

ROCHESTER INSTITUTE OF TECHNOLOGY  
ELECTRICAL ENGINEERING DEPARTMENT

**GRADUATE STUDY**

**MASTER OF SCIENCE DEGREE  
IN ELECTRICAL ENGINEERING**

2008~2009

*"Lighting the Way to a Bright Future"*

Rochester Institute of Technology, Rochester, NY 14623

# Master of Science Degree in Electrical Engineering

Advanced education is the best way to keep up with advanced technology. That's why a master's degree is such a valuable advantage to an engineer's career. It's also why RIT offers a full range of graduate programs in engineering.

The Department of Electrical Engineering encourages practicing engineers in the greater Rochester and Buffalo industrial community to pursue the Master of Science degree. Since many of the courses in the graduate programs in engineering are scheduled in the late afternoons or early evenings, the master's program can be pursued without interruption of the student's work assignment at their place of employment.

Students employed full-time in industry can register for two courses or eight credits each quarter. A student who wishes to register for more than eight credits while employed full-time in industry must obtain the permission of his or her advisor and the approval of the department head. It is possible for a student to obtain the MS degree in two academic years (or six academic quarters) by taking courses in late afternoons or early evening only.

In order to enable the practicing engineer to take graduate courses with the minimum amount of inconvenience, courses for RIT credit can be offered in selected industrial locations, provided there is sufficient demand.

The Electrical Engineering Department offers experienced faculty and excellent facilities.

*For additional information contact:*

Department of Electrical Engineering  
Rochester Institute of Technology  
Rochester, NY 14623  
Phone (585) 475-2164

Dr. Sohail Dianat, Chair, Graduate Program  
Phone (585) 475-2164

## **Steps Towards Earning Your Master Degree in Electrical Engineering**

- Contact the EE department for information regarding the Masters program
- Contact Patti Vicari in the EE department at 585/475-2164 if you have any questions
- Complete the graduate application and submit it to the admissions office at the Institute
- Decide on your focus area
- Register for your first quarter
- After completing approximately 12 credits, begin to consider a topic for your graduate paper or thesis
- While completing your remaining 24 to 28 credits, continue to develop your paper or thesis idea and discuss your thoughts with the advisor of your choice from the EE department
- Register for your graduate paper or thesis.
- When you register, make sure that you register depending upon your ability to complete your thesis or paper. There is a five credit minimum for registration of a graduate paper, so you may register for the paper in increments of two and three, one at a time, or all five at once. Registering for all five credits at once means that you will be charged for the total amount of credits and have only three quarters to complete your paper. However, if you register one credit at a time, you will be charged one credit a quarter and will have seven to fourteen quarters to finish your work. The same can be said for the thesis option, which requires a minimum of 9 credit hours. However, most students register for nine credits for the thesis option.
- Once you have registered for your graduate paper or thesis, you must KEEP REGISTERING for the paper and thesis for as long as your work is still in progress. This allows you to stay in the system. You are allowed one free quarter in which to complete your paper or thesis AFTER you have registered for all five or nine credits respectively. For example, if you are completing a graduate paper, and you have already registered for all five credits, you must then register for **Completion of Graduate Paper (0301-800-99)** for one credit. You will be allowed one free credit the following quarter of which you will not be charged. After that, you will be charged for one credit until you complete your thesis or paper. Summer quarters are free as well.
- During the quarter prior to the one you intend to graduate in, complete an application for graduation and turn it in to the EE department.
- Following completion of your graduate paper or thesis, retain the required approval and turn in the necessary copies to the EE department.
- Following completion of your coursework and graduate paper or thesis, please stop into the EE office so we may say good-bye and wish you well!

## GENERAL INFORMATION

**Admission Requirements** Admission into the graduate studies leading to an MS degree in electrical engineering requires a BSEE degree from an accredited program. An applicant with a strong undergraduate record and a Bachelor of Science degree in another branch of engineering (mechanical, computer, industrial, etc) will also be considered for admission. In this case the student must complete a certain number of undergraduate courses in order to bridge over to electrical engineering. Additional information in this regard is available from the department.

**Graduation** The Master of Science degree in electrical engineering is awarded upon the successful completion of an approved graduate program consisting of a minimum of 45 credit hours. Under certain circumstances a student chooses or is required to complete more than the minimum number of credits.

**Focus Areas** Within electrical engineering, a student can specialize in six separate areas for the MS degree. **These areas are:**

- Control Systems
- Communications
- Digital Systems
- Integrated Electronics
- Signal & Image Processing
- MEMS

The boundaries between some of the areas are not as sharp or pronounced as they were in the past. Therefore, students are urged to discuss the significance of their choices with graduate advisors in the department.

**Plan of Study** Every matriculated student must arrange to have a Plan of Study prepared in consultation with the student's advisor *at the beginning of the program*.

### **Policies**

The following general rules apply to all students:

1. All students seeking the MSEE degree must satisfactorily complete one core course, 0301-703: Matrix Methods in EE. Students will be expected to take the required core courses immediately after entering the program since these courses are prerequisites for many of the other graduate courses.
2. Those students who have selected the focus areas in Control Systems, Communications, Signal & Image Processing, and MEMS must also take 0301-702: Random Signals and Noise. Students who want to develop a minor in any of the above areas are also encouraged to take Random Signals and Noise.
3. Each student must take four courses from the EE department in their chosen focus area. The student is expected to perform the research needed for a graduate paper or thesis in the same area.
4. Each student must take three courses from a related area within the EE department.

5. The academic student advisor must approve all course selections. All courses must be 700-level or above with one exception: a student is allowed to take a maximum of two 600-level courses for full credit in the graduate program.
6. All student must satisfy a research component by one of the following activities:
  - Graduate Thesis (9 credit hours)
  - Graduate Research Paper (5 credit hours)
7. All the graduate work must be completed within a seven-year period starting from the first course applied towards the MSEE degree. Also, a student who is pursuing the thesis/graduate paper options may be required to register for a continuation of thesis credits if he or she is not enrolled for any credits in a given quarter. For complete details, please consult the Continuation of Thesis Credit requirements discussed in the beginning section of the RIT Graduate Catalog.

**Transfer Credits**

A maximum of 8 credit hours can be earned from courses available from other departments within RIT with the prior approval of the faculty/department advisor. For students transferring credits from other universities, the total number of credits transferred from outside the Electrical Engineering Department from all sources may not exceed eight.

**Graduate Student Advising**

All new students will be assigned a graduate advisor. The student generates a plan of study in consultation with his or her faculty advisor. That Faculty member will continue to be the student's advisor until a research topic has been chosen. From that time, The Thesis/Paper advisor assumes the role of academic advisor as well.

**Graduate Teaching Assistant**

The EE Department offers teaching assistantships to limited number of students during student's first academic year of study. Subsequently, however, students are encouraged to seek support as research assistants (RA) with one of the research faculty. Full time graduate teaching assistant (TA) are awarded to limited number of outstanding incoming first year graduate students.

**Good Academic Standing**

A 3.0 GPA or higher is required to graduate. All graduate courses taken after matriculating into an MS program at RIT are counted toward your grade-point average (GPA). To be in good academic standing, a graduate student at RIT must maintain a cumulative GPA of 3.0/4.0 or better throughout program of study. Students would be placed on probation if the cumulative GPA falls below 3.0. If this continues for another quarter, students will be suspended from the program. RIT institute policy states "'D' or 'F' grades do not count toward the fulfillment of the program requirements for a graduate degree." However, they are calculated in your GPA.

Schedule of Graduate Courses (700- and 800-levels)

**Scheduled Course Offerings for 2008-2009**

	Fall 2008-1	Winter 2008-2	Spring 2008-3
<b>Core Courses</b> <sup>(1)</sup>	0301-702 Random Signal and Noise 0301-703 Matrix Methods in EE	0301-702 Random Signal and Noise 0301-703 Matrix Methods in EE	
<b>Focus Area</b>			
<b>Communication</b>	0301-693 Digital Data Communication 0301-729 Antenna Theory and Design.	0301-717 Microwave Circuit Design 0301-794 Information Theory	0301-710 Advanced Electromagnetic Theory <sup>(2)</sup> 0301-802 Wireless Communication 0301-816 Design & Charac Micro Sys
<b>Control Systems</b>	0301-769 Fuzzy Logic & Applications	0301-761 Modern Control Theory 0301-815 Multivariable Modeling	0301-733 Robust Control <sup>(2)</sup> 0301-765 Optimal Control
<b>Signal &amp; Image Processing</b>	0301-887 Digital Signal Processing	0301-768 Adaptive Signal Processing 0301-779 Digital Image Processing	0301-749 Speech & Image Compression 0301-770 Pattern Recognition <sup>(2)</sup> 0301-803 Digital Video Processing
<b>Integrated Electronics</b>	0301-713 Solid State Physics 0301-821 High Performance Semiconductor Devices	0301-712 Advanced Field Effect Devices 0301-726 Mixed Signal IC Design	0301-711 Advanced Carrier Inj Transtr 0301-730 Advanced Analog IC Design
<b>Digital Systems</b>	0301-650 Design of Digital System 0301-651 Physical Implementation	0301-732 Advanced Topics in Digital System Design	0301-741 Design for Testability 0301-810 Advanced Computer Architecture
<b>MEMS</b>	0301-789 Fundamentals of MEMS <sup>(2)</sup> 0301-799 Nano & Microengineering <sup>(2)</sup>		0301-798 Microfluidic MEMS 0301-804 MEMS Evaluation

- 0301-703 Matrix Methods in EE is a required course for all focus areas  
0301-702 Random Signal and Noise is a required course for Communication, Control and Signal& Image processing focus areas.
- Offered every other year.

## Scheduled Course Offering for 2009-2010

	Fall 2009-1	Winter 2009-2	Spring 2009-3
<b>Core Courses</b> <sup>(1)</sup>	0301-702 Random Signal and Noise 0301-703 Matrix Methods in EE	0301-702 Random Signal and Noise 0301-703 Matrix Methods in EE	
<b>Focus Area</b>			
<b>Communication</b>	0301-693 Digital Data Communication. 0301-729 Antenna Theory and Design	0301-717 Microwave Circuit Design 0301-794 Information Theory	0301-710 Advanced Electromagnetic Theory 0301-802 Wireless Communication 0301-816 Design & Charac Micro Sys
<b>Control Systems</b>	0301-769 Fuzzy Logic & Applications	0301-761 Modern Control Theory 0301-815 Multivariable Modeling	0301-733 Robust Control <sup>(2)</sup> 0301-765 Optimal Control
<b>Signal &amp; Image Processing</b>	0301-887 Digital Signal Processing	0301-768 Adaptive Signal Processing 0301-779 Digital Image Processing	0301-749 Speech & Image Compression 0301-770 Pattern Recognition <sup>(2)</sup> 0301-803 Digital Video Processing
<b>Integrated Electronics</b>	0301-713 Solid State Physics 0301-821 High Performance Semiconductor Devices	0301-712 Advanced Field Effect Devices 0301-726 Mixed Signal IC Design	0301-711 Advanced Carrier Inj Transtr 0301-730 Advanced Analog IC Design
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<b>MEMS</b>	0301-789 Fundamentals of MEMS <sup>(2)</sup> 0301-799 Nano & Microengineering <sup>(2)</sup>		0301-798 Microfluidic MEMS 0301-804 MEMS Evaluation

1. EEEE-703 Matrix Methods in EE is a required course for all focus areas  
EEEE-702 Random Signal and Noise is a required course for Communication, Control and Signal& Image processing focus areas.
2. Offered every other year.

### Summer Quarter

*A selected number of 700-level courses and 600-level courses will be available during the summer quarter.  
Consult the department for details.*

0301-610	Analog Electronic design	0301-664	Embedded Microcontroller Systems
0301-615	State Space Control	0301-677	Digital Filters & Signal Processing
0301-621	Microwave Engineering	0301-679	Analog Filter Design
0301-650	Design of Digital System	0301-685	Principle of Robotics
0301-651	Physical Implementation	0301-686	Microelectromechanical Devices
0301-655	Microcomputer Software I	0301-692	Communication Networks
0301-662	Neural Networks	0301-693	Digital Data Communication

*Additional courses may be developed and offered periodically.  
Course offerings are subject to minimum enrollment requirements.*

## Graduate Paper & Thesis Policies and Procedure

### INTRODUCTION

In order to obtain an MSEE degree all students must complete a Graduate Paper or a Graduate Thesis. Of the minimum 45 credit hours needed to earn the degree, a typical student earns 36 to 40 credit hours from course work and the remaining credit hours from the Paper or Thesis.

Thesis and Graduate Paper credits do not affect the GPA. A grade of 'R' is given upon registration. At completion, the advisor approves the paper with his or her signature.

The Graduate Paper mandates a minimum of 5 credits while the Thesis credit amount to 9. You may register for these all at once or by increments of 1 credit.

NOTE: If you register for your Paper or Thesis one credit at a time, you will only be charged for one credit for five to twelve quarters, thus allowing you seven to fourteen quarters to complete your Paper or Thesis. If you register for the total amount of credits all at once, you will be charged for the total amount of credits and will have only 3 quarters to complete the Paper or Thesis. After you register for the five credits allotted for the graduate paper, you are allowed 1 free quarter in which you can register for 0301-899: Continuation of Graduate Paper. You register for 1 or 0 credit hours. After this free quarter, if you are still not done with your paper, you must register for 0301-899: Continuation of Graduate Paper for 1 or 0 credit hours. You will be charged for one credit hour. You are not charged for summer quarters. Always register for 0301-899: Continuation of Graduate Paper after you have already registered for your five credits and have not completed your paper. This is to ensure that you stay in the system.

### OBJECTIVES

The purpose of both the paper and thesis is identical: to allow the student independent research experience in electrical engineering. Topics selected for these activities could include:

- Theoretical development,
- Simulation,
- Design and fabrication of circuits or systems and
- Software development.

### PROCEDURES

#### When to Start?

The most advantageous time to start thinking about the research work is when you have completed about two thirds of the course work.

### **How to Get Started?**

If you have a topic that you would like to explore, please give the office a call. We will match you with a professor who has similar interests.

Before approaching the professor, prepare a one to two page summary of your ideas. This can be presented to the professor.

