

DEPARTMENT OF ELECTRICAL AND
COMPUTER ENGINEERING

ECE STUDENT
HANDBOOK

COLLEGE OF SCIENCE & ENGINEERING
UNIVERSITY OF MINNESOTA DULUTH

FALL 2009

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Email: ece@d.umn.edu
www.d.umn.edu/ece/

Individuals who have any disability, either permanent or temporary, which might affect their ability to perform in class are encouraged to inform the instructor at the start of the semester. Adaptation of methods, materials, or testing may be made as required to provide for equitable participation.

The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, religion, color, sex, national origin, handicap, age, veteran status or sexual orientation.

UNIVERSITY OF MINNESOTA

Duluth Campus

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Engineering*

College of Science and Engineering

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Fall 2009

Dear ECE student:

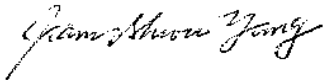
On behalf of the faculty and staff, I would like to welcome you to the Department of Electrical and Computer Engineering. I am very proud of our ECE program, our faculty and staff, and our facilities.

Our courses are rigorous and taught by well-trained, dedicated faculty. We have excellent laboratories with state-of-the-art equipment. Our faculty have rich academic, industrial, and professional engineering practice experience; therefore I strongly encourage you to visit them not only to seek assistance on specific course topics but to discuss academic and career planning as well. The student branch of the Institute for Electrical and Electronics Engineers (IEEE) also provides you with opportunities to learn about engineering outside the classroom through a variety of organized activities. I encourage you to actively participate in this professional society and departmental activities to benefit your career development.

ECE faculty and staff are here to assist you as you work towards your Bachelor or Master of Science degree in Electrical and Computer Engineering. This handbook has been assembled to provide you with important information, so please read it carefully. You can also check our updated ECE Web page at <http://www.d.umn.edu/ece>. Feel free to visit me or to contact me via telephone or email.

Again, I welcome you to the ECE Department and offer the best wishes for a successful academic career.

Sincerely,



Jiann-Shiou Yang
Professor and Department Head
Phone: (218) 726-6290
Email: jyang@d.umn.edu

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PART I: ECE DEPARTMENT INFORMATION

ECE FACULTY AND STAFF

NAME	POSITION	MWAH ROOM #	OFFICE TELEPHONE
Bai, Dr. Jing jingbai@d.umn.edu	Assistant Professor	255	8606
Bergh, Kathleen (Kathy) ece@d.umn.edu or kabergh@d.umn.edu	Office Support Assistant	271	6147
Burns, Dr. Stanley sburns@d.umn.edu	Professor and Associate Dean	102 EB 148 MWAH	7506
Carroll, Dr. Christopher ccarroll@d.umn.edu	Associate Professor and Assistant Department Head	252	7530
SCSE Assembly Student Rep.	John Hoverman	----	----
Ferguson, Tom tferguso@msn.com	Adjunct Visiting Professor (Fall 2009 – Present)	144	8844
Hasan, Dr. Mohammed mhasan@d.umn.edu	Associate Professor	254	6150
Hayee, Dr. Imran ihayee@d.umn.edu	Associate Professor and Director of Graduate Studies	278	6743
<u>IEEE Officers</u>			
Bezdicek, Ryan bezdi001@d.umn.edu	President	102	6196
Marcaccini, David marc0244@d.umn.edu	Vice President		
Buszmann, David buszm001@d.umn.edu	Secretary		
Shaikh, Usama shaik012@d.umn.edu	Treasurer		
Keffeler, Derrick keffe006@d.umn.edu	Public Relations		
Stoerzinger, Laura stoer010@d.umn.edu	Webmaster		
Intelligent Systems Lab	(Dr. Marian Stachowicz)	420	6247
Kozlovski, Donald dkozlovski@allete.com	Chair, ECE Industrial Advisory Board, 30 W Superior St, Duluth 88502	----	(218) 723-7575
Kwon, Dr. Taek tkwon@d.umn.edu	Professor	253	8211

Mularie, Dr. William mularieb@erols.com	3M McKnight Visiting Professor (September - December, 2009)	274	6385
Norr, Scott snorr@d.umn.edu	Instructor	43	8947
Saarela, Marvin msaarela@d.umn.edu	Senior Laboratory Coordinator	189E	6153
Shey Peterson speters1@d.umn.edu or ece@d.umn.edu	Executive Secretary	271	6830
Stachowicz, Dr. Marian mstachow@d.umn.edu	Professor, Jack Rowe Chair	273	6531
Tang, Dr. Hua htang@d.umn.edu	Assistant Professor	276	7095
Yang, Dr. Jiann-Shiou jyang@d.umn.edu	Professor and Department Head	271	6290

**Northland Advanced Transportation Systems Research Laboratory (NATSRL)
291 MWAH**

NAME	POSITION	MWAH ROOM #	OFFICE TELEPHONE
Kwon, Dr. Eil eilkwon@d.umn.edu	Director, Office of Transportation Research Programs	209 EB	8325
Hartwick, Jeanne jhartwic@d.umn.edu	Executive Accounts Specialist	291	8651

Great Lakes Maritime Research Institute (GLMRI)

NAME	POSITION	MWAH ROOM #	OFFICE TELEPHONE
Wolosz, Carol cwolosz@d.umn.edu	Coordinator	291	7446

ELECTRICAL & COMPUTER ENGINEERING FACULTY PROFILES

The electrical and computer engineering curriculum is presented by faculty members who bring a wide range of research, industrial and consulting experience to their teaching assignments. Each is well aware of the national goals that must be met in order to produce graduates who are prepared to compete in an international technical market place. Faculty work together to evolve a curriculum that is challenging to the student, a curriculum that reflects the scope of the faculty expertise and training. A brief summary of the research areas in which faculty members are involved follows.

