically be required to provide some type of service for this financial assistance. This service may include such jobs as helping a faculty member develop a new research area or working as a graduate teaching assistant. The student should meet with the faculty member and report progress on a regular basis. Fellowships are generally given to supplement GRA and GTA awards. Fellowships are usually paid monthly in eight equal installments during the academic year.

Graduate teaching assistants are assigned to specific laboratory courses and are expected to prepare adequately before each laboratory meeting. Some preliminary preparation may be required before the beginning of the semester. At the end of the semester, the GTA should check with the faculty member in charge of the laboratory to make sure that all duties have been completed. The member of faculty responsible for the course will issue detailed instructions for GTAs. Generally, first year international students are not eligible for a GTA position, unless they pass the English Proficiency Test and SPEAK Test.

Graduate Research Assistantship support is provided for assistance on sponsored research contracts or grants. This work not only aids the research project but may also provide a topic for the student's thesis or dissertation. The student is expected to complete the work specified by the project supervisor in a professional engineering manner. The project supervisor and the student should discuss what is to be expected from the student during the employment period and the student should expect to make a progress report (verbal or written) every week. Master's students receiving financial assistance will normally be required to be enrolled in the M.S. (thesis) program. This is particularly true for students receiving a GRA.

Financial aid is not automatically renewable from one year to the next. It is the student's responsibility to make arrangements with the project supervisor of his/her research regarding the possibility of continued employment for the next academic year. Students interested in a GTA position should contact the ECE Graduate Office. Fellowship support, with the exception of the Dean's Fellowships, is generally not available after the first year.

All students receiving financial assistance are responsible for providing withholding tax information and Social Security Card to the Payroll Office and completing Federal Employment Eligibility Form I9. Please report to the Budget Office for the School of Engineering and Applied Science in Room A205, Thornton Hall. Failure to do so will preclude being placed on payroll. All male students must complete the Selective Service Form: this form is required by the Commonwealth of Virginia and your employment will be terminated if it is not completed on time.

Equipment and Supplies

The following policies have been established concerning the use of equipment, supplies, and materials.

KEYS

Keys to the building and to the student offices are available from the ECE Graduate Office in Room C216. A deposit of $5.00 for each key will be required, and will be refunded upon return of the key. A replacement fee of $5.00 will be charged for each lost key and is not refundable.

OFFICES

Offices will normally be assigned by the ECE Grad Office. The office must be kept neat and clean as we often show visitors through the department. Do not use scotch tape on the walls as it will damage the wallboard when removed. Remember that someone else will occupy your office after you leave, so try to keep it nice. Office space is extremely limited, and can normally only be provided to those with research or teaching assistantships.

TELEPHONES/FAX MACHINE

Telephones are provided in some graduate student office areas. Necessary research related long distance calls are made with a forced authorization code (FAC). The FAC number allows the cost of the call to be directly charged to the research contract. FAC numbers may be obtained from the faculty investigator of the research project. University policy prohibits personal long distance calls to be made at University expense. Personal long distance calls must be made "collect", or by credit card, or charged to your home telephone number. A fax machine is located in the department mailroom in C222. Proper usage of the fax machine is dictated by the same policies that apply for telephones.

OFFICE/LAB SUPPLIES

You should contact the faculty investigator of your project regarding research supplies.

COPY MACHINE

The photocopy machine can only be used with the proper copy card. The department copy card is for

specific teaching assignments and departmental business only. Each research investigator typically has his/her own copy card. The copy form login sheet located on the counter top in the main ECE office is only used for departmental copying and ***not for laboratory or research copying***. The photocopy machine is available from 9am-5pm Monday through Friday only.

TRANSPARENCIES

Transparencies are to be made in the department only when directly related to a research project and charged to the appropriate research account. The department does not provide transparencies for coursework assignments. Alderman Library and Cabell Hall Copy Center provide facilities for transparencies and other copying services.

MAILBOXES

Graduate student mailboxes are located in the C3 elevator corridor. Each student will be assigned a mailbox for departmental communications and notices, etc. University mail service is not to be used for personal mail or technical journals. Mailboxes should be checked on a regular basis.

E MAIL, WORD PROCESSING & COMPUTING FACILITIES

The department of Information Technology and Communication (ITC) provides general purpose computing resources for the University of Virginia. Please obtain an account (http://www.virginia.edu/comp.html) promptly and read your mail and news (uva.ece.general) daily, as these will be primary methods by which the department will communicate important information to you.

If you wish to send email to all ECE graduate students, address your message to eegrads@virginia.edu.

EQUIPMENT/SUPPLIES

Instruments and electronic components are available through the Dept Lab Manager located in room E102. Do not remove equipment from the instrument room. Under no circumstances should equipment be taken from the teaching laboratories for research projects without permission.

TRAVEL

Your advisor can advise and assist you concerning research or Department related travel. Reimbursements for travel expenses are done online at http://www.virginia.edu/~travel.

ADDRESS CHANGES

Please inform the Graduate Office as well as the University, of any changes in your address or telephone number. It is important that we have an address at which you can be reached during the holidays and summer as well as the academic year. If you are graduating, please leave a forwarding home or business address.