Upon mutual agreement on the topic and the scope of your work, the professor becomes your advisor. If you do not have a firm idea about a topic, please call us; we will be able to arrange a professor to talk to you. The professor may have a research topic that you could be interested in.

### **REGISTRATION**

If you are registering for a Graduate Paper, register for course 0301-800, Section 1, the same way you would register for a course.

If you are registering for a Thesis, register for 0301-890 Section 1.

If your work is not completed by the end of the quarter for which you registered for your final credit, you have one “free” quarter to finish during which you do not need to register for any credits. If your work is not completed at the end of this quarter, you are required to register for a continuation of Thesis/Graduate Paper, course 0301-800 section 99 (Paper) or course 0301-890 section 99 (Thesis). You will be charged tuition for one credit hour.

Once your work has been completed and your Thesis/Paper is approved and accepted, the EE department will certify you for graduation internally, provided all other graduate requirements have been met.

### **GRADUATE PAPER**

The Graduate Paper differs from the Thesis mostly in formatting requirements. However, a Paper, unlike a Thesis, need not be approved by a faculty committee; the Advisor alone approves or disapproves the paper. The final document need not be leather bound, but should have a soft binding. A copy is not kept in the library.

You must work out a plan for frequent interactions and consultations with your advisor during the course of the research. A document generated without such consultation faces almost certain rejection.

### **What Are The Formalities?**

The Graduate Paper is complete when your advisor approves it. He or she may ask you to give a presentation before faculty and students or may simply accept the written document. The final copy must also be signed by the Department Head.

### **Format for Graduate Paper**

You must write a final report describing your research work. It must be printed double-spaced on one side of a standard 8-1/2 x 11 sheet of paper. You are encouraged to bind the document. (Comb Binding is available at the Hub Crossroads).

### **How Many Copies?**

One copy of the final document, signed by your advisor and department head, must be submitted to the Electrical Engineering office.

**You and your advisor should each have a copy.**

Thus, the minimum number of copies is three though your supervisor at work or colleagues may want a copy as well.

## **THESIS**

### **Filing of Subject**

The candidate must select the subject of the Thesis in consultation with a faculty member who agrees to act as the Thesis advisor. The candidate must report the subject of the Thesis and the name of his advisor to the graduate-committee chairman.

### **Style Format for the Thesis**

1. The default style format for your thesis is the [\*Chicago Manual of Style\*](#). Your thesis must meet the minimum requirements for correct sentence structure, spelling, punctuation and technical accuracy.
2. The Library requests that you leave a margin of 1 inch on all sides of the paper to accommodate the bindery process.
3. The thesis should be 1.5 or double-spaced. Footnotes and long quotations should be single-spaced.
4. Font size must be no smaller than 10-point or larger than 12-point.
5. All preliminary pages should be numbered with Roman numerals.
6. The main text, illustrations, appendices and bibliography should use Arabic numbering.

### **Presentation to Committee**

The advisor for the Masters candidate submits the final Thesis to a Faculty Committee for examination and approval. This committee is appointed by the Thesis advisor and consists of three members of the graduate committee of the Department of Electrical Engineering. Its approval is indicated by signatures on the title page of the original and the two required copies of the thesis.

The thesis must be defended and accepted in final form at least 30 days before the completion of the quarter in which it is expected the degree will be conferred. The original and two copies must be given to the Department Office after signed approval by the student's advisor. Two of these copies are for transmittal to the Institute Library and one to the faculty advisor.

### **Binding and Publication**

All copies must be signed by the Department Chair, Graduate Advisor and Committee Members before binding may take place.

### **Permissions, Copyright, & Embargoes**

#### **Permissions**

You are required to include a Thesis Author Permission Statement for the RIT Archives. In this state, indicate one of the following options: permission for others to photocopy or reproduce all or any part of your print thesis, or your denial of photocopying (reproduction) privileges of all or any part of your print thesis. (As of March 1, 2008, this permission statement will not be used. See the Proquest/UMI section for more information).

#### **Copyright**

Each student is responsible for obtaining any necessary permission (s) for including previously published material within his or her thesis. For information about using intellectual property and its inherent copyright, please visit: [http://www.umi.com/products\\_umi/dissertations/copyright/](http://www.umi.com/products_umi/dissertations/copyright/).

#### **Your thesis is automatically copyrighted when completed.**

If you would like another level of protection, you can apply either to the [U.S. Copyright Office](#) or have ProQuest/UMI officially copyright it for you. The U. S. Copyright Office charges \$45 (hard copy) or \$35 if sent electronically. The ProQuest/UMI cost \$65.

#### **Embargoes**

Any student who desires an embargoed thesis must make a request through the Office of the Dean of Graduate Studies to Dean Andrew Moore. Contact the Dean at: [andrew.morre@rit.edu](mailto:andrew.morre@rit.edu) or (585)475-4476.

## **Preparation of the Thesis for Binding**

Your thesis should include the following:

**The paper for RIT Archives copy must be 100% cotton bond (acid-free).**

**The title page-Please include the following information:**

1. Title: the spine title of your bound copy needs to be 96 or fewer characters in length (including spaces). If your title is longer than 96 characters, please create an abbreviated title that will be used for the spine only.
2. Author's name
3. Type of degree
4. Name of department and college
5. Date approved: month, day, year

**Committee Signature page**

1. The printed names and signatures of the committee members
2. The thesis must be signed and dated by the Department Chair and/or your Graduate Advisor before binding takes place.
3. An unsigned thesis will not be processed.

**Abstract**

The abstract should summarize the entire manuscript and its arguments for readers. It should be a single typed page, approximately 300 words.

**The Thesis Author Permission Statement includes print reproduction and submission to the RIT Digital Media Library.**

1. A copy of this form can be found at: <http://wally.rit.edu/userservices/ETDPermissionForm.pdf>
2. The completed statement will be permanently bound into the library copy.
3. Your department will determine if this form should be included in the other copies of your print thesis.
4. A PDF of the form should accompany the electronic version of your thesis.

## **How to get your Thesis Bound**

Bring the following to the Publishing and Scholarship Support Center when dropping off your thesis for binding:

1. 1 copy of your thesis is required for the RIT Archives (Library).
2. Copy/copies of your thesis for yourself
3. Copy/copies of your thesis for your department.
4. Paid receipts (1 pink, 1 white) for the Bursar's Office.

**Note:**

You are responsible for paying the binding fee for any copies other than the RIT Archives copy and those that are paid for by your department.

**The current binding fee is \$13.00 per copy. The Library pays for the binding of its copy. The binding fee(s) must be paid at the Bursar's Office.**

**Slides and CD-ROMS(optional)**

Slides are bound with the thesis. All slides must be placed in a slide preserver sheet (provided by student).

CD-ROMS are placed in back with an adhesive pocket (provided by student) when returned from bindery.

**Name, phone number or e-mail of individual picking up your copies.**

## **Binding Process**

The binding of your thesis copies takes approximately 2-4 weeks.

Bindery shipments are sent and received on alternate Thursdays.

The designated pickup person will be notified when your copies return from the bindery. Please arrange to have them picked up promptly.

Master's thesis copies are bound in black and gold lettering and doctoral dissertations are bound in blue with gold lettering. Only the spine is lettered. The spine lettering includes the title, the author's last name and the year of acceptance for degree requirements.

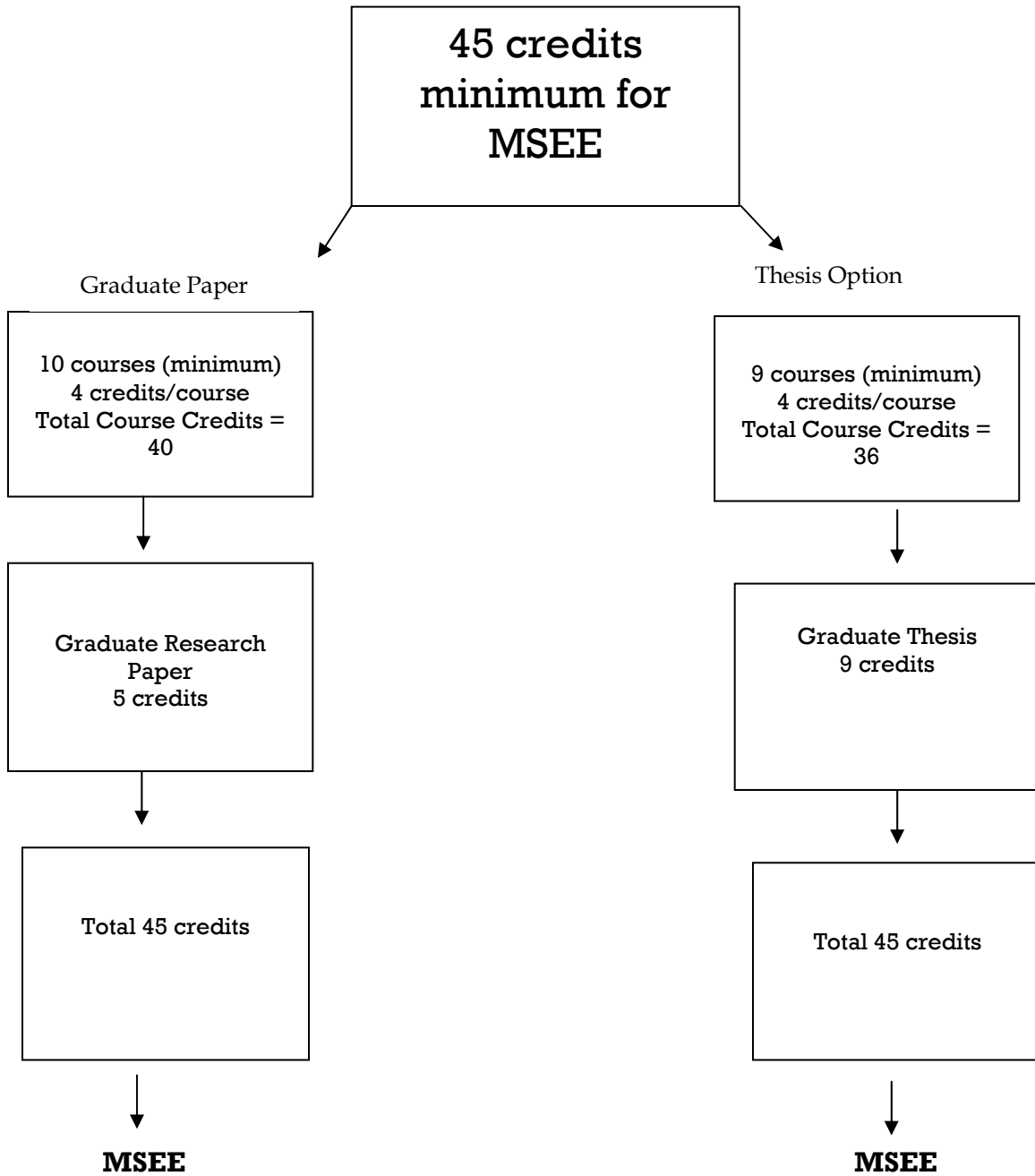
The RIT Archive's copy will be catalogued in Einstein (RIT Libraries Catalog), World Cat, and shelved in the RIT Archives.

**Publish Your Thesis in ProQuest/UMI**

Currently, the submission of your thesis to the ProQuest/UMI database is optional. As of March 1, 2008, it is required that all thesis be submitted to ProQuest/UMI. This data base includes citations for materials ranging from the first U.S. Dissertation accepted in 1861, to those accepted last semester. RIT offers this database to members of the RIT community through a paid subscription each year. To include your thesis in the database, a standard fee of \$45 for a thesis is charged.

**NOTE: THE ELECTRICAL ENGINEERING OFFICE HAS COPIES OF ACCEPTED THESIS AND GRADUATE PAPERS. YOU ARE ENCOURAGED TO CONSULT THESE DURING THE COURSE OF YOUR WORK.**

## Appendix A: MSEE Credit Requirements



## **Appendix B: Focus Areas**

- DIGITAL SYSTEMS
- INTEGRATED ELECTRONICS

For the above focus areas, (0301-703) Matrix Methods in Electrical Engineering is a required core course.

- COMMUNICATIONS
- CONTROL SYSTEMS
- MEMS
- SIGNAL AND IMAGE PROCESSING

For the above focus areas, (0301-703) Matrix Methods in Electrical Engineering AND (0301-702) Random Signals and Noise are required core courses.

Students must take at least 4 courses in addition to core courses from a chosen focus area (with concurrence from the advisor.) The remaining courses may be electives selected from any graduate level offerings from the EE department.