Dr. Jing Bai, Assistant Professor: Dr. Bai joined the ECE Department in Fall 2007. She received her Bachelor of Engineering degree from Tsinghua University, China, and M.S. and Ph.D. degrees in electrical and computer engineering from Georgia Institute of Technology. Her research interests include optoelectronic devices, semiconductor nanostructures, nonlinear optics, quantum optics and micro-electro-mechanical system (MEMS).

Dr. Stanley G. Burns, Professor and Associate Dean: Dr. Burns joined ECE as department head in 1998. He received his B.S., M.S., and Ph.D. degrees in electrical engineering from the University of Wisconsin-Madison. Dr. Burns' research interests include microelectronics, semiconductor device processing, and high frequency analog circuit design. He is a senior member of the IEEE, and a member of ASEE and ECS. Dr. Burns is a registered Professional Engineer in Minnesota and Iowa.

Dr. Christopher Carroll, Associate Professor and Assistant Department Head: Dr. Carroll has been at UMD since the fall of 1988. He received his Bachelor of Engineering Science degree from Georgia Institute of Technology. He received the Master of Science in Electrical Engineering and a Ph.D. in Computer Science from California Institute of Technology. Dr. Carroll's research interests include special purpose digital systems, VLSI design, and microprocessor/microcontroller applications.

Mr. Tom Ferguson, Adjunct Visiting Professor: Mr. Ferguson joined the ECE Department as 3M McKnight Professor from Fall 2007 to Spring 2009. He is now an adjunct visiting professor. He was Vice President of Power Delivery and Transmission with Minnesota Power for many years. Mr. Ferguson received his B.S.E.E. and M.S.E.E. degrees from the University of Minnesota. He is a registered Professional Engineer in the State of Minnesota and had served as the Chair of the Department's Industrial Advisory Board for many years. His research and teaching interests include renewable energy, power delivery and transmission, and telecommunication.

Dr. Mohammed Hasan, Associate Professor: Dr. Hasan began with the ECE Department in September 1997. He received a B.S. degree in Mathematics from the University of Baghdad, Iraq, and an M.S. degree in Electrical Engineering, from Colorado State University. Dr. Hasan has a Ph.D. in Applied Mathematics from Colorado State University, and a Ph.D. in Electrical Engineering, from Colorado State University. His research interests include modeling and estimation of random processes and their applications to signal processing and biomedical research, adaptive filtering and sinusoidal estimation.

Dr. Imran Hayee, Associate Professor: Dr. Hayee joined the ECE Department in Fall 2004. He received a B.Sc.E.E. at UET Pakistan, and his M.S.E.E. and Ph.D. at the University of Southern California in Los Angeles. Dr. Hayee's research interests are in the field of state-of-the-art optical fiber communication products, cabled and wireless communication regimes.

Dr. Taek Mu Kwon, Professor: Dr. Kwon has been in the department since Fall 1988. He received his B.S. degree in electrical engineering from Sung-jun University, Seoul, Korea, and his M.S. and Ph.D. degrees from the Florida Institute of Technology. Among others, Dr. Kwon's research interests include neural networks, neural nets and fuzzy controllers, genetic algorithms, digital signal processing, and computer networks.

Dr. William Mularie, 3M McKnight Visiting Professor: Dr. William Mularie joined the faculty of ECE at UMD as a 3M McKnight Visiting Professor for the fall semester of 2009. He is currently CEO of Telework Consortium, Inc., and was Information Systems Office Director at DARPA during 1999-2002. He received his M.S.E.E. and Ph.D. degrees from the University of Minnesota, Twin Cities.

Mr. Scott Norr, Instructor: Mr. Norr has 13 years of industry experience in the areas of power systems and electrical consulting. He is especially interested in dynamic stability of power systems, voltage collapse phenomena and power quality. Mr. Norr received his B.S.E.E. from North Dakota State University in 1986. He is a Registered Professional Engineer in the State of Minnesota.

Dr. Marian Stachowicz, Jack Rowe Chair: Dr. Stachowicz has been in the department since the fall of 1991. He received his M.S. degree in control and computer engineering from the Leningrad Electrical Institute, and both his Ph.D. and D.Sc. in digital electronics and computer control systems from the University of Cracow, Poland. Dr. Stachowicz's research interests include control systems, fuzzy set theory, system theory, soft computing and their applications to control of industrial processes.