BUILDING USE AND SECURITY

We need your help and cooperation in deterring would be thieves! Please observe the following procedures:

- Keep your office door locked whenever it is unoccupied.

- Teaching assistants must not leave until all students have left the laboratory and must then secure all doors and windows.

- If you see someone carrying equipment from the building on nights or weekends, call the University Police (dial 911) and notify the department Chair or Assistant Chair.

- Only recognized student organizations are permitted to hold private parties or other events in the building, arcade or Darden Court. All such functions must be scheduled and approved in advance by Assistant Dean William Thurneck.

- Personal belongings are not covered under the University Insurance Policies**.** Check your home policy to see if you are covered.

AUDIO VISUAL EQUIPMENT

The department maintains overhead (view-graph) and slide projectors for course and research use. In addition, a digital camera as well as a laptop computer and computer projector are available. See the Dept Lab Manager in room E102 to obtain the equipment. Other audio-visual equipment (VCR, TV, tape, etc.) may be borrowed from the Division of Technology, Culture, and Communication for coursework and student organization use.

CONFERENCE ROOMS

Conference rooms are available for oral and written exams, research meetings, and other course or research functions. The department conference rooms C310 and C311 can be reserved through the ECE Graduate Office located in C216.

Appendix I

Electrical & Computer Engineering Graduate Course Listings and Descriptions

COURSE NUMBER SYSTEM

500-599 Joint undergraduate and graduate level courses
600-699 First year graduate level courses and professional school courses
700-899 Second and third year graduate level courses
900-999 Graduate level courses, primarily for readings, research, independent study, theses, and dissertations.

HOW TO READ COURSE LISTINGS:

EX: (3) - number of credits which will be earned upon successful completion of the course.
(Y) – code for frequency with which the course is offered. Variations are:

S offered fall and spring semesters
Y offered at least once every academic year (fall or spring)
E offered every other year, in the academic years when the fall semester occurs in an even year (e.g. 1998-99)
O offered every other year, in academic years when the fall semester occurs in an odd year (e.g. 1997-98)
SI offered upon sufficient student interest
IR offered irregularly
SS offered during summer session

ECE 525 – (3) (SI)
Introduction to Robotics
Prerequisite: ECE 402, or 621, or equivalent
Analyzes kinematics, dynamics and control of robot manipulators, and sensor and actuator technologies (including machine vision) relevant to robotics. Includes a robotics system design project in which students completely design a robotic system for a particular application and present it in class. Includes literature related to emerging technologies and Internet resources relevant to robotics.

ECE 541 – (3) (SI)
Optics and Lasers
Prerequisite: ECE 303, 309, 323
Reviews the electromagnetic principles of optics; Maxwell's equations; reflection and transmission of electromagnetic fields at dielectric interfaces; Gaussian beams; interference and diffraction; laser theory with illustrations chosen from atomic, gas and semiconductor laser systems; detectors including photomultipliers and semiconductor-based detectors; and noise theory and noise sources in optical detection.

ECE 556 – (3) (Y)
Microwave Engineering I
Prerequisite: ECE 309 or instructor permission.
Design and analysis of passive microwave circuits. Topics include transmission lines, electromagnetic field theory, waveguides, microwave network analysis and signal flow graphs, impedance matching and tuning, resonators, power dividers and directional couplers, and microwave filters.

ECE 564 – (3) (Y)
Microelectronic Integrated Circuit Fabrication
Prerequisite: ECE 303 or equivalent
Explores fabrication technologies for the manufacture of integrated circuits and icrosystems. Emphasizes processes used for monolithic silicon-based systems and basic technologies for compound material devices. Topics include crystal properties and growth, Miller indices, Czochralski growth, impurity diffusion, concentration profiles, silicon oxidation, oxide growth kinetics, local oxidation, ion implantation, crystal annealing, photolithography and pattern transfer, wet and dry etching processes,

anisotropic etches, plasma etching, reactive ion etching, plasma ashing, chemical vapor deposition and epitaxy; evaporation, sputtering, thin film evaluation, chemical-mechanical polishing, multilevel metal, device contacts, rapid thermal annealing, trench isolation, process integration, and wafer yield.

ECE 576 – (3) (Y)
Digital Signal Processing
Prerequisite: ECE 323 and 324, or equivalent.
The fundamentals of discrete-time signal processing are presented. Topics include discrete-time linear systems, continuous time signal sampling and reconstruction, Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT), Spectral analysis, Z-transform, FIR and IIR digital filter design, and digital filter implementations. Problem solving using MATLAB is required.

ECE 578 – (1.5) (Y)
Digital Signal Processing Laboratory
Prerequisite: ECE 323 and 324; *Corequisite:* ECE 576
This course provides hands-on exposure to real-time digital signal sampling (DSP) using general-purpose DSP processors. The laboratory sequence explores sampling/reconstruction, aliasing, quantization errors, fast Fourier transform, spectral analysis, and FIR/IIR digital filter design and implementation. Programming is primarily in C++, with exposure to assembly coding.

ECE 586/587 – (1-3) (SI)
Special Topics in Electrical and Computer Engineering
Prerequisite: Instructor permission.
A first-level graduate/advanced undergraduate course covering a topic not normally covered in the course offerings. The topic usually reflects new developments in the electrical and computer engineering field. Offering is based on student and faculty interests.