## Appendix C: Course Descriptions

### 600 Level Courses - only 2 may be taken from this list toward the MSEE degree

#### **0301-601 Modern Optics for Engineers**

This course provides a broad overview of modern optics in preparation for more advanced courses in the rapidly developing fields of lasers, fiber optics and non-linear optics. Topics covered: propagation of light, geometrical optics, polarization, interferometry, diffraction and laser resonators. Introduction to non-linear optics: harmonic generation, optical parametric oscillators and amplifiers. At the end of the quarter, the students should have a firm foundation in classical optics. Lasers and non-linear optics will be introduced from a semi-classical perspective and will not require a quantum mechanical background. Students will write a paper on a topic of current research interest in the field. (0301-474) class 4, Credit 4

#### **0301-610 Analog Electronic Design**

Enhances the student's skills in designing analog circuits. Subjects covered include nonideal characteristics of op-amps; op-amp applications; A/D and D/A conversion; multipliers and modulators; phase-locked loop, and frequency synthesis. Students meet in the classroom three hours each week and three hours in the laboratory. The laboratory time is used to discuss and troubleshoot circuits. Students are expected to work on design projects at their own pace outside of class hours. Class 3, Lab 3, Credit 4

#### **0301-612 Semiconductor Devices III**

Continuation of an undergraduate professional elective sequence in semiconductor device physics. Coverage of four major topics: (1) bipolar junction transistor (BJT) fundamentals, including carrier injection, current gain, modes of operation, Ebers-Moll model; (2) BJT advanced topics, including Early effect, high-level injection, Kirk effect, charge-control model, and small-signal models; (3) MOSFET transistor fundamentals, including charge-control analysis, current-voltage characteristics, threshold voltage, and CMOS; (4) MOSFET advanced topics, including channel-length modulation, sub-threshold current, velocity saturation, scaled MOS devices, drain-induced barrier lowering (DIBL), hot carrier effects and scaling issues. (0301-360) Class 4 Credit 4 (W)

#### **0301-615 State Space Control**

In this course students are introduced to MIMO systems and their designs using state space techniques. Linear algebra: Vectors, linear independent of vectors, vector space and null space, rank of a matrix eigen values and eigen vectors, transformation of matrices, functions of matrices, matrix polynomials, Cayley Hamilton theorem state space formulations, canonical forms, controllability and observability, relations between state space and transfer functions models, solution of state equations, state space design (pole placement), comparison with conventional design, and introduction to other forms of state space designs. (0301-514) Class 4, Credit 4

#### **0301-621 Microwave Engineering**

Studies of the theory and design of microwave components and circuits. Reviews basic EM theory, TEM waves in transmission lines, TE and TM waves in rectangular waveguides, microstriplines and striplines, TE and TM waves in cylindrical waveguides; the scattering matrix description of multiport microwave circuits; waveguide tees, directional couplers and phase shifters; microwave integrated circuit components—branchline couplers, power dividers, hybrid ring couplers and phase shifters; rectangular, cylindrical and coaxial cavity resonators; waveguide and coaxial line filters and waveguide frequency meters; microwave integrated circuit high pass and band pass filters; ferrite components. Laboratory illustrates various microwave component design and measurement techniques. Class 3, Lab 3, Credit 4 (W)

#### **0301-630 Biomedical Instrumentation**

Study of fundamental principles of electronic instrumentation and design consideration associated with biomedical measurements and monitoring. Topics to be covered include biomedical signals and transducer principles, instrumentation system fundamentals and electrical safety considerations, amplifier circuits and design for analog signal processing and conditioning of physiological voltages and currents as well as basic data conversion and processing techniques. Laboratory experiments involving instrumentation circuit design and test will be conducted. (0301-382, 482, 554) Class 4, Lab 3 Credit 4 (W)

**0301-631 Biomedical Sensors and Transducers I**

Biological entities probably represent one of the most difficult environments in which to obtain or generate accurate and reliable signals. This course will discuss the techniques, mechanisms and methods necessary to transfer accurate and reliable information or signals with a biological target. Various biomedical sensor and transducer types including their characteristics, advantages, disadvantages and fabrication will be covered. Discussions will include the challenges associated with providing a reliable and reproducible interface to a biological entity, the nature and characteristics of the associated signals, the types of applicable sensors and transducers and the circuitry necessary to drive them. (0301-382, 482) Class 4, Lab 3, Credit 4

**0301-632 Fundamental Electrophysiology**

Investigation and study of the concepts and underlying mechanisms associated with electrical signals in mammalian biology and physiology with a significant emphasis on methods, techniques and understanding of electrical potential distribution and current flow derived from circuit analysis. Intended to provide engineers with insight into the relationship between the study of electricity and its applicability to a wide variety of physiological mechanisms ranging from intracellular communication and control to cognitive function and bodily movement. Successful completion of the course will require generation of a significantly in-depth analysis report on some electrophysiological phenomenon or mechanism. (0301-381, 1026-365) Class 4, Lab 3, Credit 4 F, W

**0301-633 Biomedical Signal Processing**

Discussion and study of the methods and techniques that may be optimally employed for the fixed and adaptive processing of information with biological and physiological origin. The challenges and unique features of these types of signals will be discussed and application of known signal processing techniques that accommodate linear, non-linear and stochastic signals for the purpose of analysis, detection and estimation, monitoring and control will be studied. Successful participation in the course will entail completion of at least one project involving incorporation of these techniques in a biomedical application. (Permission of instructor or graduate standing) Class 4 Credit 4

**0301-636 Biorobotics/Cybernetics**

Cybernetics refers to the science of communication and control theory that is concerned especially with the comparative study of automatic control systems (as in the nervous system and brain and mechanical-electrical communication systems). This course will present material related to study of cybernetics as well as the aspects of robotics and controls associated with applications of a biological nature. Topics will also include the study of various paradigms and computational methods that can be utilized to achieve the successful integration of robotic mechanisms in a biological setting. Successful participation in the course will entail completion of least one project involving incorporation of these techniques in a biomedical application.(Permission of instructor or graduate standing) Class 4, Credit 4

**0301-637 Control Sys/Biomed Apps**

Application of control system principles associated with input-output analysis, steady state and transient response, feedback concepts, system identification and simulation to the study of physiological processes involved in the regulation and maintenance of homeostasis in a human being. Among areas of interest are coordinated movement, vision, cardiovascular response, fluid management and metabolism. (0301-514 and permission of instructor) Class 4 Credit 4

**0301-646 Power Electronics**

The study of a variety of semiconductor devices generally used for purposes other than signal processing, including thyristors, unijunction transistors, opto-couplers, power MOS and IGBTs. Applications stressed are concerned with the use of electrical power for control of lighting, motion and heat. Particular attention is given to calculating power dissipation, heat sinks and thermal management. (0301-545) Class 3, Lab 3, Credit 4

**0301-647 Artificial Intelligence Explorations**

The course will start with the history of artificial intelligence and its development over the years. This course will explore a variety of artificial intelligence techniques, and their applications and limitations. Some of the AI techniques to be covered in this course are intelligent agents, problem-solving, knowledge and reasoning, uncertainty, decision making, learning (Neural networks and Bayesian networks), reinforcement learning, swarm intelligence, genetic algorithms, particle swarm optimization, applications in robotics, controls, and

communications. Students are expected to have any of the following programming skills: C/C++, Matlab, Java, or any other high level programming language. Class 4. Credit 4.

### **0301-650 Design of Digital Systems**

Deals with the design of both synchronous and asynchronous digital systems. The accent is on design methodologies for final implementation on programmable logic devices. Design techniques are based on top-down design using ASM charts and bubble diagrams along with microprogramming applications. Students also learn how to rapidly develop digital systems with VHDL. Design strategies for testability are discussed along with their impact on performance. The practical aspects of component interconnection (crosstalk, noise, transmission line effects) with effects on performance are also surveyed. The laboratory portion consists of four distinct projects proposed, designed, simulated (two projects require actual hardware implementation), and tested by the student. The design laboratory is supported by the ALTERA MAX+PLUS II VHDL design tools and EPLD/FPGA programmers. (0301-240, 365) Class 3, Lab 3, Credit 4

### **0301-651 Physical Implementation**

A technical elective that introduces students to the fundamental principles of Application Specific I.C. (ASIC) design. Both circuit design and system design are covered. The student also is introduced to CAD tools for schematic capture, placement and routing of standard cells. The projects are designed and simulated using commercial CAD tools. Top-down design using a hardware description language (VHDL) is included. (0301-650) Class 4, Credit 4

### **0301-655 Microcomputer Software I**

Discussion of the use of the C Programming language in generating software specifically for microprocessor based systems. The tools and procedures necessary for the organized and efficient development of high-level code for a target microprocessor as well as establishing a compiler, linkers, object code libraries, and symbolic debugging as well as monitor programs and real-time multi-tasking kernel principles. Programming projects with emphasis on the applications in electrical engineering are required. (0301-365) Class 4, Lab 3, Credit 4

### **0301-662 Neural Networks**

Artificial Neural Networks (ANN) is the name given to a broad class of processing algorithms that are loosely based on how the brain processes information. The term "artificial" distinguishes the silicon-based systems from the biological systems (such as ourselves). ANNs are used in numerous applications from manufacturing controls to handwriting recognition to optical visual processing, or in any application that can handle some "fuzziness" in the output. Artificial Neural Networks also form the foundation for artificial intelligence (AI) systems. This course begins with a discussion of what ANNs are and what features define them, then examines a number of the most common neural algorithms and techniques such as backward error propagation ("Back-prop"). Software implementations of the algorithms (requiring C programming skills) as well as hardware implementations (requiring PSPICE simulations) will be discussed. Credit 4

### **0301-664 Embedded Microcontroller Systems**

Gives the student detailed knowledge of the hardware and software organization of 8-bit microcontroller systems with an emphasis on design. Peripheral interfacing, serial and parallel I/O, including interrupts, are considered. Special attention is given to interfacing microcontroller with the analog world, including the use of A/D and D/A converters. Software organization as well as design tools are discussed. Design case studies of typical microcomputer-embedded systems are examined. (0301-365) Class 3, Lab 3, Credit 4 (F)

### **0301-677 Digital Filters and Signal Processing**

A continuation of the topics studied in 0301-554. Topics include study of the design methods for digital IIR filters via s-plane transformations; study of design methods for digital FIR filters, including emphasis on the question of linear phase response; a review of the discrete Fourier transform (DFT) and an in-depth study of fast algorithms (FFTs) for implementing the DFT, including radix 2, radix 4 and mixed radix algorithms; quantization effects in discrete systems; an introduction to digital signal processing computer chips and their use in the implementation of digital processing systems; and applications of digital signal processing, including speech processing and two-dimensional image processing. Includes several design projects in the digital signal-processing laboratory. (0301-554) Class 4, Credit 4

**0301-679 Analog Filter Design**

A study of the various techniques for the design of filters to meet given specifications. Approximations to the ideal filter characteristic through Butterworth, Chebyshev and other polynomials are discussed in detail. The emphasis is on active network realizations using op amp stages. Topics include review of analysis of op amp circuits and transfer function of networks; magnitude and frequency scaling; ideal filter characteristics; Butterworth, Chebyshev and Bessel-Thompson approximations to the ideal filters; determination of transfer functions to meet given specifications; high-pass to low-pass and band-pass to low-pass transformations; standard op amp circuits for filter realizations; negative impedance converters; generalized impedance converters; and switched capacitor filters. (0301-453) Class 4, Credit 4

**0301-685 Principles of Robotics**

An introduction to a wide range of robotics-related topics, including but not limited to: sensors, interface design, robot devices and applications, mobile robots, intelligent navigation, task planning, coordinate systems and positioning, image processing, digital signal processing applications on robots, and controller circuitry design. Prerequisite of the class is the basic understanding of signals and systems, matrix theory, and computer programming. Software assignments will be given to the students in robotic applications. Students will prepare a project, in which they will complete software or hardware design of an industrial or mobile robot. There will be two-hour lab additional to the lectures. (0301-346, 453) Class 3, Lab 2, Credit 4

**0301-686 MemS Design**

Microelectromechanical systems (MEMS) are widely used in aerospace, automotive, biotechnology, instrumentation, robotics, manufacturing and other applications. There is a critical need to synthesize and de-sign high performance MEMS which satisfy the requirements and specifications imposed. Integrated approaches must be applied to design and optimized MEMS, which integrate microelectromechanical motion devices, ICs, and microsensors. This course covers synthesis, design, modeling, simulation, analysis, control and fabrication of MEMS. Synthesis, de-sign and analysis of MEMS will be covered including CAD. (fourth or fifth year standing for undergraduates, or graduate standing) Class 4, Credit 4

**0301-688 MEMs Systems Evaluation**

This course focuses on evaluation of MEMs, Microsystems and microelectromechanical motion devices utilizing MEMs testing and characterization. Evaluations are performed using performance evaluation matrices, comprehensive performance analysis and functionality. Applications of advanced software and hardware in MEMs evaluation will be covered. (Senior-standing required) Class 4, Credit 4

**0301-692 Communication Networks**

A major portion of today's communication takes place over digital networks. This includes communication between people in the form of voice, facsimile (fax) and e-mail, as well as communication between machines. Digital networks are most likely to be the dominant element of communication links of the future. The current effort in ISDN points to such a trend. This course covers key aspects of the structure of present-day digital communication networks. (0301-534) Class 4, Credit 4

**0301-693 Digital Data Communication**

Principles and practices of modern data communication systems. Topics include pulse code transmission and error probabilities, M-ary signaling and performance, RF communications link budget analysis, an introduction to channel coding, a discussion of modulation/coding tradeoffs and a discussion of digital telephony. (0301-534) Class 4, Credit 4

## **700 & 800 Level Courses (all courses earn 4 credits unless otherwise noted)**

### **0301- 702 Random Signals & Noise**

In this course, the student is introduced to random variables and stochastic processes. Topics covered are: probability theory, conditional probability and Bayes theorem, discrete and continuous random variables, distribution and density functions, moments and characteristic functions, functions of one and several random variables, Gaussian random variables, and the central limit theorem, estimation of a random variable, random processes, stationarity and ergodicity, autocorrelation, cross-correlation and power spectrum density, response of linear systems to stochastic inputs, introduction to linear prediction, Wiener filtering, elements of detection, matched filters. (Graduate Standing) Class 4, Credit 4.

### **0301-703 Matrix Methods in Electrical Engineering**

This course deals with the elements of discrete transforms and linear algebra. Topics include: discrete-time signals and systems, the Z-transform and its application, solution of difference equations, concepts of stability, discrete Fourier analysis, DFT, FFT algorithms, topics in linear algebra and matrices, eigenvalues and eigenvectors, functions of matrices, matrix transformations and operations, matrix poly-nomials and the Cayley-Hamilton theorem, state variables, relation between transfer functions and state variable representation of LTI systems, state transition matrix, and solution of state equations. Class 4, Credit 4.

### **0301-710 Advanced Electromagnetic Theory**

The primary objective is to provide the mathematical and physical fundamentals necessary for a systematic analysis of electromagnetic field problems. Topics include potential representations, scalar and vector Green's functions, Green's theorem, reciprocity, duality, equivalence principle, image theorem, and radiation from apertures, scattering, integral equation solutions, perturbation and numerical methods. (graduate Standing). Class 4, Credit 4

### **0301-711 Advanced Carrier Injection Transistors**

An advanced-level course in electronic transport in semiconductors and the operation of bipolar devices (pn junction diodes, bipolar junction transistors and semiconductor controlled rectifiers.) Topics include: electron drift, diffusion and carrier lattice interactions, energy band diagrams in non-uniformly doped semiconductors, continuity equations, impact ionization, tunneling, advanced static and dynamic analysis of diodes and bipolar transistors, design of bipolar devices. Topics also include Heterojunction Bipolar Transistors (HBT), including SiGeHBT. Class 4, Credit 4.