Dr. Hua Tang, Assistant Professor joined the department in Fall 2005. He received his B.E. in Electrical Engineering from North China Electric Power University (Beijing), Beijing, P.R. China, and M.S. and Ph.D. in Electrical Engineering from State University of New York at Stony Brook, Stony Brook, NY in 2002 and 2005 respectively. Dr. Tang's research interests include high-performance analog, digital and mixed-signal VLSI circuit design and computer aided design. He is a member of IEEE.

Dr. Jiann-Shiou Yang, Professor and Department Head: Dr. Yang began teaching at UMD in the fall of 1988. He received his B.S. and M.S. degrees in control engineering from National Chiao-Tung University, Taiwan and received his M.S. and Ph.D. degrees in electrical engineering from the University of Maryland, College Park. Dr. Yang's research interests include robust control, system theory, computer-aided control system design, optimization, traffic control, and biped locomotion. He is a senior member of the IEEE.

(Updated June 2009)

ELECTRICAL & COMPUTER ENGINEERING STAFF PROFILES

Marvin Saarela, Senior Laboratory Services Coordinator: The Department of ECE laboratories facilitate on-site learning experiences for our students. As lab services coordinator, Marvin provides equipment, maintenance, and support for these laboratories. See Marvin if you need materials, supplies, or equipment for use in laboratory instruction.

Shey Peterson, Executive Secretary: As department secretary, Shey provides administrative support for the ECE office. See Shey for information on UROP grant expenses, payroll, applying to the upper division of ECE, advisement, etc.

Kathy Bergh, Office Support Assistant: As the department receptionist, Kathy greets students and guests, answers the department telephone, and provides information to faculty and students.

IEEE STUDENT BRANCH

The UMD branch chapter of the IEEE Computer Society is a student organization for electrical and computer engineering students, as well as other students majoring in technical/engineering fields. The UMD IEEE Computer Society is affiliated with the Institute of Electrical and Electronics Engineers (IEEE), an international professional organization.

New members are always welcome. To join, application forms are available (during the academic year only) in the IEEE office (102 MWAH), or in the ECE department office (271 MWAH). There is an annual membership fee. IEEE membership includes subscriptions to two national IEEE publications. Members are eligible for scholarships and can participate in national and regional professional conferences. The ECE student group sponsors student-faculty feedback forums, arranges tours to industries, publishes an annual "Resume Book" in collaboration with the department, and plans recreational activities.

Meetings are held starting late September, with regular meetings to follow. Check your email for meeting announcements. Faculty advisor is Scott Norr.

E-mail contacts for the IEEE Student Branch are: ieee_officers@d.umn.edu

Ryan Bezdicek, President, bezdi001s@d.umn.edu
David Marcaccini, Vice President, marc0244@d.umn.edu
David Buszmann, Secretary, buszm001@d.umn.edu
Usama Shaikh, Treasurer, shaik012@d.umn.edu
Derrick Keffeler, Public Relations, keffe006@d.umn.edu
Laura Stoerzinger, Webmaster, stoer010@d.umn.edu

GENERAL INFORMATION ABOUT THE DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

ECE DEPARTMENT OFFICE HOURS - The ECE department office (271 MWAH) is open from 8:00 a.m. to 4:30 p.m. This is subject to change during semester breaks and summer, and adjusted hours are usually posted. Your cooperation in visiting the department office during scheduled office hours will be appreciated.

GRADUATE SCHOOL AND CAREER INFORMATION is available in 102 MWAH and on the bulletin board outside 291 MWAH. Please do not remove these materials from either area. (FYI: Employment, internship, and undergraduate opportunities are also sent via UMD email to ECE majors.)

EMAIL is routinely used to inform students of course changes, seminar announcements, employment, internships, undergraduate opportunities and other pertinent information. Please be sure to check your email on a regular basis. When sending email to the department office, you will receive the quickest response if you address it to ece@d.umn.edu. You should use only your UMD email address for resumes and communicating with potential employers.

ECE BULLETIN BOARDS

Department Bulletin Board (across from the ECE Office) is for ECE announcements only. Please check with Shey or Kathy if you wish to post something on the department bulletin board. Important information about course changes is posted on this board, as well as information on new courses, seminar announcements, information on UROP, etc.

Employment Board is located next to the display case (just outside the department office). Information on internships and employment for graduates is posted here. (This information is also sent via email.) Please check with Shey or Kathy to post information on the employment board.

Miscellaneous Board is next to the VLSI Lab (295 MWAH); University and miscellaneous announcements are placed here. Please check with Shey or Kathy to post information on the miscellaneous board.

PHOTOCOPYING is available in the Library or Kirby Student Center. The photocopier in the ECE Office is not available for student use, nor are ECE staff allowed make copies for students. There is a fax machine in the Bookstore.

ECE WORKROOM - Due to security concerns, undergraduate students are not allowed in the ECE workroom. For your convenience, there is a paper cutter, paper punch, stapler, and tape dispenser in 102 MWAH.