ECE 601 – (3) (SI)
Network Analysis and Synthesis
Prerequisite: ECE 204 and 324 or equivalent
Design with active and passive elements is introduced from an immittance realization standpoint. Initially, the course deepens the student's circuit theory to include general passive and active elements and their characterization and manipulation using matrix methods. Passive synthesis is then used as a foundation for active synthesis employing immittance-conversion devices. The course also introduces some of the software packages available for approximation, network function extraction, circuit synthesis and tolerance analysis. This material provides a good background for continuing studies in signal processing, communications, passive or active circuit design.

ECE 602 – (3) (SI)
Electronic Systems
Prerequisite: ECE 204/307 or equivalent
Explores frequency response and stability of feedback electronic circuits. Analysis and design of analog integrated circuits, such as operational amplifiers, multipliers, phase locked loops, A/D and D/A converters and their application to instrumentation, and control.

ECE 611 – (3) (Y)
Probability and Stochastic Processes
Prerequisite: APMA 310, MATH 310, or equivalent.
Topics include probability spaces (samples spaces, event spaces, probability measures); random variables and vectors (distribution functions, expectation, generating functions); and random sequences and processes; especially specification and classification. Includes detailed discussion of second-order stationary processes and Markov processes; inequalities, convergence, laws of large numbers, central limit theorem, ergodic, theorems; and MS estimation, Linear MS estimation, and the Orthogonality Principle.

ECE 613 – (3) (Y)
Communication Systems Engineering
Prerequisite: Undergraduate course in probability.
A first graduate course in principles of communications engineering. Topics include a brief review of random process theory, principles of optimum receiver design for discrete and continuous messages, matched filters and correlation receivers, signal design, error performance for various signal geometries, Mary signaling, linear and nonlinear analog modulation, and quantization. The course also treats aspects of system design such as propagation, link power calculations, noise models, RF components, and antennas.

ECE 614 – (3) (Y)
Estimation Theory
Prerequisite: ECE 611 or instructor permission.
Presents estimation theory from a discrete-time viewpoint. One-half of the course is devoted to parameter estimation, and the other half to state estimation using Kalman filtering. The presentation blends theory with applications and provides the fundamental properties of, and interrelationships among, basic estimation theory algorithms. Although the algorithms are presented as a neutral adjunct to signal processing, the material is also appropriate for students with interests in pattern recognition, communications, controls, and related engineering fields.

ECE 621 – (3) (Y)
Linear Automatic Control Systems
Prerequisite: ECE 323 or instructor permission.
Provides a working knowledge of the analysis and design of linear automatic control systems using classical methods. Introduces state space techniques; dynamic models of mechanical, electrical, hydraulic and other systems; transfer functions; block diagrams; stability of linear systems, and Nyquist criterion; frequency response methods of feedback systems design and Bode diagram; Root locus method; System design to satisfy specifications; PID controllers; compensation using Bode plots and the root locus. Powerful software is used for system design. Cross-listed as MAE 651

ECE 622 – (3) (Y)
Linear State Space Control Systems
Prerequisite: APMA 615, ECE 621, or instructor permission.
Studies linear dynamical systems emphasizing canonical representation and decomposition, state representation, controllability, observability, normal systems, state feedback and the decoupling problem. Representative physical examples. Cross-listed as MAE 652.

ECE 631 – (3) (Y)
Advanced Switching Theory
Prerequisite: ECE 230 or equivalent
Review of Boolean Algebra; synchronous and asynchronous machine synthesis; functional decomposition; fault location and detection; design for testability techniques.

ECE 632 – (3) (Y)
VLSI Design
Prerequisite: ECE 203, 204, 230 or equivalent. ECE 303, ECE 333 or equivalent is desirable.
Digital CMOS circuit design and analysis: combinational and sequential circuits, arithmetic structures, memories. Modern design issues: power, variation, leakage, optimization, clocking, and interconnect. Advanced VLSI topics. VLSI circuit design, simulation and layout. Semester-long research project.

ECE 634 – (3) (Y)
Fault-Tolerant Computing
Examines techniques for designing and analyzing dependable computer-based systems. Topics include fault models and effects, fault avoidance techniques, hardware redundancy, error detecting and correcting codes, time redundancy, software redundancy, combinatorial reliability modeling, Markov reliability modeling, availability modeling, maintainability modeling, safety modeling, trade-off analysis, design for testability, and the testing of redundant digital systems. Includes a research project and investigation of current topics. Cross listed as CS 634.

ECE 635 – (3) (Y)
Computer Organization and Design
Prerequisites by Topic: ECE 230 or equivalent, ECE 333 or equivalent, Assembly Language Programming
Integration of computer organization concepts such as data flow, instruction interpretation, memory systems, interfacing, and microprogramming with practical and systematic digital design methods such as behavioral versus structural descriptions, divide-and-conquer, hierarchical conceptual levels, trade-offs, iteration, and postponement of detail. Design exercises are accomplished using a hardware description language and simulation.