### **0301-712 Advanced Field Effect Devices**

An advanced-level course on MOSFET's and submicron MOS devices. Topics include: MOS capacitors, gated diodes, long channel MOSFET, subthreshold conduction and offstate leakage, short channel effects, hot-carrier effects, ion-implanted channels, MOS technologies. Class 4, Credit 4.

### **0301-713 Solid State Physics**

An advanced level course on solid-state physics, with particular emphasis on semiconductor materials. Topics include: basic semiconductor properties, elements of quantum mechanics, general and time-independent formulation of wave mechanics, outcomes and predictions, energy band theory, statistical mechanics and equilibrium carrier statistics, excess carriers in semiconductors, carrier transport. Class 4, Credit 4

### **0301- 717 Microwave Circuit Design**

The primary objective is to study the fundamentals of microwave engineering with emphasis on microwave network analysis and circuit design. Topics include microwave transmission lines such as wave-guides, coax, microstrip and stripline, microwave circuit theory such as S- matrix, ABCD matrices, and even-odd mode analysis, analysis and design of passive circuits and components, matching networks, microwave resonators and filters. Class 4 Credit 4.

### **0301-726 Mixed Signal Integrated Circuit Design**

This course covers basic analog functional blocks and mixed signal blocks, in CMOS technology. Topics include: device models, current sources and active loads, precision reference, operational amplifiers, comparators, sample and hold circuits and data converters design. Course involves circuit design and layout projects. (Graduate standing). Class 4 Credit 4

**0301-727 VLSI Design**

A course in the design of very large scale integrated circuits at the level of Mead and Conway's VLSI Design. Topics include MOS devices and circuits, n-channel MOS process, data and control flow in systematic structures, implementing integrated system design, system timing and examples of LSI computer systems. Class 4, Credit 4

**0301-729 Antenna Theory and Design**

The primary objective is to study the fundamental principles of antenna theory applied to the analysis and design of antenna elements and arrays including synthesis techniques and matching techniques. Topics include antenna parameters, linear antennas, array theory, wire antennas, microstrip antennas, self and mutual impedances, equivalence principle, Huygen's principle, aperture antennas, traveling wave antennas, reflector antennas. Class 4, Credit 4

**0301-730 Advanced Analog IC Design**

An advanced course in analog integrated circuit design. Students will study bipolar and MOS realization of operational amplifiers, analog multipliers, A to D and D to A convertors, switched capacitor filters, and more. The students will participate in design projects including circuit design, layout, and SPICE simulation. (0301-726) Class 4, Credit 4.

**0301-732 Advanced Topic-Digital System Design**

The purpose of this course is to introduce students to advanced topics in digital systems design not covered in depth in undergraduate classes or topics that are new to the design community. Topics include: design of digital systems using Hardware Description Languages (VHDL/Verilog), design of digital systems using asynchronous clock distribution in large digital systems, design of digital systems with threshold gates, multi-valued logic and design of DSP specific blocks. For specific evaluation and grading policy, contact assigned instructor before registration. (0301-240,347,365,545) Class 4, Credit 4

**0301-733 Robust Control**

One of the most useful qualities of a properly designed feedback control system is robustness, i.e., the ability of the closed-loop system to continue performing satisfactorily despite large variations in the (open-loop) plant dynamics. This course will provide an introduction to the analysis and design of robust feedback control systems. Topics covered: overview of linear algebra and linear systems,  $H_2$  and  $H_\infty$  spaces, modeling and paradigms for robust control; internal stability; nominal performance (asymptotic tracking); balanced model reduction; uncertainty and robustness;  $H_2$  optimal control;  $H_\infty$  control;  $H_\infty$  loop shaping; controller reduction; and design for robust stability and performance. Software: MATLAB: Robust Control Toolbox, and mu-Toolbox. (0301-703). Class 4, Credit 4.

**0301-741 Design for Testability**

This course deals with the design systems for testability and for maintainability. A survey of criteria for testability is given. A discussion of fault simulation and test pattern generation is included. Random test pattern generators and associated data compression schemes such as signature analysis are also described. Scanning techniques (both scan path and boundary scan) are discussed. The trade-offs between built in testing capacity and additional silicon structures are weighed. A small project, usually involving simulation will be required. (0301-650) Class 4, Credit 4.

**0301-742 Advanced Topic-Embedded systems SW Design**

An introduction to the theory and application of top-down design, structure, abstraction, segmentation, high-level languages, and operating systems to real-time programs for micro-processors. The students will become proficient in a structured high level language. Topics include: Structure diagrams, separate module compilation, data types, data structures, self documenting code, procedures, meaningful variable names, linkage with other languages, object code libraries, operating system calls, multi-tasking concurrent and re-entrant programs, and symbolic debugging. (0301-655) Class 4, Credit 4.

**0301-749 Speech & Image Compression**

Modern compression techniques used in efficient digital transmission and storage of speech and image waveforms are dealt with in this course. Topics include digital communication channels, sampling and reconstruction of one-dimensional and two-dimensional signals, coding concepts, bit rate, coder complexity, rate distortion and information-theoretic bounds, characteristics of speech and image waveforms, quantization techniques, uniform nonuniform, logarithmic, optimum (Max), entropy coding, adaptive, pulse code modulation (PCM) of audio and video waveforms, DPCM, ADPCM, and delta modulation, linear prediction, transform coding, optimum (Karhunen-Loeve) transform and its gain, suboptimum transforms, DFT, DCT, DST, DHT, and DWHT, special coding

schemes, run-length coding, block truncation coding, sub-band coding, vector quantization, comparative performance of various schemes. Computer assignments and demonstrations are involved. Class 4, Credit 4.

### **0301-753 Optimization Techniques**

This course provides a rigorous introduction to the principles and applications of optimization techniques. Optimization has applications in almost every branch of science and engineering. The course aims to present those aspects of optimization methods that are currently of foremost importance in solving real world engineering problems. The topics covered include linear optimization, Quadratic models, Descent methods and stability, Newton's technique, Conjugate direction methods, constrained optimization, Lagrange multipliers, Convexity, and Duality. Nonlinear programming and integer programming as well as principles of non-smooth optimization are included. (0301-703) **Class 4, Credit 4**

### **0301-761 Modern Control Theory**

An advanced course in control theory. Topics covered include: review of state-space formulation of SISO systems, solutions of state equations, State Transition Matrix and its properties, application of state-space concepts, state variable design, multivariable systems, preliminaries, systems of least order, stability and control. Class 4, Credit 4.

### **0301-764 Digital Control Systems Design**

An introduction to the analysis and design of control systems in which the microcontroller plays a principal role. Topics include: sampled data systems, Z and W-place analysis and design, algorithm generation, and the effect of computer word length on noise and stability. The student will be expected to make use of the digital computer in the implementation of design procedures. (0301-703) Class 4, Credit 4.

### **0301-765 Optimal Control**

The course covers different optimization techniques, as applied to feedback control systems. The main emphasis is on the design of optimal controllers for digital control systems. The major topics are: different performance indices, formulation of optimization problem with equality constraints, LaGrange multipliers, Hamiltonian and solution of discrete optimization problem. Discrete Linear Quadratic Regulators (LQR), optimal and suboptimal feedback gains, Riccati equation and its solution, linear quadratic tracking problem, Dynamic Programming, Bellman's principle of optimality, and optimal controllers for discrete and continuous systems. (0301-761 or equivalent) **Class 4, Credit 4**

### **0301-768 Adaptive Signal Processing**

An introduction to the fundamental concepts of adaptive systems; open and closed loop adaptive systems, adaptive linear combiner; performance function and minimization; decorrelation of error and input signal. Adaptation algorithms such as: steepest descent, LMS and LMS/Newton algorithm. Noise and maladjustments. Applications will include system identification, deconvolution and equalization, adaptive arrays and multipath communications channels. (0301-702 or permission of instructor) Class 4, Credit 4.

### **0301-769 Fuzzy Logic & Applications**

This course introduces fuzzy logic and its applications in areas like control systems, image processing, decision making etc. Major topics: fuzzy sets - rule base - generation and combinations of rules - defuzzification. Fuzzy systems - choice of fuzzy variables - their division into fuzzy sets - choice of membership functions - the effect of these on system performance. Applications: discussion of published works and student projects using fuzzy logic. Students are required to research the published literature and/or do projects and take an active part in these discussions. Class 4, Credit 4.

### **0301-770 Pattern Recognition**

This course provides a rigorous introduction to the principles and applications of statistical pattern recognition. The topics covered include Bayesian decision theory, nearest-neighbor techniques, linear discriminant functions, and clustering. Parameter estimation and supervised learning as well as principles of feature selection are included. (0301-702). Class 4, Credit 4.

### **0301-772 Special Topics**

Topics and subject areas that are not among the courses listed here are frequently offered under the title of Special Topics. Such courses are offered in a normal format, that is, regularly scheduled class sessions with an instructor. (No regular course schedule) Class 4, Credit 4

**0301-779 Digital Image Processing**

This is an introductory course in digital image processing. The course begins with a study of two dimensional signal processing and transform methods with applications to images. Image sampling is discussed followed by gray level description of images and methods of contrast manipulation including linear/nonlinear transformation and histogram equalization and specification. Image smoothing methods are considered including spatial and frequency domain low pass filtering, AD-HOC methods of noise removal and median filtering. Following this, methods of image sharpening are studied including derivative methods and high pass filtering. Edge and line detection methods are discussed using masks and hough transforms and methods of image segmentation are degradation and methods of image restoration including deblurring. Several extensive computer and DSP lab assignments are required. (0301-702, 703 or permission of instructor). Class 4, Credit 4

**0301-780 Independent Study**

This course number should be used by students who plan to study a topic on an independent study basis. The student must obtain the permission of the appropriate faculty member before registering for the course. Class 4, Credit 4

**0301-786 MEMS Devices**

Microelectromechanical systems (MEMS) are widely used in aerospace, automotive, biotechnology, instrumentation, robotics, manufacturing, and other applications. There is a critical need to synthesize and design high performance MEMS that satisfy the requirements and specifications imposed. Integrated approaches must be applied to design and optimized MEMS, which integrate microelectromechanical motion devices, ICs, and microsensors. This course covers synthesis, design, modeling, simulation, analysis, control and fabrication of MEMS. Synthesis, design and analysis of MEMS will be covered including CAD. (Fourth or fifth year standing for undergraduates, or graduate standing) Class 4, Credit 4.

**0301-789 Fundamentals of MEMS**

This course introduces the student to Microelectromechanical systems (microscale transducers, actuators and sensors with ICs). Synthesis, design, modeling, simulation, analysis, control and fabrication of MEMS will be covered. The primary emphasis of the course will be concentrated on development of basic theory to attain fundamental application of MEMS in robotics, electronics, biotechnology, medicine, avionics, transportation, security, defense, etc. (graduate standing-for graduate students, 0301-531 for undergraduate students) Class 4, Credit 4

**0301-794 Information Theory**

This course introduces the student to the fundamental concepts and results of information theory. This is a very important course for students who want to specialize in signal processing, image processing, or digital communication. Topics include: definition of information, mutual information, average information or entropy, entropy as a measure of average uncertainty, information sources and source coding, Huffman codes, run-length constraints, discrete memoryless channels, channel coding theorem, channel capacity and Shannon's theorem, noisy channels, continuous sources and channels, coding in the presence of noise, performance bounds for data transmission, rate distortion theory. 0301-702. Class 4, Credit 4.

**0301-798 Microfluidic MEMS**

The course begins with an overview of microfluidic technology to provide a framework and to clarify the relationship of microfluidics to microelectromechanical systems (MEM) and Microsystems in general. Three major topics comprise the course: 1) selected elements of fluidic dynamics theory, and the scaling and application of that theory to microscale dimensions, 2) design, fabrication, and characterization of microfluidic devices and microsystems including exploration of major alternative fabrication technologies, process integration and materials issues, and device-and system-level packaging; encapsulation challenges; 3) applications, including micro-valves, micropumps, microflow control sensor, and devices for chemical and biochemical analysis. Class 4, Credit 4

**0301-799 Nano & Microengineering**

This course focuses on analysis and synthesis of nano- and microelectromechanical systems and devices. Synthesis, design, optimization, analysis, control and fabrication of nano and microsystems will be covered. Utilizing basic physical laws of nano and microengineering, distinct systems and devices will be examined. The application of nano and microengineering in nanocomputers avionics, security and transportation will be emphasized. Specific applications included are: super-fast data processing and computing, data storage, imaging, molecular intelligent

automata, etc. (graduate standing for graduate students; permission of instructor for undergraduate students) Class 4, Credit 4

### **0301-800 Graduate Paper**

This course number is used to fulfill the graduate paper requirement under the non-thesis option for the MS degree in electrical engineering. The student must obtain the approval of an appropriate faculty member to supervise the paper before registering for this course. Credit 5.