102 MWAH STUDENT ACTIVITY AND LEARNING CENTER See page 12

ECE TEACHING LABS - Labs in 41, 60, 293, 295, 355, 391, and 393 MWAH have digital locks requiring special codes, which are available from the professor(s) in charge of each lab; these codes are changed every semester. Upon obtaining code(s), you will be responsible for the following:

1. You must not give this code to any other student, not even another ECE student.
2. You are responsible for locking the lab and closing the windows when you leave.
3. Equipment, program manuals, computer disks and other supplies are not to be removed from any lab. Anyone found removing such items will have their lab privileges revoked.
4. You must not work alone after business hours in any of the departmental laboratories.
5. Please keep the labs clean; dispose of food wrappers, recycle scrap paper and pop cans, etc.

SENIOR DESIGN PROJECT GUIDELINES - Pick up a copy of the ECE Senior Design Project Guidelines in the ECE Department office.

SENIOR DESIGN PROJECT/INDEPENDENT STUDY PERMISSION NUMBERS - You need to have written permission from the faculty member with whom you are going to do your senior project or independent study. To receive your permission number, pick up the appropriate request form in the ECE Office (yellow for senior project, pink for independent study).

Complete the form, **including the title of your project and the names of your team members** and bring to the faculty member with whom you wish to do your project to obtain their signature. Bring to the ECE Office for department head approval and override number. You may fill out one form for all your team members; if you list their names and email addresses, the department will email the permission number to each.

FORMS AND INFORMATION AVAILABLE IN ECE

Application to Upper Division	ECE Electives
Change of Advisor/Major	ECE/CS Double Major
Liberal Education Information	Lab Access Forms
ECE Senior Design Project Permission Number Request Form	ECE Ind. Study Permission Number Request Form

ITEMS AVAILABLE IN SCSE STUDENT AFFAIRS, 140 ENGINEERING BUILDING (EB). (Note: Some of these forms are available on the web. Go to: <http://www.d.umn.edu/registrar/> and click "Forms".

SCSE Amendment Forms	Registration Materials/Class Schedules
Change of College Request Form	Petition forms
APAS	Transcripts

ADVISEMENT AND REGISTRATION

1. **ALL ECE MAJORS MUST SEE THEIR ADVISORS BEFORE THEY CAN REGISTER.** (Exception: Seniors who are graduating at the end of the semester.)
2. Do not expect to see your advisor without an appointment. Sign up ahead of time, preferably a day in advance so that your advisor has time to retrieve your file from the ECE Office.
3. Check your registration queue time, and sign up for advisement in plenty of time to allow you to register as scheduled.
4. Check your advisor's calendar early (posted near or on their office door), to make sure there are not blocks of times when he/she is going to be unavailable. If your advisor will be unavailable during the time just preceding your queue time, sign up early.
5. Bring your signed advisement Hold Release form to the SCSE Dean's Office, 140 Engr. Bldg. **Do not bring to the ECE Department Office.**
6. Remember, lack of planning on your part does not constitute an emergency for your advisor or the department. Please do your part to make advisement a worthwhile experience for you.
7. Students are also encouraged to visit with their advisor to discuss career planning and the practice of engineering. It is important to observe that your academic advisor is often a good choice as a reference for job applications.

GRADES

A "D" is the minimum grade required in an ECE course. Although it is not required, students receiving a D in an ECE course are encouraged to retake the course.

REPEATING A COURSE - The student should pick up a "Course Repeat" card at the Solon Campus Center Information Desk. Complete the card and bring to the instructor for approval. Return to the Information Desk.

DIRECTIONS FOR APPLYING TO ELECTRICAL & COMPUTER ENGINEERING UPPER DIVISION PROGRAM

1. Students should complete these courses before applying to the junior/senior ECE program. Admission is competitive and on a space-available basis. A minimum GPA of 2.0 is required for admission.

ECE Lower Division Courses (10)

ECE 1001 - Introduction to ECE (2)
ECE 1315 - Digital System Design (4)
ECE 2006 - Electrical Circuit Analysis (4)

Required Courses from other programs*

Chem 1151 - General Chemistry I (5)
WRIT 1120 - College Writing (3)
CS 1511 - Computer Science I (5)
CS 1521 - Computer Science II (5)
Math 1296 - Calculus I (5)
Math 1297 - Calculus II (5)
Math 3280 - Differential Equations (4)*
Phys 2011 - General Physics I (4)
Phys 2012 - General Physics I (4)

**Six out of the nine non-ECE courses required*

2. Students who have completed the above courses should apply to the ECE upper division program. Application forms are available in the ECE Department Office, 271 MWAH. Complete the form, sign it, and leave with the department secretary.
3. Students who are accepted will receive a confirming e-mail from the department.
4. Students who are not accepted will receive a letter (or e-mail) from department head indicating what they need to do in order to be accepted into the program. Required GPA is 2.0. (You must maintain at least a 2.0 GPA in order to stay in the program and to graduate).
5. For additional information, visit the ECE Department Office, 271 MWAH.
6. Steps to Complete Prior to Graduation:

_____ Review Senior Checklist by checking the web site: <http://www.d.umn.edu/registrar>
_____ Review Credit Check Balance Sheet: <http://www.d.umn.edu/registrar/eDegree/index.htm>
_____ Review Application for Degree: <http://www.d.umn.edu/registrar/eDegree/index.htm>
_____ Register with Career Services, 21 Solon Campus Center
_____ Respond to Exit Interview request promptly. (You will receive a letter from department head before the end of the semester in which you graduate.) The exit interview is a BSECE graduation Requirement.
_____ Students who want the automatic CS Minor on their transcript should indicate so on the application form.