ECE 642 – (3) (Y)
Optics for Optoelectronics
Prerequisite: ECE 541 or instructor permission.
Covers the electromagnetic applications of Maxwell's equations in photonic devices such as the dielectric waveguide, fiber optic waveguide and Bragg optical scattering devices. Includes the discussion of the exchange of electromagnetic energy between adjacent guides, (i.e., mode coupling). Ends with an introduction to nonlinear optics. Examples of optical nonlinearity include second harmonic generation and soliton waves.

ECE 645 – (3) (Y)
Computer Graphics in Engineering Design
Prerequisite: Knowledge of C
Analyzes display devices, line and circle generators; clipping and windowing; data structures; 2-D picture transformations; hidden line and surface algorithm; shading algorithms; free form surfaces; color graphics; 3-D picture transformation. Cross-listed as CS 645.

ECE 652 – (1.5) (Y)
Microwave Engineering Laboratory
Corequisite: ECE 556 or instructor permission.
Explores measurement and behavior of high-frequency circuits and components. Equivalent circuit models for lumped elements. Measurement of standing waves, power, and frequency. Use of vector network analyzers and spectrum analyzers. Computer-aided design, fabrication, and characterization of microstrip circuits.

ECE 655 – (3) (O)
Microwave Engineering II
Prerequisite: ECE 556 or instructor permission.
Explores theory and design of active microwave circuits. Review of transmission line theory, impedance matching networks and scattering matrices. Transistor s-parameters, amplifier stability and gain, and low-noise amplifier design. Other topics include noise in two-port microwave networks, negative resistance oscillators, injection-locked oscillators, video detectors, and microwave mixers.

ECE 663 – (3) (Y)
Solid State Devices
Prerequisite: ECE 303 or equivalent, or solid state materials/physics course
Introduces semiconductor device operation based on energy bands and carrier statistics. Describes operation of p-n junctions and metal-semiconductor junctions. Extends this knowledge to descriptions of bipolar and field effect transistors, and other microelectronic devices. Related courses: ECE 564, 666, and 667.

ECE 666 – (1.5) (Y)
Microelectronic Integrated Circuit Fabrication Laboratory
Corequisite: ECE 564
Topics include the determination of semiconductor material parameters: crystal orientation, type, resistivity, layer thickness, and majority carrier concentration; silicon device fabrication and analysis techniques: thermal oxidation, oxide masking, solid state diffusion of intentional impurities, metal electrode evaporation, layer thickness determination by surface profiling and optical interferometer; MOS transistor design and fabrication using the above techniques, characterization, and verification of design models used.

ECE 667 – (3) (Y)
Semiconductor Materials and Devices
Prerequisite: some background in solid state materials and elementary quantum principles.
Examines the fundamentals, materials, and engineering properties of semiconductors; and the integration of semiconductors with other materials to make optoelectronic and microelectronic devices. Includes basic properties of electrons in solids; electronic, optical, thermal and mechanical properties of semiconductors; survey of available semiconductors and materials choice for device design; fundamental principles of important semiconductor devices; sub-micron engineering of semiconductors, metals, insulators and polymers for integrated circuit manufacturing; materials characterization techniques; and other electronic materials. Cross-listed as MSE 667.

ECE 671 – (3) (Y)
Pattern Recognition
Prerequisite: ECE 611 or equivalent
Studies feature extraction and classification concepts: analysis of decision surfaces, discriminant functions, potential functions, deterministic methods, automatic training of classifiers, analysis of training algorithms and classifier performance, statistical classification including optimality and design of optimal decision rules, clustering and non-supervised learning, feature selection and dimensionality reduction. Assignments include programming and analytical problem setsm and a final computer project.

ECE 673 – (3) (Y)
Analog Integrated Circuits
Prerequisite: ECE 303 and 307 or equivalent.
Design and analysis of analog integrated circuits. Topics include feedback amplifier analysis and design including stability, compensation, and offset-correction; layout and floor-planning issues associated with mixed-signal IC design; selected applications of analog circuits such as A/D and D/A converters, references, and comparators; and extensive use of CAD tools for design entry, simulation, and layout. Includes an analog integrated circuit design project.

ECE 682 – (3) (Y)
Digital Image Processing
Prerequisite: Graduate standing
Analyzes the basic concepts of image formation and image analysis: imaging geometries, sampling, filtering, edge detection, Hough transforms, region extraction and representation, extracting and modeling three-dimension objects. Students will be assigned analytical and programming assignments to explore these concepts. Cross-listed as CS 682.

ECE 686/687 – (3) (SI)
Special Topics in Electrical and Computer Engineering
Prerequisite: Instructor permission.
A first-level graduate course covering a topic not normally covered in the graduate course offerings. The topic will usually reflect new developments in the electrical and computer engineering field. Offering is based on student and faculty interests.

ECE 693 – (3) (S)
Independent Study
Detailed study of graduate course material on an independent basis under the guidance of a faculty member.

ECE 695 – (3-6) (S)
Supervised Project Research
Formal record of student commitment to project research under the guidance of a faculty advisor. A project report is required at the completion of each semester. May be repeated as necessary.

ECE 696 – (1) (Y)
Electrical and Computer Engineering Seminar
This one-hour weekly seminar course features presentations given by ECE faculty members, to introduce various research areas, topics, and advances in Electrical and Computer Engineering. It is a one-credit course required for all first-year ECE graduate students.