### **0301-802 Wireless Communications**

The course will cover advanced topics in wireless communications for voice, data and multimedia. Topics covered are: 1) Channel modeling: Overview of current wireless systems, modeling wireless channels, path loss for different environments, log-normal shadowing, flat and frequency-selective multipath fading, LS estimation of channel parameters, and capacity limits of wireless communication channels. 2) Transmission over fading channels, 3) Techniques to improve the speed and performance of wireless links (adaptive modulation and diversity techniques such as maximum gain combining to compensate for flat-fading). 4) Techniques to combat frequency-selective fading 9adaptive equalization, space time coding, multicarrier modulation (OFDM), and spread spectrum). 5) Applications for these systems, including the evolution of cell phones and PDA's, sensor networks will be discussed. (0301-693, 702) Class 4, Credit 4

### **0301-803 Digital Video Processing I**

In this graduate level course the following topics will be covered: Representation of digital video - introduction and fundamentals. Time-varying image formation models including motion models and geometric image formation. Spatio-temporal sampling including sampling of analog and digital video, two dimensional rectangular and periodic sampling, sampling of 3-D structures, and reconstruction from samples. Sampling structure conversion including sampling rate change and sampling lattice conversion. Two-dimensional motion estimation including optical flow based methods, block-based methods, Pel-recursive methods, Bayesian methods based on Gibbs Random Fields. Three-dimensional motion estimation and segmentation including methods using point correspondences, optical flow & direct methods, motion segmentation, and stereo and motion tracking. (0301-779 or permission of instructor) Class 4, Credit 4

### **0301-804 MEMS Evaluation**

This course focuses on evaluation of MEMS, microsystems and microelectromechanical motion devices utilizing MEMS testing and characterization. Evaluations are performed using performance evaluation matrices, comprehensive performance analysis and functionality. Applications of advanced software and hardware in MEMS evaluation will be covered. (0301-786, senior standing) Class 4 Credit 4

### **0301-805 Modern Optics for Engineers**

This course provides a broad overview of modern optics in preparation for more advanced courses in the rapidly developing fields of lasers, fiber optics and non-linear optics. Topics covered: propagation of light, geometrical optics, polarization, interferometry, diffraction and laser resonators. Introduction to non-linear optics: harmonic generation, optical parametric oscillators and amplifiers. At the end of the quarter, the students should have a firm foundation in classical optics. Lasers and non-linear optics will be introduced from a semi-classical perspective and will not require a quantum mechanical background. Students will write a paper on a topic of current research interest in the field. (0301-474) Class 4, Credit 4

### **0301-810 Advanced Computer Architecture**

This course covers advanced topics in computer and processor architecture. Topics include: pipeline and parallel processor design, branch tables and prediction algorithms, single issue versus multiple issue processor architectures (VLIW, SIMD, superscalar), cache architectures, quantitative and qualitative evaluation of instruction set architectures. For specific evaluation and grading contact the assigned instructor before registration. (0301-240, 347, 365, 545) Class 4, Credit 4

### **0301-812 Advanced Topic-Physical Implementation**

This course covers the analysis and physical design of very large-scale integrated circuits. Topics covered include: synthesis, cell layout, cell placement and system routing, extraction, layout versus schematic check, signal integrity, timing and noise immune design techniques. The course will address issues in current state-of-the-art submicron and

deep submicron CMOS technologies, with an emphasis on digital circuits and systems. For specific evaluation and grading policy contact the assigned instructor before registration. (0301-240, 347, 365, and 545) Class 4, Credit 4

#### **0301-814 RF I.C. Design**

An advanced course in analog RF integrated circuit design. Topics include: accurate modeling of passive elements, modeling of devices, low noise amplifiers, voltage controlled oscillators, and mixer circuits. Circuits will be designed using CMOS technology for frequencies up to 5 GHz. (0301-726) Class 4, Credit 4

#### **0301-815 Multivariable Modeling**

This course introduces students to the major topics, methods, and issues in modeling multiple-input, multiple-output (MIMO) linear systems. The course covers methods of creating models and refining them. Modeling topics include model-order determination, canonical forms, numerical issues in high-order models, numerical issues in broadband models, methods of creating frequency-response models from time-domain measurements, methods of model-order reduction, model transformations and information loss, and estimating model accuracy of MIMO models. Use of MIMO models in controller design will be discussed. (0301-703) Class 4 Credit 4

#### **0301-816 Design & Charac Micro Sys**

The primary objective is the design and experimental illustration of the fundamentals of microwave circuits and antennas. Projects will involve the design, construction and characterization a microwave system to satisfy a set of specified design criteria. Microwave measurement techniques will involve the use of network analyzers, and spectrum analyzers in conjunction with the probe station. Simulated results will be obtained using some popular commercial EM software for the design of microwave circuits and antennas. (0301-717)Class 4, Lab 3. Credit 4

#### **0301-820 Modeling and Simulation of Semiconductor Process and Devices**

Semiconductor process and device simulation techniques are introduced. Standard process simulators - ATHENA is used for modeling and simulation of process technologies - crystal growth, film deposition, oxidation, diffusion, ion implantation, dry etching, metallization, oxygen implantation, annealing, etc. Physics-based modeling topics - carrier transport, Poisson's equation, current continuity equation, breakdown phenomena, device scaling, etc. are covered. Standard multi-dimensional device simulator - ATLAS is used to simulate different semiconductor devices. In conjunction with ATHENA and ATLAS, UTMOST is used to extract BSIM model parameters for circuit simulation using SPECTRE. (graduate standing) Class 4, Credit 4

#### **0301-821 Physics and Modeling of High-Performance Devices**

Semiconductor devices based on III-V materials are introduced. Basic properties and physics of III-V materials and metal-semiconductor contacts and two-terminal Heterojunction devices are covered. Physical operation, non-idealities, modeling DC and microwave characteristics of Heterojunction Bipolar Transistors (HBT), Metal-Semiconductor Field-Effect Transistors (MESFET) and High Electron Mobility Transistors (HEMT) are analyzed. (0301-360 or equivalent) Class 4, Credit 4

#### **0301-831 Biomedical Sensors & Transducers II**

This course will discuss the fabrication and design of sensors and transducers for biomedical applications. It will include discussion of applicable fabrication processes and techniques including consideration associated with the utilization of microelectromechanical and nanoelectromechanical structures to allow the integration of sensor and transduction mechanisms with signal simulation and fabrication design tools will be covered. The course will involve the design and simulation of an actual transducer suitable to be considered for actual fabrication. (0301-610,631 and permission of instructor) Class 4, Credit 4

#### **0301-887 Digital Signal Processing**

A continuation of the topics studied in 0301-554. Topics include study of the design methods for digital IIR filters via s-plane transformations, study of design methods for digital FIR filters, including emphasis on the question of linear phase response, a review of the discrete Fourier transform (DFT) and an in-depth study of fast algorithms (FFTs) for implementing the DFT, including radix 2, radix 4 and mixed radix algorithms, quantization effects in discrete systems; an introduction to digital signal processing computer chips and their use in the implementation of digital processing systems, and applications of digital signal processing, including speech processing and two-dimensional image processing. Includes several design projects in the digital signal processing laboratory. (0301-554) Class 4, Credit 4

**0301-890 Thesis**

An independent engineering project or re-search problem to demonstrate professional maturity. A formal written thesis and an oral defense are required. The student must obtain the approval of an appropriate faculty member to guide the thesis before registering for the thesis. A thesis may be used to earn a maximum of 9 credits.

**Former Special Topics Courses****0301-772 Software and Hardware Implementations of Artificial Neural Networks**

Artificial Neural Networks (ANN) Artificial Neural Networks (ANN) is the name given to a broad class of processing algorithms that are loosely based on how the brain processes information. The term artificial is important because it distinguishes the silicon-based systems from the biological systems (such as ourselves). ANNs are used in numerous applications from manufacturing to controls to handwriting recognition to optical visual processing, or in any application that can handle some "fuzziness" in the output. Artificial Neural Networks also form the foundation for artificial intelligence (AI) systems. In this course, we will begin by discussing what ANNs are and what features define them, and then we will examine a number of the most common neural network algorithms and techniques such as backward error propagation ("Back-prop"). We will discuss software implementations of the algorithms (requiring C programming skills) as well as hardware implementations (requiring PSPICE simulations)

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**Appendix E: Specimen Title Page (GRADUATE PAPER)**

THE PURPLE PLAGUE

by

Chef Boyardee

A Graduate Paper Submitted

in

Partial Fulfillment

of the

Requirements for the Degree of

MASTER OF SCIENCE

in

Electrical Engineering

Approved by:

PROF.

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(Graduate Paper Advisor's Name, Printed)

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(Department Head's Name, Printed)

DEPARTMENT OF ELECTRICAL ENGINEERING

COLLEGE OF ENGINEERING

ROCHESTER INSTITUTE OF TECHNOLOGY

ROCHESTER, NEW YORK

MAY, 2009

**Appendix F: Specimen Title Page (THESIS)**

THE PURPLE PLAGUE

by

Chef Boyardee

A Thesis Submitted

in

Partial Fulfillment

of the

Requirements for the Degree of

MASTER OF SCIENCE

in

Electrical Engineering

Approved by:

PROF.

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(Thesis Advisor's Name, Printed)

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(Department Head's Name, Printed)

DEPARTMENT OF ELECTRICAL ENGINEERING

COLLEGE OF ENGINEERING

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ROCHESTER, NEW YORK

MAY, 2009

## Appendix G: Representative Graduate Research Thesis & Papers

<u>DATE</u>	<u>AUTHOR</u>	<u>TITLE</u>	<u>ADVISOR</u>
2008	Harsha Narne	Minimization of Halftone Noise in “Flat” Regions for Improved Print Quality	Dr. Saber
2008	Sreenivas Patil	Reconfigurable Hardware for Color Space Conversion	Dr. Peskin
2008	Norman Lopes Matos	Monte Carlo Modeling of Direct X-Ray Imaging Systems	Dr. Dianat
2008	Prudhvi Gurram	Comparison of 1-D, 2-D, and 3-D Printer Calibration Algorithms with Printer Drift	Dr. Dianat
2008	Karteeek Chandu	Automatic Image Registration and Defect Identification of a Class Structural Artifacts in Printed Documents	Dr. Saber
2007	Jason Enslin	An Evolutionary Algorithm Approach to Simultaneous Multi-Mission Radar Waveform Design	Dr. Amuso
2007	Luis Garcia Ugarriza	Automatic Image Segmentation by Dynamic Region Growth and Multiresolution Merging	Dr. Saber
2007	Andrea Wyant	Genetic Algorithm Optimization Applied to Planar and Wire Antennas	Dr. Amuso
2007	Daniel Zhu	Source Localization within a Uniform Circular Sensor Array	Dr. Dianat
2007	Puneet Goyal	Design and Simulation of Strained-Si/Strained-SiGe Dual Channel Hetero-structure MOSFETs	Dr. Moon
2007	Manoj Kumar Reddy	A New Adaptive Edge Enhancement Algorithm for Color Laser Printers	Dr. Saber
2007	Hans Rotmann	Energy-and Area-Efficient DC-DC Converters Fabricated in Low Temperature Crystalline Silicon-on-Glass Technology	Dr. Bowman
2008	Karteeek Chandu	Automatic Image Registration and Defect Identification of a Class Structural Artifacts in Printed Documents	Dr. Saber
2007	Iheanyi Umez-Eronini	Online Structure, Parameter, and Utility Updating of Bayesian Decision Networks for Cooperative Decision-Theoretic Agents	Dr. Sahin
2007	Mustafa Jaber	Identification and Ranking of Relevant Image Content	Dr. Saber
2007	Anurag Sinha	Optimization of a New Digital Image Compression Algorithm Based on Nonlinear Dynamical Systems	Dr. Glenn Sr.
2007	Christopher Urban	Active Noise Cancellation Using Feed forward Techniques	Dr. Mukund
2007	Dereck Padden	Recursive Modeling of Interpositional Transfer Functions with a Genetic Algorithm Aided by an Adaptive Filter for the Purpose Of Altering Free-Field Sound Localization	Dr. Amuso
2006	Eric Harvey	Design and Fabrication of Silicon on Insulator Optical Waveguide Devices	Dr. Abushagur
2006	Mustafa Hussain	Dynamic Object Tracking by Partial Shape matching for Video Surveillance Application	Dr. Saber
2006	Sumit Nathany	Design of a 14-bit fully Differential Discrete Time Delta-Sigma Modulator	Dr. Islam
2006	Hector Santos	Streak Detection in Mottled and Noisy Images	Dr. Saber
2006	Lonnie Parker	Enhancement of a Three Dimensional Target Model for Deep Ground Penetrating Radar Systems	Dr. Amuso
2006	Guru Balasubramanian	Unsupervised color Image Segmentation Using a Dynamic Color Gradient Thresholding Algorithm	Dr. Saber
2006	Melissa Manney	A Charge control Model for III-V HEMTs Using a Self-Consistent Numerical solution of the Schrodinger and Poisson Equations	Dr. Islam
2006	Onome Ugbeme	An Automated Algorithm for the Identification of Artifacts in Mottled And Noisy Images	Dr. Saber
2006	Brandon Mikulis	Sequential Slice Object Labeling in Tomographic Data Via Trajectory Estimation	Dr. Rao
2006	Surat Teerakapibal	Tissue Surface Identification for Microwave Imaging System Calibrations	Dr. Dianat
2006	Aparna Limaye	Size Reduction of Microstrip Antennas Using Left-handed Materials Realized by Complementary Split-Ring Resonators	Dr. Venkataraman
2006	Varsha Sampath	Transrectal Ultrasound Image Processing for Brachytherapy Applications	Dr. Saber
2005	Daniel Brown	Analytical and Numerical Modeling, Fabrication and RF Measurement Techniques for RF Planar Micro-Inductors on Silicon	Dr. Venkataraman
2005	Mark Reisinger	A Piecewise Linear Approximation D/A converter for Small Format LCD Applications	Dr. Bowman
2005	Irme Knausz	An Ultra Low Power Digital to Analog Converter Optimized for Small Format LCD Applications	Dr. Bowman