ECE LABORATORY SAFETY RULES

1. No horseplay or running is allowed in the labs.
2. No bare feet or open sandals are permitted.
3. Before energizing any equipment, check whether anyone is in a position to be injured by your actions.
4. When working on equipment where more than 120 volts exist between circuit points and/or ground, get your lab instructor's approval before energizing the circuit.
5. Read the appropriate equipment instruction manual sections or consult with your instructor before applying power or connecting unfamiliar equipment or instruments into any circuits.
6. Position all equipment on benches in a safe and stable manner.
7. Do not make circuit connections by hand while circuits are energized. This is especially dangerous with high voltage and current circuits.
8. Do not work alone in the lab if equipment is energized; at least one other person is to be present. You must not work alone after normal business hours.
9. The use of 110 volts, 60 Hz plug-in cords with open wire or alligator clip ends is hazardous; use them only with the permission and direction of your instructor.
10. For safety reasons, metal cases of instruments and appliances are usually grounded through the third wire ground. Do not consider any departure from the use of the third wire ground. e.g., "cheater plugs", without the instruction and supervision of your instructor. Failure to know whether or not an instrument case is grounded can lead to hazardous circuit conditions.
11. Tag instruments with badly frayed or broken power leads and deliver them to the shop (189E) for repair. Notify your instructor. Also notify your instructor if equipment is not working correctly.
12. Do not bring food or beverages near the work areas in the labs.
13. Do not attempt chemical or electro-chemical experiments or activities, e.g., printed circuit board etching, without proper supervision, or in areas other than those designated for that purpose.
14. When using equipment with high voltage, e.g., color television circuits, take precautions to guard against radiation, primarily x-rays.
15. Remove metal rings and metal watch bands when working around energized, especially high voltage and current, circuits.
16. Treat high voltages with care to avoid endangering your life or the lives of your lab partners.

Rules for Use of ECE Laboratories

1. Labs are maintained for use not only by you but also by others. Do not treat equipment as your personal property. It is a resource made available for specific purposes. Whether for class work or for research, be sure that your use of equipment does not diminish its value to others.
2. Some labs are equipped with combination locks to allow authorized people to use those facilities at their convenience. If you are such an authorized person in one or more of these labs, treat that access as a privilege, not a right. Do not disclose the combination to unauthorized persons. Only authorized lab users should enter such rooms. Labs are crowded enough ... don't bring your friends. Labs are places to work and learn, not to socialize.
3. The equipment on lab benches is organized into lab "stations," where each station is properly configured to support the class(es) using that room. Do not reconfigure the lab stations by moving instruments from one station to another, or by taking an instrument from a lab station for use elsewhere. Doing so makes life difficult for the next user of that lab station. If additional equipment is needed for a particular experiment, see your lab TA or research advisor and s/he will either find it for you or show you how to work around its absence.

Some spare instruments are stored in cabinets in the above lab rooms for temporary use within that lab when additional equipment is required. For long-term needs, such as senior project use, please check out instruments from Marvin. Such instruments will be your responsibility until you personally check them back in to Marvin.

4. Be observant and security-minded. You could buy a nice house with the equipment in many of our labs. If you see someone engaged in questionable activities please call 911 from the public telephone in the ground-floor hall of MWAH and report it. False alarms are better than suffering a loss that might seriously impair your educational opportunities.

Student Activity and Learning Center (MWAH 102)

Access

MWAH 102 is intended for ECE students and faculty as a venue for studying/research, meetings, socialization, and events. Access cards are available through the department office in 271 MWAH. Since these cards are available, the door should not be propped open except during events. Visitors should be accompanied at all times. Please do not abuse the room or its resources.

Food/Drink

Food and drink are allowed in MWAH 102. This is a privilege that can be taken away, so guidelines must be followed. Students bring their own lunches, and the IEEE provides light refreshments for purchase by students. A refrigerator and microwave are provided for safe storage and preparation of food. The food purchasing is handled on the honor system, so payments must be made in full and on time to prevent the IEEE from losing money in this service. When finished, food scraps and food containers must be removed or disposed of properly. Drinks and foods such as candy, chips, or other packaged snack foods may be disposed of in a bag-lined garbage can. Other foods (i.e. greasy foods) cannot be thrown away with regular garbage. An example would be pizza boxes (even empty). If this food is served at an event, one of the following means of disposal will be used: 1) Make arrangements with Facilities Management for pickup immediately following said event; 2) Bring garbage to a food dumpster (get access from Facilities Mgmt); 3) Take garbage out of the building and away after said event. The university's policy can be found following this link: <http://www.d.umn.edu/ehso/events/serving.html>

Computers/Equipment

MWAH 102 serves as a departmental personal computer lab, used in several ECE courses. The PC's in this room are maintained to support educational activities in course work and beyond. Feel free to use the equipment as needed. However, the equipment is meant for serious work, and such work takes priority over game playing or just "surfing" the Internet. Please be considerate of others and realize that these machines are not your personal workstations. Do not leave the disks cluttered with programs or data that are of no use to others, and if you are using the computers for frivolous games or other such activities, yield to students who need the computers for course work.