ECE 712 – (3) (Y)
Digital Communications
Prerequisite: ECE 611
An in-depth treatment of digital communications techniques and performance. Topics include performance of uncoded systems such as Mary, PSK, FSK, and multi-level signaling; orthogonal and bi-orthogonal codes; block and convolutional coding with algebraic and maximum likelihood decoding; burst correcting codes; efficiency and bandwidth; synchronization for carrier reference and bit timing; baseband signaling techniques; intersymbol interference; and equalization.

ECE 715 – (3) (O)
Performance Analysis of Communication Networks
Prerequisite: ECE 611 or instructor permission.
Analyzes topologies arising in communication networks; queuing theory; Markov Chains and ergodicity conditions; theory of regenerative processes; routing algorithms; multiple-access and random-access transmission algorithms; mathematical methodologies for throughput and delay analyses and evaluations; performance evaluation; performance monitoring; local area networks (LANs); interactive LANs; multimedia and ATM networks. Cross-listed as CS 715.

ECE 717 – (3) (Y)
Information Theory and Coding
Prerequisite: ECE 611 or instructor permission.
A comprehensive treatment of information theory and its application to channel coding and source coding. Topics include the nature of information and its mathematical description for discrete and continuous sources; noiseless coding for a discrete source; channel capacity and channel coding theorems of Shannon; error correcting codes; introduction to rate distortion theory and practice of data compression; information and statistical measures.

ECE 722 – (3) (SI)
Robotics
Prerequisite: ECE 525, 621 or instructor permission.
Analyzes kinematics of manipulator robots in terms of homogeneous matrices, solution of the kinematics equations; differential translations and rotations, the Jacobian and the inverse Jacobian; manipulator path control; manipulator dynamics, the Lagrange's and Newton's formulations; manipulator control; principles of machine vision applied to robots, sensors, edge and feature detection, object location and recognition; stereo vision and ranging; programming of robot tasks.

ECE 723 – (3) (O)
Optimal Control Systems
Prerequisite: ECE 622 or instructor permission.
Analyzes the development and utilization of Pontryagin's maximum principle, the calculus of variations, Hamilton-Jacobi theory and dynamic programming in solving optimal control problems; performance criteria including time, fuel, and energy; optimal regulators and trackers for quadratic cost index designed via the Ricatti equation; introduction to numerical optimization techniques. Cross-listed as MAE 753.

ECE 725 – (3) (SI)
Multivariable Robust Control Systems
Prerequisite: ECE 622 or equivalent, or instructor permission.
Studies advanced topics in modern multivariable control theory; matrix fraction descriptions, state-space realizations, multivariable poles and zeroes; operator norms, singular value analysis; representation of unstructured and structured uncertainty, linear fractional transformation, stability robustness and performance robustness, parametrization of stabilizing controllers; approaches to controller synthesis; H_2-optimal control and loop transfer recovery; H_2-optimal control and state-space solution methods. Cross-listed as MAE 755.

ECE 726 – (3) (O)
Nonlinear Control Systems
Prerequisite: ECE 621 and 622
Studies the dynamic response of nonlinear systems; analyzes nonlinear systems using approximate analytical methods; stability analysis using the second method of Liapunov, describing functions, and other methods. May include adaptive, neural, and switched systems. Cross-listed as MAE 756.

ECE 728 – (3) (E)
Digital Control Systems
Prerequisite: ECE 412 and 621, APMA 615, or equivalent
Includes sampling processes and theorems, z-transforms, modified transforms, transfer functions, and stability criteria; analysis in frequency and time domains; discrete state models of systems containing digital computers. Some in-class experiments using small computers to control dynamic processes. Cross-listed as MAE 758.

ECE 735 – (3) (Y)
Digital and Computer System Design
Prerequisite: ECE 435 or equivalent
Studies the design of the elements of special purpose and large scale digital processors using a hardware description language. Selected topics from the literature.

ECE 736 – (3) (Y)
Advanced VLSI Systems Design
Prerequisite: ECE 563 or instructor permission.
Includes structured VLSI design, special purpose VLSI architectures, and algorithms for VLSI computer-aided design. A major part of the class is devoted to the design and implementation of a large project. Uses papers from current literature as appropriate.

ECE 738 – (3) (Y)
Computer System Reliability Engineering
A mathematical introduction to system reliability theory, emphasizing the analysis of digital computer systems. Includes time-to-failure models and distributions, fault tree analysis, Markov models and counting processes, failure and repair dependencies, sensitivity and importance analysis, hardware and software redundancy management, and dependability measurement.

ECE 741 – (3) (SI)
Fourier Optics
Prerequisite: ECE 324 and 541 or instructor permission.
Presents the fundamental principles of optical signal processing. Begins with an introduction to two-dimensional spatial, linear systems analysis using Fourier techniques. Includes scalar diffraction theory, Fourier transforming and imaging properties of lenses and the theory optical coherence. Applications of Wavefront-reconstruction techniques in imaging. Applications of Fourier Optics to analog optical computing.