## Appendix G: Representative Graduate Research Thesis & Papers cont.

2005	Ashish Vora	A 90 dB, 85 MHz Operational Transconductance Amplifier (OTA) Using Gain Boosting Technique	Dr. Moon
2005	Suneetha Kosaraju	Novel VLSI Architecture for Quantization and Variable Length coding For H-264/AVC Video Compression Standard	Dr. Hsu
2005	Mohamed Benmansour	Digitally Tunable Low Noise Amplifier	Dr. Mukund
2005	Paul Thompson	HCC Architecture-Hormonal Communications & Control Architecture	Dr. Amuso
2005	Mittal Bhatt	Detecting Glaucoma in Biomedical Data Using Image Processing	Dr. Rao
2005	Robert Kapfer	An Advanced Specular & Diffuse Bidirectional Reflectance Distribution Function Target	Dr. Amuso
2005	Ashish Digvadekar	A Sub 1 V Bandgap Reference Circuit	Dr. Amuso
2005	Modi Kalpesh	Vision Application of Humman Robot Interaction: Development of a Ping Pong Playing Arm	Dr. Sahin
2005	Sheetal Sonar-Pardeshi	The Development & Performance Evaluation of PIF Logic Functional Blocks	Dr. Patru
2004	Surat Atluri	Data Hiding in Images Based on Fractal Modulation and Diversity Combining	Dr. Rao
2004	Aaron Burry	An Adaptive Estimation Scheme for Deducing Communication in a Distributed Control Implementation	Dr. Hopkins
2004	Jeff McFiggins	Analytical & Numerical Modeling to Address Signal Integrity Issues in Mixed Signal Application	Dr. Venkataraman
2004	Jonathan Sippel	A Physics-Based Analytical Model of a AlGaIn/GaN High Electron Mobilty Transistor	Dr. Islam
2004	Marie Yvanoff	Generalized Analytical Model for RF Planner Inductors using a Segmentation Technique	Dr. Venkataraman
2004	Mike Seymour	Extraction of Frequency-Dependent Electrical Characteristics for Biological Tissues Using Ultra-Wideband Electromagnetic Pulse	Dr. Venkataraman
2004	Andrew Michael	Circle Formation Algorithm for Autonomus agents with Local Settings	Dr. Mathew
2004	Sankha Mukherjee	A Physics-Based Model of SIC-Based MESFETs	Dr. Islam
2004	Vaibhav Avachat	Computer Aided design of the Pipelined Interconnect Free Logic	Dr. Patru
2004	Tejasvi Das	Dynamic Input Match Correction in R.F. Low Noise Amplifiers	Dr. Mukund
2004	Mithun Mukerjee	P-HIP A Multiresolution Halftoning Algorithm for Progressive Display	Prof. Sharma
2004	Vignesh Kumar	Aswarm Intelligence Based Approach to the Mine Detection Problem	Dr. Sahin
2004	Frank Krueger	The Computer-Aided Design of Nano-scaled Digital Circuits	Dr. Lyshevski
2003	Bryce Tennant	Construction of M-Band Bandlimited Wavelets for Orthogonal Decomposition	Dr. Rao
2003	Murat Ozbas	Power Supply Noise Coupling In A Standard Voltage Reference Circuit	Dr. Patru
2003	Samantha Smith	A Survey of Epiretinal Implant Devices	Dr. Mukund
2003	Larry Wilkinson	Low -Pass Filter Design of Two-Channel IIR Perfect Reconstruction Filter Bank	Dr. Rao
2003	Konboye Oyake	Revision and Development of Laboratory Exercises (Microcomputer Systems & Computer Architecture)	Dr. Phillips
2002	Ajay Pasupuleti	A Fuzzy System for Adaptive Network Routing	Dr. Mathew
2002	Maulin Bhagat	Equivalent Circuit Models For Package Level Discontinuities And Chip-Package Interconnects	Dr. Venkataraman
2002	Aaron Thompson	Passive Amplitude-Modulated Microwave Backscatter Modulation System	Dr. Venkataraman

## **Appendix H: Electrical Engineering Department Faculty**

**Mustafa A. G. Abushagur**, Ph.D., California Institute of Technology, Director Chair of Ph.D. program in Microsystems Engineering. optical communications, computing, interconnects, MEMS, and optical signal processing, fiber bragg grating and sensors.

**Vincent J. Amuso**, Ph.D., Rensselaer Polytechnic Institute, Department Head, signal processing, communications

**David Borkholder**, Ph.D., Stanford University, Assistant Professor, biosensors (electromagnetic and chemical), biomedical instrumentation, MEMs fabrication, systems engineering

**Robert J. Bowman**, Ph.D., University of Utah, Professor, analog Integrated circuit design semiconductor physics, biomedical instrumentation

**Edward Brown**, Ph.D., Vanderbilt University, Assistant Professor, rehabilitation, robotics, control systems, biomechatronics

**Sohail A. Dianat**, Ph.D., George Washington University, Professor, control systems, communications, signal/Image processing

**Christopher Hoople**, Ph.D., Cornell University, Visiting Assistant Professor, power electronics, device physics

**Mark Hopkins**, Ph.D., Virginia Polytechnic, Associate Professor, control systems, system identification

**Sergey Lyshevski**, Ph.D., Kiev, Polytechnic Institute, Professor, microsystems

**A.V. Mathew**, Ph.D., Queens University (Ontario), Professor, control systems, robotic vision

**James Moon**, Ph.D., University of California at Berkeley, Associate Professor, solid state devices, VLSI Design, semiconductor physics, integrated circuit design, electronic & photographic imaging systems

**P.R. Mukund**, Ph.D., University of Tennessee, Gleason Professor, VLSI design, analog circuit design and electronics packaging

**Dorin Patru**, Ph.D., Washington State University, Assistant Professor, mixed-signal and digital integrated circuits

**Eric R. Peskin**, Ph.D., University of Utah, Assistant Professor, digital systems, reconfigurable computing

**Daniel Phillips**, Ph.D., University of Rochester, Associate Professor, biomedical instrumentation, signal processing & visualization, and embedded systems

**Sannasi Ramanan**, Ph.D., IIT, India, Associate Professor, semiconductor devices

**Raghuvveer Rao**, Ph.D., University of Connecticut, Professor, image and signal processing, digital communication

**Eli Saber**, Ph.D., University of Rochester, Associate Professor, signal, image & video processing communications, biomedical, computer vision

**Ferat Sahin**, Ph.D., Virginia Polytechnic Institute, Associate Professor, robotics, artificial intelligence, control systems

**Gill Tsouri**, Ph.D., Ben-Gurion University, Assistant Professor, signal processing, communications

**Jayanti Venkataraman**, Ph.D., Indian Institute of Science, India, - Professor, electro-magnetics, theoretical modeling and measurement of microstrip antennas and integrated microwave circuits, CRHL transmission line metamaterials, RF Microsystems, bioelectromagnetics.

## **Appendix I: Representative Publications**

### **Dr. Mustafa A. G. Abushagur**

- "Optical Fourier and Hartley Transform Adaptive Filters," *Microwave and Optical Technology Letters*, Vol. 40, pp. 280-285, M.A.G. Abushagur and Robert Berinato (2004).
- "Micro-optical crossconnect switch," *Proc. SPIE*, Vol. 5346, pp. 116-118 M.A.G. Abushagur (2004).
- "Lenslet-array-based Stokes vector imagery," *Proc. SPIE*, Vol. 5432, pp. 127-132, M.A.G. Abushagur, A.M. El-Saba (2004).
- "Highly efficient optical coupler using hybrid photonic crystal structures," *Proc. SPIE*, Vol. 5510, pp. 68-70, M.A.G. Abushagur and Rami Wahsheh (2004).

### **Dr. Vincent Amuso**

- **Vincent J. Amuso**, Jason Enslin, "The Strength Pareto Evolutionary Algorithm 2 (SPEA2) Applied to Simultaneous Multimission Waveform Design", Third International Conference on Waveform Diversity and Design, Pisa, Italy, June 2007.
- Vincent J. Amuso, R S Schneible, Y Zhang and P Antonik, "A Strength Pareto Evolutionary Algorithm (SPEA) for Multi-mission Radar Waveform Optimization", First International Conference on Waveform Diversity and Design, November 2004.
- Russell Brown, Jerry Genello, Douglas Lynch John Norgard, Michael Wicks Robert Kapfer, and Vincent J. Amuso, "System Survey of Deep penetrating Radar", Proceedings of the Tenth International Conference on Ground Penetrating Radar, Delft, the Netherlands, June 2004.
- Vincent J. Amuso, R S Schneible, Y Zhang and P Antonik, "Simultaneous Orthogonal Waveform Optimization via Evolutionary Computation", Second Annual Waveform Diversity Workshop, Verona NY, February 2004.
- Vincent J. Amuso, R S Schneible, Y Zhang and P Antonik, "Simultaneous Orthogonal Waveform Optimization via Evolutionary Computation", Second Annual Waveform Diversity Workshop, Verona NY, February 2004.
- Vincent J. Amuso, P Antonik, R.A. Schneible, and Y. Zhang, "Evolutionary Computation for Multi-mission Waveform Optimization", First Annual Waveform Diversity Workshop, NRL Washington DC, February 2003.
- Vincent J. Amuso, P Antonik, R.A. Schneible, and Y. Zhang, "Evolutionary Computation Approach to Multi-mission Waveform Design", Radar 2002, Edinburgh, Scotland, UK, October 2002.
- M.I. Savic, Vincent J. Amuso and D. Benincassa, "Speaker Separation", Proc. IEEE Dual Use Conference, Utica, NY, May 1995.

### **Dr. David Borkholder**

- Czernikowski, R.S., Bailey, M.B., **Borkholder, D.A.**, Marshall, M.M., Nye, A.H., and Reeve, N.R., "RIT's Engineering Honors Program: Product Innovation in a Global Economy," *Proceedings of the 37<sup>th</sup> Annual ASEE/IEEE Frontiers in Education Conference*, Milwaukee, WI, October 10-13 (2007).
- Johnson, D.G., Zhou, X.X., Frisina, R.D., and **Borkholder, D.A.**, "Micro-Molded Cannulae for Intracochlear Infusions in Small Rodents," *Proceedings of the 29th IEEE Annual Engineering in Medicine and Biology Society Conference*, Lyons, France, August 23-26 (2007).
- D. G. Johnson, X. X. Zhou, R. D. Frisina and D. A. Borkholder, "Micro-Molded Cannulae for Intracochlear Infusions in Small Rodents," Proc. 29th IEEE Annu. Engineering in Medicine and Biology Society Conf., August 23-26, 2007
- Johnson, D.G., Zhu, X., Frisina, R.D. and **Borkholder, D.A.**, "Engineered Interface for Intracochlear Infusions in Small Rodents," *ARO 2007 – 30th Annual Midwinter Meeting of the Association for Research in Otolaryngology*, Denver, CO, February 10-15 (2007).
- Raisi, F., Belgrader, P., Borkholder, D. A., Herr, A. E. Kintz G. J., Pourhamadi, F., Taylor, M. T., and Northrup, M. A., "Microchip Isoelectric Focusing Using a Miniature Scanning Detection System," *Electrophoresis*, 22(11):2291-2295 (2001).
- Belgrader, P., Okuzumi, M., Pourahmadi, F., Borkholder, D.A., and Northrup, M.A., "A Microfluidic Cartridge to Prepare Spores for PCR Analysis," *Biosensors & Bioelectronics* 14:849-852 (2000)

### Dr. Robert Bowman

- B. Mott, C. Natoli, C Feuerstein, N. Montena, J. Revelli, R. Bowman, “*Sensing RF Connector Tightness Using a Grounded Plate Capacitive Structure*”, accepted for publication in the IEEE Sensors Journal.
- *Electrical Engineering Freshman Practicum*, R J Bowman, Wiley, 5<sup>th</sup> edition, 2008, ISBN 9780470431252
- *Electrical Engineering Freshman Practicum*, R J Bowman, Wiley, 4<sup>th</sup> edition, 2006, ISBN 0470-10867-3.
- *Electrical Engineering Sophomore Practicum*, R J Bowman, Wiley, 3rd edition, 2006, ISBN 0-471-71924-2
- *Electrical Engineering Sophomore Practicum*, R J Bowman, Wiley, 2<sup>nd</sup> edition, 2005, ISBN 0-471-71924-2
- D. Patru, J. Kolzak, and R. J. Bowman, “A Custom Launch System for Satellites Smaller than 1Kg”, Small Satellite Conference, Utah St. Univ., August, 2006.
- I. Knausz and R. J. Bowman, “A 250 Microwatt 0.042mm<sup>2</sup>, 2MS/s 9b DAC for Liquid Crystal Display Drivers”, IEEE International Solid State Circuits Conference, 9.1, Feb.,2006.
- R. J. Bowman, "Electrical Engineering Freshman and Sophomore Practicum", ASEE St. Lawrence Section Conference, Binghamton University, 8-9 April 2005. Best Paper Award for the conference.
- S. Mukherjee, S. Islam, and R. Bowman, "An Analytical Model of SiC MESFET incorporating trapping and thermal effects", Solid State Electronics, 48, pp. 1709-1715, Elsevier, 2004 Electrical Engineering Freshmen Practicum, R J Bowman, Wiley, 2<sup>nd</sup> edition, 2003, ISBN 0-471-62863-8
- Electrical Engineering Sophomore Practicum, R J Bowman, Wiley, 2004, ISBN 0471-71924-2 Book Chapter in *The Design of Analog Integrated Circuits*, Edited by Mohammed Ismail, "Analog Integrated Circuit Design Conceptualization" by R. J. Bowman, Kluwer Publishing, 1990.

### Dr. Edward Brown

- Brown, Jr., E.E., "The ST@R Project: An Initiative to Increase the Retention Rates of 1<sup>st</sup> and 2<sup>nd</sup> Year Underrepresented Students Enrolled in Electrical Engineering," *2007 ASEE Annual Conference*, Honolulu, HI, June 24-27<sup>th</sup>, 2007.
- Brown, Jr., E. E., "An Introduction to the Biomechatronic Learning Lab," *NSF Workshop for the Advancement and Retention of Underrepresented and Minority Engineering Educators*, Arlington, VA, March 5-8<sup>th</sup>, 2006.
- Phillips, D. B., Borkholder, D. A., Brown, Jr., E. E., "Establishing a Biomedical Option in Electrical Engineering," *2005 ASEE St. Lawrence Section Conference*, Binghamton, NY, April 8-9, 2005.
- Park, J., Ratanaswasd, P., Brown, Jr., E. E., Rogers, T. E., Kawamura, K., and Wilkes, D.M., "Towards a Personal Robotic Aid System", *International Journal of Human-Friendly Welfare Robotic Systems*, Vol. 5, No. 2, pp.2-12, June 2004.
- Brown, Jr., E.E., Wilkes, M., Kawamura, K., “Development of an Upper Limb, Intelligent Orthosis Using Pneumatically Actuated, McKibben Artificial Muscles,” *7<sup>th</sup> International Conference on Rehabilitation Robotics*, Evry, France,p.24-30, April 2001
- Northrup, S., Brown, Jr., E.E., Parlaktuna, O., and Kazuhiko, K., “Biologically-Inspired Control Architectures for an Upper Limb, Intelligent Robotic Orthosis,” submitted to the *Journal of the Human-Friendly Welfare Robot System Engineering Research Center (HWRS-ERC)*, Oct, 2001
- Wilkes, M., Alford, A., Pack, T., Roger, T., Brown, Jr., E., Peters II, A., and Kazuhiko, K., “Service Robots for Rehabilitation and Assistance,” In: Teodorescu, H-N., L. and Jain, L. C. (Eds.), *Intelligent Systems and Technologies in Rehabilitation Engineering*, CRC Press, Boca Raton, FL, 2001

### Dr. Sohail Dianat

- S. A. Dianat, “SNR Estimation in Nakagami Fading Channels with Arbitrary Constellation,” *IEEE International Conference on Acoustics, Speech and Signal Processing*. Toulouse, Honolulu., Hawaii April 15-20, 2007.
- S. A. Dianat, L. K. Mestha, “Dynamic Optimization Algorithm for Generating Inverse Printer Map with Reduced Measurements” Accepted for publication. *2006 IEEE International Conference on Acoustics, Speech and Signal Processing*. Toulouse, France, May 14-19, 2006.