The IEEE will also post procedures for security and file storage.

Be sensitive to the feelings of your colleagues. Inappropriate screen savers or related materials on the computers is strictly prohibited.

MWAH 102 is also a student presentation area, both for developing presentations and for making the presentations to small audiences. All students participate in oral presentations that are part of the senior project or design workshop experience.

In summary, MWAH 102 serves the ECE department in many ways. It is a room focused on student activities, whether for presentations, computer use, meetings, or general student gatherings. This is a room designed for you. Please take the responsibility of keeping it neat and orderly so that its use in the above functions is not impeded.

PART II: ECE CURRICULUM INFORMATION

FALL 2009

AND

PRELIMINARY SPRING 2010

<http://www.d.umn.edu/courseinfo/>

ECE PROGRAM DESCRIPTION

The electrical and computer engineering B.S.E.C.E. program combines traditional electrical engineering topics with current computer design and analysis topics. The program is concerned with the theory, design, and application of electrical phenomena and digital computers, including electronic circuits, signal analysis, system design, and computer architecture. The department displays strengths in such diverse areas as electronics, signal processing, electromagnetics, digital computer systems, communications, and controls. Individual faculty members specialize in areas such as VLSI design, microprocessor systems, image processing, robust control, solid state devices, optoelectronics, nanostructures, robotics, instrumentation, neural networks, and fuzzy logic. The program balances theoretical and practical experience in electrical and computer engineering through analysis, synthesis, and experimentation, using facilities that include major instructional laboratories and research laboratories.

ECE MISSION STATEMENT

The Mission of the Department of Electrical and Computer Engineering is to provide a high quality educational opportunity for students by delivering a program with a strong hands-on laboratory and design component in conjunction with a thorough foundation in theory and to provide students with the tools and skills to be a life-long major contributor to their profession and society as a whole.

ECE PROGRAM OBJECTIVES AND OUTCOMES

Using the ECE Mission Statement for guidance, the ECE Program Educational Objectives are given below (The resultant Outcomes are listed in Table 1).

ECE Program Educational Objectives

Consistent with the mission of the University, the Duluth campus, and the College, the Electrical and Computer Engineering program educational objectives are to produce graduates who will

1. Develop a productive career. [Public service, teaching and learning, career foundation mission]
2. Advance knowledge in their field through technical innovations and scholarly research. [Research mission]
3. Integrate the imparted ethical foundation, creative purpose, and technical knowledge into responsible citizenship. [Teaching and learning, liberal education mission]
4. Contribute to the well-being of their community. [Public service, teaching and learning mission]
5. Pursue life-long learning. [Teaching and learning, research mission]

ECE MAJOR: GENERAL INFORMATION

Freshman-Level Admission: Students who enter the Electrical and Computer Engineering program as freshmen must follow the lower division program listed under Required Courses below.

Junior-Level Admission: Students should complete the lower division ECE program before applying to the upper division (junior and senior years) program. Admission is competitive and on a space-available basis. A minimum GPA of 2.0 is required for admission to the upper division program. See department for further details.

Honors Requirements: To receive department honors upon graduation, students must finish the program with an overall GPA of at least 3.50, satisfactorily complete a research project under the guidance of a faculty member, and convey the results in an oral and written presentation to the department.

Advising: ECE majors are required to meet with their advisor each semester to discuss their academic plans for the upcoming semester and to obtain a registration hold release. Students are encouraged to meet as often as needed to discuss curriculum choices, professional interests, and any other topics that will be of assistance as they pursue their electrical and computer engineering education. Students who have questions about any part of the ECE program should see their advisor.

NOTE: Completion of the ECE program as outlined below satisfies the requirements for a Computer Science minor. Please see your advisor on arranging your program to obtain, in addition, an Applied Mathematics minor.