ECE 753 – (3) (O)
Electromagnetic Field Theory
Prerequisite: ECE 409 or instructor permission.
Topics include techniques for solving and analyzing engineering electromagnetic systems; relation of fundamental concepts of electromagnetic field theory and circuit theory, including duality, equivalence principles, reciprocity, and Green's functions; applications of electromagnetic principles to antennas, waveguide discontinuities, and equivalent impedance calculations.

ECE 757 – (3) (Y)
Computer Networks
Prerequisite: CS 656 or instructor permission.
Analyzes network topologies; backbone design; performance and queuing theory; data-grams and virtual circuits; technology issues; layered architectures; standards; survey of commercial networks, local area networks, and contention-based communication protocols; encryption; and security. Cross-listed as CS 757.

ECE 763 – (3) (Y)
Physics of Semiconductors
Prerequisite: ECE 663 or instructor permission.
Analyzes semiconductor band theory; constant energy surfaces and effective mass concepts; statistics treating normal and degenerate materials; spin degeneracy in impurities; excited impurity states and impurity recombination; carrier transport; scattering mechanisms; and prediction techniques.

ECE 768 – (3) (Y)
Semiconductor Materials and Characterization Techniques
Prerequisite: ECE 663 or instructor permission.
Analyzes semiconductor growth and characterization methods applicable to III-V heteroepitaxial growth along with etching and contact formation mechanisms; and the physical, structural, and electrical characterization tools including X-ray diffraction, Auger, Hall and C(V).

ECE 774 – (3) (E)
Adaptive and Statistical Signal Processing
Prerequisite: ECE 611, 576, or equivalent; *corequisite*: ECE 614
Topics include a review of probability and stochastic processes, parametric and non-parametric spectral estimation, optimal filtering, linear prediction, methods of steepest descent, LMS filters, methods of least squares, RLS filters, Kalman filters, and arry signal processing techniques.

ECE 776 – (3) (O)
Multi-Dimensional Signal Processing
Prerequisite: ECE 576 or instructor permission.
Provides the background of multi-dimensional digital signal processing, emphasizing the differences and similarities between the one-dimensional and multi-dimensional cases. Includes M-D Fourier transforms, M-D sampling and reconstruction, M-D DFT, M-D filtering, M-D spectral estimation, and inverse problems such as tomography, iterative signal reconstruction, and coherent imaging. Broad applications in radar, sonar, seismic, medical, and astronomical data processing are introduced.

ECE 782 – (3) (Y)
Advanced Computer Vision
Prerequisite: ECE 682
Studies automated reconstruction of imaged objects and computer interpretation of imaged scenes; techniques for three-dimensional object reconstruction; computing motion parameters from sequences of images; computational frameworks for vision tasks such as regularization, and stochastic relaxation; approaches for autonomous navigation; depth image analysis; novel imaging techniques and applications; parallel architectures for computer vision. Cross-listed as CS 782.

ECE 786/787 – (3) (SI)
Special Topics in Electrical and Computer Engineering
Prerequisite: Instructor permission.
A second-level graduate course covering a topic not normally covered in the graduate course offerings. Topics usually reflect new developments in electrical and computer engineering and are based on student and faculty interests.

ECE 793 – (3) (S)
Independent Study
Detailed study of graduate course material on an independent basis under the guidance of a faculty member.

ECE 814 – (3) (SI)
Advanced Detection and Estimation
Prerequisite: ECE 611 or instructor permission.
Analyzes classical detection theory and hypothesis testing (Bayes, Neymon-Pearson, minimax); robust hypothesis testing; decision criteria; sequential and nonparametric detection; classical estimation theory (Bayes, minimax, maximum likelihood); performance bounds; robust-outlier resistant estimation of location parameters; stochastic distance measures; parametric and robust operations in time series (Prediction, interpolation, filtering). Applications to problems in communications, control, pattern recognition, signal processing.

ECE 815 – (3) (SI)
Special Topics in Communications
Prerequisite: Instructor permission.
A variable content course addressing specific areas of interest to students. Possible course topics include optical communication; computer networks, satellite communications systems; phase lock loop theory; advanced signal processing devices; advanced stochastic processes and martingale theory; advanced detection; and estimation theory.

ECE 825 – (3) (SI)
Adaptive Control
Prerequisite: ECE 621 and 622, or instructor permission.
Analyzes parametrized control system models, signal norms, Lyapunov stability, passivity, error models, gradient and least squares algorithms for parameter estimation, adaptive observers, direct adaptive control, indirect adaptive control, certainty equivalence principle, multivariable adaptive control, stability theory of adaptive control, and applications to robot control systems.

ECE 828 – (3) (SI)
Advanced Topics in Control Theory
A seminar examining current papers from the literature on recent developments in control. Topics covered depend on teacher and student interest.

ECE 838/839 – (3) (SI)
Advanced Topics in Digital Systems
Prerequisite: Instructor permission.
A variable content course addressing specific areas of current interest and importance, and focusing on the current literature. Possible topics include computer architecture, computer system design, advanced switching theory, design automation, test technology, fault tolerant computing, and VLSI.