- S.A Dianat and M.R. Raghuveer, `` Estimation of Parameters of Input Traffic Streams from Statistically Multiplexed Output,`` Accepted for publication. *SPIE Conf. on Digital Wireless Communication*, Orlando, FL, April 2006.
- P. K. Gurram, S. A. Dianat, L. K. Mestha, and Raja Bala, "Comparison of 1-D,2-D and 3-D Printer calibration Algorithms with Printer Drift" *Proc. IS&T's Int. Conf. On Digital printing technology*, Baltimore., Maryland, September 2005.
- Eli Saber, S. A Dianat, L. K. Mestha and Perry Y. Li "Applications of Signal Processing Techniques to Digital Color Printing Systems", *IEEE Signal Processing Magazine – June 2005*.
- L. K. Mestha, R. E. Viturro, Y. R. Wang, and S.A. Dianat, "Gray Balance Control Loop for Digital Color Printing Systems" *Proc. IS&T's Int. Conf. On Digital printing technology*, Baltimore., Maryland, September 2005.
- S. A Dianat and Raghuveer Rao "A Subspace-Based Approach to Carrier Phase Estimation," *SPIE Conf. on Digital Wireless Communications*, Orlando, FL, March 2005.
- Anar Mehta and S. A. Dianat "Combined MAP-Kalman Filter Channel Estimation Algorithm for Space-Time Block Coded Communication Systems", *First International Conference on Waveform Diversity and Design*, Edinburgh, Scotland Nov 8-10, 2004.
- D.E. Viassolo, S.A. Dianat and L. K. Mestha "A practical algorithm for the inversion of an experimental input-output color map for color correction," *Journal of Optical Engineering. Accepted for publication*. Vol. 42, No. 3, March 2003.
- Rajesh Narasimha and S. A. Dianat "Blind Adaptive Decision Feedback Multiuser Detector for DS-CDMA with Power Estimation", *IEEE Vehicular Technology Conference, Birmingham, AL, May 6-9, 2002*.
- Perry Li, and S.A. Dianat," Robust Stabilization of Tone Reproduction Curves for the Xerographic Process," *IEEE Transactions on Control Systems Technology*, Vol.9, No.2, pp. 407-415, March 2001.

#### **Dr. Mark Hopkins**

- Hopkins, Mark A., "Relating continuous-time and discrete-time in the classroom," *Proceedings of ASEE 2008 Annual Conference and Exposition*, AC-2008-2741, Pittsburgh PA, June 22-25, 2008.
- Hopkins, Mark A., "Improved selection of state-weighting matrices for LQR MIMO-controller design," *Proceedings of IASTED, 10th International Conference on Intelligent Systems and Control*, L. M. Sztandera, ed., Vol. 592-800, Cambridge MA, November, 2007.
- Hopkins, Mark A., "Demonstrating in the classroom the ideas of frequency response," *Proceedings of ASEE Engineering Teaching and Learning Practices*, Joan Dannenhoffer, ed., Toronto ONT, October, 2007.
- Mark A. Hopkins, "Improved selection of state-weighting matrices for LQR MIMO-controller design," *10th IASTED International Conference on Intelligent Systems and Control*, to be presented Nov. 19-21, 2007, Cambridge MA.
- Rowen, D.W., and M.A.Hopkins, "H-infinity controller design for structural damping," *Proceedings of SPIE*, Vol. 6169, 13th International Symposium on Smart Structures and Materials, Damping and Isolation Conference, February 26 - March 3, 2006.
- Mark A. Hopkins, David A. Smith, Phillip Vallone, Richard Sandor, "Hybrid multivariable controller architecture", *Proceedings of SPIE Vol. 5760 Smart Structures and Materials Symposium, Damping and Isolation Conference*, March 2005, pages 390-401.

#### **Dr. Sergey Lyshevski**

- S. Yanushkevich, S. E. Lyshevski and V. Shmerko, *Computer Arithmetics for Nanoelectronics*, CRC Press, Boca Raton, FL, 2008
- V. Giurgiutiu and S. E. Lyshevski, *Micromechatronics: Modeling, Analysis, and Design With MATLAB®*, CRC Press, Boca Raton, FL, 2008 (second edition)
- S. E. Lyshevski, *Electromechanical Systems and Devices*, CRC Press, Boca Raton, FL, 2008
- S. E. Lyshevski, V. P. Shmerko, M. A. Lyshevski and S. N. Yanushkevich, "Neuronal processing, reconfigurable neural networks and stochastic computing," *Proc. IEEE Conference on Nanotechnology*, Arlington, TX, 2008.
- S. E. Lyshevski, "Neuroarchitectonics and neuromorphological molecular processing platforms," *Proc. IEEE Conference on Nanotechnology*, Arlington, TX, 2008

- S. E. Lyshevski, "Characterization of physical defects and fault analysis of molecular and nanoscaled integrated circuits," *Proc. IEEE Conference on Nanotechnology*, Arlington, TX, 2008
- M. A. Lyshevski and S. E. Lyshevski, "Molecular and biomolecular processing: Three-dimensional-topology processing and memory cells," *Proc. IEEE Conference on Nanotechnology*, Arlington, TX, 2008
- S. E. Lyshevski, "Quantum-effect multi-terminal molecular electronic devices," *Proc. IEEE Conference on Nanotechnology*, Arlington, TX, 2008
- S. E. Lyshevski and A.S.C. Sinha, "Control of charge carriers in molecular devices," *Proc. IEEE Conference on Nanotechnology*, Arlington, TX, 2008
- M. A. Lyshevski and S. E. Lyshevski, "Rhodopsin photon receptor energetics: Studies of biomolecular sensing and processing," *Proc. IEEE Conference on Nanotechnology*, Arlington, TX, 2008.
- S. E. Lyshevski, "Quantum mechanics and electromagnetics of weak magnetic field sensing, storage and retrieval in biosystems and *engineered* systems," *Proc. IEEE Conference on Nanotechnology*, Arlington, TX, 2008.
- S. E. Lyshevski, V. P. Shmerko and S. N. Yanushkevich, "Benchmarking performance and physical limits on processing electronic device and systems: Solid-state, molecular and *natural* processing paradigms," *Proc. NanoTech Conference*, Boston, MA, vol. 3, pp. 31-34, 2008.
- E. Vaganova, H. Ovadia, S. E. Lyshevski, V. Khodorkovsky, I. F. Pierola and S. Yitzchaik, "Conformational changes of acetylcholine during spontaneous diffusion through a nano/microporous gel," *Proc. NanoTech Conference*, Boston, MA, vol. 1, pp. 348-351, 2008.
- M. A. Lyshevski and S. E. Lyshevski, "Three-dimensional-topology processing and memory cells," *Proc. NanoTech Conference*, Boston, MA, vol. 3, pp. 35-38, 2008
- M. A. Lyshevski and S. E. Lyshevski, "*Fluidic* molecular processing and interfacing devices," *Proc. NanoTech Conference*, Boston, MA, vol. 1, pp. 266-269, 2008
- S. E. Lyshevski, "Sensing weak magnetic fields by living systems and a magnetoreception mechanism for navigation," *Proc. NanoTech Conference*, Boston, MA, vol. 3, pp. 199-202, 2008
- S. E. Lyshevski, "Genomics and proteomics: *Information-theoretic* analysis in frequency domain," *Proc. NanoTech Conference*, Boston, MA, vol. 2, pp. 19-21, 2008

#### **Dr. A.V. Mathew**

- David Coumou and Athimoottil Mathew, "A *Fuzzy system Solution For Digital Image Watermarking*" SPIE Annual International Conference, August 2003
- A. Pasupuleti, A. V. Mathew, N. Shenoi and S.A Dianat "A *Fuzzy System for Adaptive Network Routing*," SPIE Conf. on Digital Wireless Communications, Orlando, Fl, April 2002.
- Odd Moore and Athimoottil Mathew, "*Improved Fuzzy Frequency Hopping*", MILCOM conference, November 1997
- Craig Garvin and Athimoottil Mathew, "*The Application of the Method of Simultaneous Stabilization to the Control of a Nonlinear Servo Valve*", IEEE Trans. on Control Systems Technology, vol.4, No.6, November 1996
- V. Swarnakar, A.V. Mathew, E.R. Dougherty and C. Sibata, "*A Discrete Lattice Theoretic Approach*", SPIE Optimal Restoration of Compressed Biomedical Images: Conference on Medical Imaging, California, Feb. 1996

#### **Dr. James Moon**

- S. A. Parke, J. E. Moon, H. C. Wann, P. K. Ko, and C. Hu, "Design for Suppression of Gate-Induced Drain Leakage in LDD Mosfet's using a Quasi-Two-Dimensional Analytical Model," *IEEE Trans. Electr. Dev.*, vol. 39, p. 1694, July 1992
- J.E. Moon, C. Galewski, T. Garfinkel, M. Wong, W. G. Oldham, P. K. Ko, and C. Hu, "A Deep-Submicrometer Raised Source/Drain LDD Structure Fabricated Using Hot-Wall Epitaxy," *Int. Symp. VLSI Technology, Systems, and Applications*, Taiwan, 1991.

### Dr. P.R. Mukund

- T.Das, A. Gopalan, C. Washburn and P.R. Mukund, "Towards Fault-tolerant RF front-ends", *Journal of Electronic Testing (JETTA)*, Vol.22, No. 4-6, December, 2006, pp. 371-386
- T.Das, A. Gopalan, C. Washburn and P.R. Mukund, "Self-Calibration of Input-Match in R.F. Front-end Circuitry", *IEEE Transactions on Circuits and Systems*, Vol.52, No. 12, pp. 821 – 825, Dec. 2005
- Sri Priya R Bandi<sup>1</sup>, Clyde Washburn<sup>1</sup>, P.R.Mukund<sup>1</sup>, Jan Kolnik<sup>2</sup>, Ken Paradis<sup>2</sup>, Steve Howard<sup>2</sup>, and Jeff Burleson, "Universal MOSFET Gate Impedance Model For 200M-20GHz Frequency Range", *Accepted, Journal of Solid State Electronics*.
- Sri Priya R Bandi, Clyde Washburn, P.R.Mukund, Jan Kolnik, Ken Paradis, Steve Howard and Jeff Burleson, "Effect of Gate Poly-Silicon Depletion on MOSFET Input Impedance", *IEEE Microwave and Wireless Components Letters*, Vol.16, issue 5, May 2006, pp. 290-292.
- Anand Gopalan, M. Margala, P.R. Mukund, "A Current Based Self-Test Methodology for RF Front-end Circuits", *Accepted by the Microelectronics Journal*.
- Anand Gopalan, Tejasvi Das, Clyde Washburn and P.R. Mukund, "BiST for Multi-GHz CMOS RF Front-ends", *Under review at the IEEE Transactions on Circuits and Systems I*.
- Jay Fukumoto, Tejasvi Das, Ken Paradis, Jeff Burleson, J.E Moon and P.R. Mukund, "Impact of Asymmetric Metal Coverage on High Performance MOSFET Mismatch", *Journal of Solid-State Electronics*, Oct-Nov 2004, vol.48, pp 1667-1670
- R.Narasimha, S.Bandi, R.M. Rao and P. R. Mukund, "Discrete-Time Simulation Model for 1/f Noise", *IEEE Transaction on Electron Devices*, August 2004, vol. 51, no.8, pp 1340-1343
- Tejasvi Das, Clyde Washburn, Steve Howard, Ken Paradis, Jung-Geau Jang, Jan Kolnik, Jeff Burleson and P.R.Mukund, "Effects of Technology and Dimensional Scaling on Input Loss Prediction of RF MOSFETs", *Accepted for publication at the 18<sup>th</sup> International Conference on VLSI Design*, Kolkata, India, January 2005.
- Anand Gopalan, Tejasvi Das, Clyde Washburn and P.R.Mukund, "An Ultra-Fast, On-chip BiST for RF Low Noise Amplifiers", *Accepted for publication at the 18<sup>th</sup> International Conference on VLSI Design*, Kolkata, India, January 2005.

### Dr. Dorin Patru

- Dorin Patru, Daniel B. Phillips, Eric Peskin, "A Two Course Sequence in Computer Engineering Principles for Electrical Engineering Students", *Proceedings of the ASEE Conference 2007*.
- Marcos Esterman, Vincent Amuso, Edward Hensel, Dorin Patru, Mark Smith "Development of Integrated Project Tracks for a College-Wide Multidisciplinary Engineering Design Program at RIT", *Proceedings of the ASEE Conference 2007*.
- Dorin Patru, Jeffrey D. Kozak, Robert J. Bowman, "The Design of a Small Satellite Launch System – A Multidisciplinary Capstone Experience", *Proceedings of the 9th International Conference on Engineering Education*, San Juan, PR, 2006.
- Dorin Patru, Konboye Oyake, "A Coherent Sequence of Computer Architecture Laboratory Assignments", *Proceedings of the 9th International Conference on Engineering Education*, San Juan, PR, 2006.
- Dorin Patru, Jeffrey D. Kozak, Robert J. Bowman, "A Custom Launch System for Satellites Smaller than 1 kg", *Proceedings of the 20th Small Satellite Conference*, Logan, UT, August 2006.