ECE MAJOR - DEGREE REQUIREMENTS (128)

Requirements for the B.S.E.C.E. in electrical and computer engineering (128 credits) include:

- UMD liberal education requirements - courses listed within the major or minor indicated by * may be used to fulfill this requirement
- Advanced writing requirement: COMP 3130 Advanced writing: engineering (3 credits)
- 3 technical elective credits to include at least one course on this list: ECE 4305, ECE 5315
- 6 technical elective credits to achieve breadth and depth in the major
- Enough required math, science, engineering science, engineering design, and composition credits to meet or exceed accreditation requirements

Required Courses for the ECE Major:

Lower Division (22)

ECE 1001 – Introduction to Electrical and Computer Engineering (2)

ECE 1315 - Digital System Design (4)

ECE 2006 - Electrical Circuit Analysis (4)

ECE 2111 - Linear Systems and Signal Analysis (4)

ECE 2212 - Electronics I (4)

ECE 2325 - Microcomputer System Design (4)

Upper Division (30)

ECE 3151 - Control Systems (3)

ECE 3235 - Electronics II (4)

ECE 3341 - Digital Computer Circuits (4)

ECE 3445 - Electromagnetic Fields (3)

ECE 3611 - Intro to Solid State Semiconductors (3)

ECE Technical Electives (9)

ECE 4899 - Senior Design Project I (1)

AND ECE 4999 - Senior Design Project II (3)

OR ECE 4951- Design Workshop (4)

Required Courses from Other Programs:

Lower Division (40)

WRIT 1120 - College Writing (3)*

Chem 1151 - General Chemistry I (5)*

CS 1511 - Computer Science I (5)*

CS 1521 - Computer Science II (5)

Math 1296 - Calculus I (5)*

Math 1297 - Calculus II (5)

Math 3280 - Differential Equations (4)

Phys 2011 - General Physics I (4)*

Phys 2012 - General Physics II (4)

Upper Division (36)

Econ 1022 - Principles of Economics: Macro (3)*

OR Econ 1023 - Principles of Economics: Micro (3)*

Engineering “Breadth” elective (3)*

CS 2511 - Software Analysis and Design (4)

WRIT 3130 - Advanced Writing: Engineering (3)

CS 5631 - Operating Systems (4)

Math 3298 - Calculus III (4)

Phil 3242 – Values and Technology (3)*

Stat 3611 - Intro to Probability and Statistics (4)

Liberal Education Electives (14)†

† Lib Ed electives (include Phil 3242 and either Econ 1022 or 1023) must include the following:

- At least one course from category 7
- At least one course from category 9
- At least one course from category 10 or 2nd category 9 course with a different designator
- At least one course emphasizing international perspective
- At least one course emphasizing cultural diversity

* Courses that may be used to fulfill UMD liberal education program requirements

‡ Engineering-outside-ECE requirement is met by taking one of the following courses:

Engr 2015, Engr 2110, ChE 2001, ChE 2011, ChE 2111

Final Project: Electrical and computer engineering students must complete a capstone design project integrating the knowledge from their academic career. This team project must involve the design of hardware or software to meet specifications agreed upon by the student and the faculty project advisor. Oral and written reports are required.

DEGREE REQUIREMENTS FOR THE ECE MINOR (42)

Lower Division (38)

ECE 1315 - Digital System Design (4)

ECE 2006 - Electrical Circuit Analysis (4)

ECE 2111 - Linear Systems and Signal Analysis (4)

ECE 2212 - Electronics I (4)

ECE 2325 - Microcomputer System Design (4)**

Math 1296 - Calculus I (5)*

Math 1297 - Calculus II (5)

Phys 2011 - General Physics I (4)*

Phys 2012 - General Physics II (4)

Upper Division (4)

Math 3280 - Differential Equations with Linear Algebra (4)

* Courses that may be used to fulfill UMD liberal education program requirements

** For computer science majors: CS 2521 - Computer Organization (4) may be substituted for ECE 2325 Microcomputer System Design (4)

REQUIREMENTS FOR THE B.S.E.C.E.

- (1) Completion of at least of 128 degree credits.
- (2) Completion of at least 30 degree credits at UMD.
- (3) Completion of at least 20 of the last 30 credits earned before graduation at UMD.
- (4) Completion of the electrical and computer engineering major. Admission to the upper division program is competitive and on a space-available basis. A minimum GPA of 2.0 in all work attempted at UMD, successful completion (with grades of A through D, or S) of all lower division courses listed on page 14, and a minimum GPA of 2.0 overall (including transfer credits) are required for admission to the ECE upper division program.
- (5) Completion of UMD and ABET liberal education requirements. Liberal education elective choices must include the following:
 - Econ 1022 or Econ 1023 (category 6)
 - At least one course from category 7
 - Phil 3242 (category 8)
 - At least one course from category 9
 - At least one course from category 10 or 2nd category 9 course with a different designator
 - At least one course emphasizing international perspective
 - At least one course emphasizing cultural diversity
- (6) A minimum GPA of 2.00 in all courses taken in the major, including required supporting courses is required for graduation. This average applies to all courses in the major taken at UMD and calculated separately and also to all courses in the major when transfer credits are included.
- (7) Acceptance to the upper division of ECE by filing the Academic Progress Audit System (APAS) form with the department. Students who fail to file this form after completing all lower division credits may not be permitted to register.
- (8) Completion of the Electrical and Computer Engineering “Exit Survey”, and a one-to-one exit interview with the ECE Department Head.
- (9) Compliance with the general regulations governing the granting of degrees.