ECE 862 – (3) (SI)
High Speed Transistors
Prerequisite: ECE 663 or 768 or instructor permission.
Includes the principles of operation, device physics, basic technology, and modeling of high-speed transistors. A brief review of material properties of most important compound semiconductors and heterostructure systems, followed by the discussion of high speed Bipolar Junction Transistor technology, Heterojuction Bipolar Transistors, and Tunneling Emitter Bipolar Transistors and by the theory and a comparative study of MESFETs, HFETs, and Variable-Threshold and Split-gate Field Effect Transistors. Also includes advanced transistor concepts based on ballistic and hot electron transport in semiconductors such as Ballistic Injection Transistors and Real Space Transfer Transistors (RSTs) concepts.

ECE 863 – (3) (SI)
High Frequency Diodes
Prerequisite: ECE 556, 663, or instructor permission.
Lectures on the basic two terminal solid state devices that are still extensively used in high frequency microwave and millimeter-wave detector and oscillator circuits. Devices discussed are PIN Diode limiters and phase shifters; Schottky Diode mixers and varactors; Planar-Doped Barrier and Heterostructure Barrier mixer diodes; Superconducting-Insulating- Superconducting mixer devices; Metal-Semiconductor-Metal photodetectors; Transferred Electron Devices; IMPATT Diodes; and Resonant Tunelling Diodes. Basic concepts related to Noise in high frequency circuits, Mixers, Resonators, and Oscillators are reviewed. Emphasis on basic device theory, and device fabrication.

ECE 868 – (3) (SI)
Special Topics in Semiconductor Materials and Devices
Prerequisite: Instructor permission.
A seminar with topics chosen from the current literature according to student interest. May include hot electron transport effects, degradation mechanisms in semiconductors, methods of manufacture, applications and limitations of very large scale integrated circuits (VLSI), device modeling, novel measurement techniques, submicrometer lithography, and high field breakdown.

ECE 886/887 – (3) (SI)
Special Topics in Electrical and Computer Engineering
Prerequisite: Instructor permission.
A third-level graduate course covering a topic not normally covered in the graduate course offerings. The topic will usually reflect new developments in the electrical and computer engineering field. Offering is based on student and faculty interests.

ECE 895 – (3-6) (S)
Supervised Project Research
Formal record of student commitment to project research under the guidance of a faculty advisor. Registration may be repeated as necessary.

ECE 897 – (Credit as arranged) (S)
Graduate Teaching Instruction
For master's students.

ECE 898 – (Credit as arranged) (S)
Thesis
Formal record of student commitment to master's thesis research under the guidance of a faculty advisor. Registration may be repeated as necessary.

ECE 996 - (3) (S)
Supervised Graduate Teaching Experience
For doctoral students.

ECE 997 – (Credit as arranged) (S)
Graduate Teaching Instruction
For doctoral students.

ECE 999 – (Credit as arranged) (S)
Dissertation
Formal record of student commitment to doctoral research under the guidance of a faculty advisor. May be repeated as necessary.

Faculty Modifier Numbers

Instructor Numbers for the Electrical & Computer Engineering Department

1596	ACTON, S.
6042	AYLOR, J.
3894	BARKER, N. S.
6734	BEAN, J.
A480	BERGER, T.
8134	BLALOCK, T.
4075	BRADLEY, R.
4032	BRANDT-PEARCE, M.
C071	CALHOUN, B.
C081	CAMPBELL, J.
3436	CROWE, T.
4022	DUGAN, J.
3554	GELMONT, B.
B665	GHOSH, A.
1794	GIRAS, T.
4465	GLOBUS, T.
B479	GUPTA, M.
1618	HARRIOTT, L.
8034	HESLER, J.
2215	JOHNSON, B.
C933	HOLMES, A.
1619	LACH, J.
0284	LICHTENBERGER, A.
7424	LIN, Z.
4079	MARSHALL, P.
7426	REED, M.
9613	SILVERSTEIN, S.
6414	STAN, M.
B087	SWAMI, N.
1935	TAO, G.
A280	VEERARAGHAVAN, M.
2783	WEIKLE, R.
2940	WILLIAMS, R.
3438	WILSON, S.