### Dr. Eric Peskin

- G. P. Balasubramanian, E. Saber, V. Misic, E. Peskin, and M. Shaw. "Unsupervised color image segmentation using a dynamic color gradient thresholding algorithm". In *Human Vision and Electronic Imaging XIII* (B. E. Rogowitz and T. N. Pappas, eds.), vol. 6806, SPIE, 2008.
- Dorin Patru, Daniel Phillips, and Eric Peskin. [A Two Course Sequence in Computer Engineering Principles for Electrical Engineering Students](#). In *Proceedings of the 2007 ASEE Annual Conference and Exposition (ASEE2007)*, paper number AC 2007-2683, June 2007.
- Timothy Lantz and Eric Peskin. A QCA Implementation of a Configurable Logic Block for an FPGA. To appear in *Proceedings of the Third International Conference on Reconfigurable Computing and FPGAs 2006 (ReConFig'06)*. September 2006.
- Dorin Patru, Konboye Oyake, Eric R. Peskin. [A Coherent Sequence of Computer Architecture Laboratory Assignments](#). In *Proceedings of the Ninth International Conference on Engineering Education (ICEE 2006)*, pages M4G-12-M4G-17, July 2006.

- C. J. Myers, W. Belluomini, K. Killpack, E. Peskin, H. Zheng. Timed Circuits: A new Paradigm for high-speed design. In Proceedings of the Asia and South Pacific Design Automation Conference, pages 335-340, February 2001.

#### **Dr. S. Ramanan**

- Ramanan, S., Turkman, R., Fuller, L.F. and Pearson, R.E., "*An One-Dimensional Electro-Thermal Simulation Program for Device Analysis at Cryo Temperatures*", University/Government/Industry Microelectronics Symposium Proceedings IEEE. CAT. 87CH2401-8, pp. 214-217, June 1987.
- Pearson, R.E., Fuller, L.F., Turkman, R. and Ramanan, S., "*PMOS Metal Gate Process, Ideal for Undergraduate Integrated Circuit Fabrication Projects*," University/Government/Industry Microelectronics Symposium Proceedings IEEE. CAT. 87CH2401-8, pp. 126-128, June 1987.

#### **Dr. Raghuvver Rao**

- E. Bayraktar, H.V. Poor and R.M. Rao, "Prediction and Tracking of Long Range Dependent Sequences." Systems and Control Letters, Vol. 54, No. 11, pp. 1083-1090, November 2005.
- S. Lee and R.M. Rao, "Self-similar random field models in discrete-space," IEEE Transactions on Image Processing, Vol. 15, No. 1, pp. 160-168, January 2006.
- B. Pidaparathi, R.M. Rao, and H. Peng "Separating linear features from textured backgrounds," Journal of Electronic Imaging, Vol. 15, No. 2, pp. 023012:1-7, April-June 2006.
- R.M. Rao and B. Himed, "Correlative Interferometric Imaging of Extended Objects for Near Field Arrays," Proc. First IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing, Puerto Vallarta, Mexico, pp. 32-35, December 2005.
- J. Tillett, T.M. Rao, F. Sahin and R.M. Rao, "Darwinian particle swarm optimization," Proceedings of International Conference on Artificial Intelligence, Pune, India, pp. 174-1487, December 2005.
- R. Narasimha, R.M. Rao and S.A. Dianat, "Finding input data rates of statistically multiplexed traffic," Proceedings of the 40<sup>th</sup> Conference on Information Sciences and Systems, Princeton, New Jersey, March 2006.
- R. Narasimha, S. Lee and R.M. Rao, "Multidimensional discrete-space self-similarity," Proceedings of the 40<sup>th</sup> Conference on Information Sciences and Systems, Princeton, New Jersey, March 2006.
- P. Varshney, M. Arora, and R.M. Rao, "Signal processing for hyperspectral data," Proceedings of the IEEE International Conference on Acoustics, Speech and Signal Processing, Toulouse, France, May 2006.
- R.M. Rao and S. Lee, "A Video Processing Approach for Distance Estimation," Proceedings of the IEEE International Conference on Acoustics, Speech and Signal Processing, Toulouse, France, May 2006.
- R. Narasimha, R.M. Rao and S.A. Dianat, "Estimating degree of mixing in statistically multiplexed data," Proceedings of the SPIE Conference on Wireless Sensing and Processing, Orlando, FL, April 2006.

#### **Dr. Eli Saber**

- V. Sampath, V. Mistic, E. Saber, H Liu and Y Yu, "Prostate Boundary Detection and Volume Estimation Using TRUS Images for Brachytherapy Applications", accepted for publication in the International Journal of Computer Assisted Radiology and Surgery.
- A. Ononye, A. Vodacek and E. Saber, "Automated Extraction of Fire Line Parameters from Multispectral Infrared Images", Journal of Remote Sensing of Environment, Vol. 108, pp. 179 – 188, 2007
- E. Saber, S. Dianat and L. K. Mestha, "Application of Digital Signal Processing Techniques to Digital Color Printing Systems", IEEE SP Magazine, July 2005.
- M. Celik, G. Sharma, A. M. Tekalp, E. Saber, "Lossless Generalized-LSB Data Embedding", IEEE Transaction on Image Processing, Feb. 2005.
- M. Vrhel, E. Saber, and H. J. Trussell, "Color Image Generation & Display Technologies", IEEE Signal Processing Magazine, January 2005.
- H. J. Trussell, E. Saber and M.Vrhel, "Color Image Processing: Basics and Special Issue Overview", IEEE Signal Processing Magazine, January 2005.
- Y. Xu, E. Saber, and A. M. Tekalp, "Dynamic Learning from Multiple Examples for Semantic Object Segmentation and Search", Computer Vision and Image Understanding, Vol.95, No. 3, pp. 334-353, Sept 2004.

- Y. Xu, P. Duygulu, E. Saber, A. M. Tekalp, and F. T. Yarman-Vural, “Object-Based Image Labeling through Learning by Example and Multi-Level Segmentation”, *Pattern Recognition*, vol. 36 (6), pp. 1407-1423, June 2003.
- Y. Xu, E. Saber, and A. M. Tekalp, “Hierarchical Content Description and Matching for Efficient Color and Shape-Based Object Retrieval by Learning from User Search-Patterns and Profiles”, *IEEE Transactions on Image Processing*, Vol. 12, No. 6, June 2003.
- Y. Xu, P. Duygulu, E. Saber. A. M. Tekalp, and F. T. Yarman-Vural, “Object-Based Image Labeling Through Learning by Example and Multi-Level Segmentation.” *Pattern Recognition*, vol.36 (6), pp. 1407-1423, June 2003
- Y. Xu, E. Saber, and A.M. Tekalp, “Hierarchical Content Description and Matching for Efficient Color and Shape-Based Object Retrieval by Learning from User Search-Patterns and Profiles”, *IEEE Transactions on Image Processing*, Vol. 12, No. 6, June 2003

#### **Dr. Ferat Sahin**

- Sahin F. and Devasia A., “Distributed Particle Swarm Optimization for Structural Bayesian Network Learning”, *Swarm Intelligence: Focus on Ant and Particle Swarm Optimization*, Advanced Robotics Systems International, December 2007.
- Sahin, F. and Kachroo P., *Practical and Experimental Robotics*, CRC Press, August 2007.
- Iheanyi C. Umez-Eronini and Ferat Sahin, “Decision Theoretic Agent Design for Personal Rapid Transit Systems”, *Engineering Letters*, 15:2, pages 266 – 271, December 2007.
- Pasupuleti A., Sahin F., “Application of soft computing techniques to estimate the effective Young’s Modulus of Thin Film Materials” *Engineering Letters*, 14:2, pages 95 – 102, June 2007.
- Sahin F., Yavuz C. M., Arnavut Z., and Uluyol O. “Fault Diagnosis for Airplane Engines using Bayesian Networks and Distributed Particle Swarm Optimization”, *Parallel Computing*, vol. 33, issue 2, pp. 124- -143, March 2007.
- Carano A. L., Vora B. S., Sahin F., and Lemaster R. L, “Monitoring of Abrasive Loading for Optimal Tool Replacement”, *Forrest Products Journal*, vol.57, no. 5, pp. 78 – 83, May 2007
- Arnavut Z. and Sahin F., “Lossless Compression of Color Palette Images with One Dimensional Techniques,” *the Journal of Electronic Imaging*, vol. 15, issue 2, pp. 023014-1;11, April-June 2006.
- Parisi, C., Sahin F., Jamshidi M., “A Discrete Event XML based System of Systems Simulation for Robust Threat Detection and Integration”, in the proceedings of *IEEE SMC International Conference on System of Systems Engineering*, Monterey, CA, June 2008.
- Straus C. and Sahin F.,” Autonomous Navigation based on a Q-learning algorithm for a Robot in a Real Environment”, in the proceedings of *IEEE SMC International Conference on System of Systems Engineering*, Monterey, CA, June 2008.
- Van Hook J., Sahin F. and Arnavut Z., “Application of Particle Swarm Optimization for Traveling Salesman Problem to Lossless Compression of Color Palette Images”, in the proceedings of *IEEE SMC International Conference on System of Systems Engineering*, Monterey, CA, June 2008.
- Sahin F., Sridhar P., Horan B, Raghavan V., and Jamshidi M., “System of Systems Approach to Threat Detection and Integration of Heterogeneous Independently Operable Systems”, in the *Proceedings of IEEE Systems, Man, and Cybernetics Conference (SMC 2007)*, Montreal, October 2007.
- Sahin F., Jamshidi M., Sridhar P. “A Discrete Event XML based Simulation Framework for System of Systems Architectures”, presented in the *Proceedings of IEEE System of Systems Engineering Conference*, San Antonio, April 2007.

#### **Dr. Gil Tsouri**

- G. R. Tsouri and D. Wulich, “Impact of Linear Power Amplifier Efficiency on Capacity of OFDM Systems with Clipping”, *IEEE 25th Convention of Electrical and Electronics Engineering in Israel*, Dec. 2008.
- G.R. Tsouri, D. wulich and L. Goldfeld, “Enabling Dual Branch Switched Diversity in Compact Wireless Devices”, *IEEE Trans. On consumer Electronics*, Nov. 2008
- G. R. Tsouri, “Optimized OFDM for wireless time varying channels,” Ph.D. dissertation - Ben-Gurion University of the Negev, Beer-Sheva Israel, Aug. 2008.
- G. R. Tsouri and D. Wulich, “Capacity Analysis and Optimization of OFDM with Distortionless PAPR Reduction”, *European Trans. on Telecommunications (ETT)*, Aug. 2008.

- G. R. Tsouri and D. Wulich, "Efficient Coding of Side Information for Selected Mapping PAPR Reduction", IEEE Wireless Telecommunications Symposium (WTS), Apr. 2008.
- G. R. Tsouri and D. Wulich, "Reverse Piloting Protocol for Securing Wireless Time Varying Channels", IEEE Wireless Telecommunications Symposium (WTS), Apr. 2008.
- G. R. Tsouri and D. Wulich, "A Physical Transmission Security Layer for Wireless Multiple Access Communication Systems", European Signal Processing Conference (EUSIPCO) – special session, Sep. 2007.
- G. R. Tsouri, D. Wulich, SigNexT Comm., (WO/2007/039908) Joint Constellation Multiple Access – PCT patent pending, Apr. 2007. (<http://www.wipo.int/pctdb/en/wo.jsp?IA=WO2007039908>)
- D. Wulich and G. R. Tsouri, "Is PAPR Reduction Always Justified for OFDM?", European Wireless Conference (EW) – invited paper, Apr. 2007.
- G. R. Tsouri and D. Wulich, "Wireless Channel Access through Jointly Formed Signal Constellations", IEEE Annual International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), Sep. 2006.
- G. R. Tsouri and D. Wulich, "Selection Combining Upgrade Schemes for Mobile Units in Wireless Networks", WSEAS Trans. on Communication, July 2005.
- G. R. Tsouri, "Enhancing switched diversity systems," M.Sc. thesis - Ben-Gurion University of the Negev, Beer-Sheva Israel, Aug. 2004.
- G. R. Tsouri, D. Wulich and L. Goldfeld, "Enhancing Switched Diversity Systems", IEEE Sensor Array and Multichannel Signal Processing Workshop (SAM), July 2004.
- D. Wulich, L. Goldfeld and G. R. Tsouri, "Peak to Average Power Ratio in Digital Communications", IST mobile & Wireless Communication Summit, June 2003.

#### **Dr. Jayanti Venkataraman**

- Yvanoff M, Venkataraman J, and Fuller, L, "Impact of Multiple Tissue Layers on an Implantable LC Sensor" Microwave and Optical Technology Letters, vol. 50, No.3, March 2008, p783
- Yvanoff M, and Venkataraman J, "Implantable LC Sensors for Biotelemetry", Invited Paper, URSI General Assembly, International Conference, Chicago August 12, 2008
- Venkataraman J, Arvas E. and Arvas S. "Project Based Graduate Antenna Courses" IEEE AP-S International Symposium, San Diego, CA, July 5, 2008
- Venkataraman J. and Arvas E. "Project Based Courses in Microwave Circuits and Antennas" Invited Paper, Applied Computational Electromagnetic Society ACES International Conference, Niagara Falls, March 30, 2008
- Bukowski S.P., Orban F., Hasanovic M., Venkataraman J, "Ka-Band Wilkinson Power Divider with Integrated Thin Film Resistor" Applied Computational Electromagnetic Society ACES International Conference, Niagara Falls, March 30, 2008
- DeSignor J. and Venkataraman J, "Reconfigurable Dual Frequency Microstrip Patch Antenna Using RF MEMS Switches" Applied Computational Electromagnetic Society ACES International Conference, Niagara Falls, March 30, 2008
- Yvanoff M, and Venkataraman J, "Implantable LC Sensor for Tissue Characterization" Invited Paper, USNC/CNC/URSI, Boulder, CO, January 4, 2008.
- J. Venkataraman "Electric and Magnetic Fields – A Double Jeopardy" IEEE AP-S International Symposium Honolulu, Hawaii, June 2007
- Marie Yvanoff, Lynn Fuller, Jayanti Venkataraman "Implantable Micro-Transceiver Wireless Link for Intra-Ocular Pressure Measurement" IEEE AP-S International Symposium Honolulu, Hawaii, June 2007
- Danny Z. Zhu, Sohail A. Dianat, Jayanti Venkataraman "Localization of a Stationary Source within a Uniform Circular Sensor Array – Part I" IEEE AP-S International Symposium Honolulu, Hawaii, June 2007
- Aparna U. Limaye and Jayanti Venkataraman "Size Reduction in Microstrip Antennas using Left-Handed Materials Realized by Complementary Split-Ring Resonators in Ground Plane" IEEE AP-S International Symposium Honolulu, Hawaii, June 2007