Appendix II

Faculty Areas of Interest

SCOTT ACTON ***Professor and Director, VIVA*** ***acton@virginia.edu***	Signal, Image and Video Processing
JAMES H. AYLOR ***Louis T. Rader Professor and Dean, SEAS*** ***jha@virginia.edu***	Design Automation; Digital Systems; VLSI Systems; Test Technology
N. SCOTT BARKER ***Assistant Professor*** ***barker@virginia.edu***	Application of Microelectromechanical Systems (MEMS) to Microwave and Millimeter Wave Circuits
JOHN C. BEAN ***John Marshall Money Professor*** ***john-bean@virginia.edu***	Molecular Beam Epitaxy; Novel Electronic Materials
TOBY BERGER ***Professor*** ***tb6n@virginia.edu***	Information Theory; Random Fields; Communication Networks; Video Compression; Signature Verification; Coherent Signal Processing
TRAVIS BLALOCK ***Associate Professor*** ***tblalock@virginia.edu***	Mixed-Signal CMOS VLSI Design; Analog CMOS Signal Processing Design; Silicon Backplane Microdisplays
RICHARD BRADLEY (NRAO) ***Visiting Research Assistant Professor*** ***rbradley@virginia.edu***	Microwave and Millimeter Wave Semiconductor Devices and Integrated Circuitry; Radio Astronomy Instrumentation
MAITE BRANDT-PEARCE ***Associate Professor*** ***mb-p@virginia.edu***	Communications Theory; Optical Communications; Detection
BEN CALHOUN ***Assistant Professor*** ***bcalhoun@virginia.edu***	Integrated Circuits and Systems
JOE CAMPBELL ***Lucien Carr III Professor*** ***jccuva@virginia.edu***	Si-Based Optoelectronics; High Speed, Low Noise Avalanche Photodiodes; GaN Ultraviolet Photodectors; Quantum-Dot IR Imaging
TOM W. CROWE ***Visiting Research Professor*** ***twc8u@virginia.edu***	High Frequency Solid-State Devices; Novel Solid-State Devices; Terahertz Sources and Receivers
JOANNE BECHTA DUGAN ***Professor and Director, Computer Engineering*** ***j.b.dugan@ieee.org***	Reliability Analysis of Hardware and Software Fault Tolerant Computer Systems; Dynamic Fault Tree Models; Markov Models; Simulation
BORIS GELMONT ***Research Associate Professor*** ***gb7k@virginia.edu***	Semiconductor Device Physics; Device Modeling
AVIK GHOSH ***Assistant Professor*** ***ag7rq@virginia.edu***	Nanoscale Transport; Nanoscale Optics; Atomistic Theory of Electronic Conduction
TATIANA GLOBUS ***Research Associate Professor*** ***tg9a@virginia.edu***	Characterization and Optimization of Electronic and Photonic Materials and Devices
MOOL C. GUPTA ***Langley Professor*** ***mgupta@virginia.edu***	Photonics; Advanced Sensors
LLOYD R. HARRIOTT ***VA Microelectronics Consortium Professor and Department Chair*** ***lrharriott@virginia.edu***	Microelectronics: Lithography; Nanofabrication Nanostructures; Electron and Ion Beam Induced Processes

Faculty Areas of Interest (continued)

JEFFREY HESLER ***Visiting Research Assistant Professor*** ***jlh6r@virginia.edu***	Microwave Devices; Millimeter and Submillimeter Wave Devices; Circuits Devices
ARCHIE HOLMES, JR. ***Professor*** ***archieholmes@virginia.edu***	The crystal growth of III-V semiconductors and the design and fabrication of electronic and optoelectronics devices.
BARRY JOHNSON ***Professor and Sr. Associate Dean, SEAS*** ***bwj@virginia.edu***	Fault Tolerant Systems; VLSI Testing; VLSI Systems
JOHN LACH ***Associate Professor*** ***jlach@virginia.edu***	Embedded (esp. Real-Time) Systems: Integrated Circuitry (IC); Computer-Aided Design (CAD) Algorithms; Field Programmable Gate Arrays (FPGA's); Processor Architecture; Low Power Design
ARTHUR LICHTENBERGER ***Research Associate Professor*** ***ArthurW@virginia.edu***	Superconducting Materials and Devices
ZONGLI LIN ***Professor*** ***zl5y@virginia.edu***	Nonlinear Control Theory; Control of Systems Subject to Actuator Saturation; Robust Control Theory; Computer-Aided Control System Design; Control Applications
P. PAXTON MARSHALL ***Professor and Undergraduate Dean, SEAS*** ***ppm5y@virginia.edu***	Electric Power and Machinery; Power Electronics; Energy Conversion; Renewable Energy
MICHAEL L. REED ***Professor*** ***reed@virginia.edu***	Microsystems; Microfabrication Technology
SETH SILVERSTEIN ***Research Professor*** ***silverstein@virginia.edu***	Statistical and Array Signal Processing; Wireless/Satellite Communications; Radar Systems; Phased Array Calibration and Beam Pattern Control Systems; Coherent Imaging (Optical, Microwave, Medical Ultrasound, Seismic Imaging)
MIRCEA STAN ***Associate Professor*** ***mircea@virginia.edu***	Low-Power VLSI, FPGAs and Reconfigurable Computing; Hardware Software Codesign; Analog and Systems Digital VLSI
NATHAN SWAMI ***Assistant Professor and Graduate Program Director*** ***nathanswami@virginia.edu***	Molecular Devices: Electronics; Sensing and Manipulation of Molecules
GANG TAO ***Professor*** ***gt9s@virginia.edu***	Adaptive Control; Nonlinear Systems; Control Applications; Multivariable Control Systems; Robust Adaptive Systems; Robotics
MALATHI VEERARAGHAVAN ***Associate Professor*** ***mv5g@virginia.edu***	Data Networks; Optical and Wireless Networks; Network System Architectures
ROBERT WEIKLE ***Associate Professor*** ***rmw5w@virginia.edu***	Microwave and Millimeter Wave Circuits and Radiating Structures
RONALD WILLIAMS ***Associate Professor*** ***rdw@virginia.edu***	Computer Design; Real-Time Systems; VLSI Design and Testing
STEPHEN G. WILSON ***Professor and Associate Department Chair*** ***sgw@virginia.edu***	Communications and Information Theory