ELECTRICAL AND COMPUTER ENGINEERING

Typical Program of Undergraduate Study

Fall Semester

First Year

MATH 1296-CALCULUS I	5
ECE 1001-INTRO TO ECE	2
WRIT 1120 COLLEGE WRITING	3
CS 1511-COMPUTER SCIENCE I	<u>5</u>
	15

Spring Semester

MATH 1297-CALCULUS II	5
ECE 1315-DIGITAL SYSTEMS	4
PHYS 2011-GENERAL PHYSICS I	4
CS 1521-COMPUTER SCIENCE II	<u>5</u>
	18

Second Year

MATH 3280-DIFF EQUATIONS LIN ALGEBRA	4
ECE 2006-ELEC CIRCUIT ANALYSIS	4
ECE 2325-MICROPROCESSOR SYS	4
PHYS 2012-GENERAL PHYSICS II	<u>4</u>
	16

MATH 3298-CALCULUS III	4
CHEM 1151 GENERAL CHEMISTRY I	5
ECE 2111-LIN SYSTEMS & SIGNALS	4
ECE 2212-ELECTRONICS I	<u>4</u>
	17

Third Year

ECE 3151-CONTROL SYSTEMS	3
ECE 3235-ELECTRONICS II	4
CS 2511-SOFTWARE ANALYSIS & DESIGN	4
PHIL 3242 – VALUES AND TECHNOLOGY	3
LIB ED ELECTIVE ¹	<u>2</u>
	16

ECE 3611-SEMICONDUCTORS	3
ECE 3341-COMPUTER CIRCUITS	4
CS 5631 OPERATING SYSTEMS	4
STAT 3611-INTRO TO STATISTICS	4
WRIT 3130 ADV WRITING – ENGR	<u>3</u>
	18

Fourth Year

ECE 3445-ELECTROMAGNETICS	3
ECE 4899-SENIOR DESIGN PROJECT I ²	1
ECE TECHNICAL ELECTIVE ³	3
LIB ED ELECTIVE ¹	3
LIB ED ELECTIVE ¹	<u>3</u>
	13

ECE TECHNICAL ELECTIVE ³	3
ECE 4999-SENIOR DESIGN PROJECT II ²	3
ECE TECHNICAL ELECTIVE ³	3
ENGINEERING “BREADTH” ELECTIVE ⁴	3
ECON 1022-MACRO-ECONOMICS or ECON1023-MICRO-ECONOMICS	<u>3</u>
	15

1. Lib Ed electives (plus Phil 3242 and either Econ 1022 or Econ 1023) must include the following:

- At least one course from category 7
- At least one course from category 9
- At least one course from category 10 or 2nd category 9 course with a different designator
- At least one course emphasizing international perspective
- At least one course emphasizing cultural diversity

2. ECE 4951-Design Workshop may be taken in place of ECE 4899 and ECE 4999

3. ECE Technical Electives must include at least one course selected from the following list: ECE 4305 (4 cr), ECE 5315 (3 cr)

4. Engineering “Breadth” elective must include one course from the following list: ENGR 2015, ENGR 2110, ChE 2001, ChE 2011, ChE 2111

ECE COURSE PREREQUISITES

KEY TO SYMBOLS:

§ = Credit will not be granted if credit has been received for the course listed after this symbol

¶ = Concurrent registration is allowed in the course listed after this symbol

= Consent of the instructor is required for registration

€ = Consent of the department is required for registration

ECE 1001. INTRODUCTION TO ELECTRICAL & COMPUTER ENGINEERING.
(2 cr; prereq Pre-engr, ChE, CS, ECE, IE majors only; A-F only)

ECE 1315. DIGITAL SYSTEM DESIGN.
(4 cr; prereq Pre-engr, ChE, CS, ECE, IE majors only; A-F only)

ECE 1501. FRESHMAN SEMINAR HONORS: RENEWABLE ENERGY.
(3 cr; A-F only)

ECE 2006. ELECTRICAL CIRCUIT ANALYSIS.
(4 cr; prereq ¶Math 3280, ¶Phys 2012; A-F only)

ECE 2111. LINEAR SYSTEMS AND SIGNAL ANALYSIS.
(4 cr; prereq 2006; A-F only)

ECE 2212. ELECTRONICS I.
(4 cr; prereq 2006; A-F only)

ECE 2325. MICROCOMPUTER SYSTEM DESIGN.
(4 cr; prereq 1315; A-F only)

ECE 3151. CONTROL SYSTEMS.
(3 cr; prereq 2111; A-F only)

ECE 3235. ELECTRONICS II.
(4 cr; prereq 2212; A-F only)

ECE 3341. DIGITAL COMPUTER CIRCUITS.
(4 cr; prereq 2325; A-F only)

ECE 3445. ELECTROMAGNETIC FIELDS.
(3 cr; prereq Math 3280, Math 3298, Phys 2012; A-F only)

ECE 3611. INTRODUCTION TO SOLID STATE SEMICONDUCTORS.
(3 cr; prereq Phys 2012; A-F only)

ECE 4305. COMPUTER ARCHITECTURE.
(4 cr; prereq 3341; A-F only)

ECE 4311. DESIGN OF VERY LARGE-SCALE INTEGRATED CIRCUITS.
(3 cr; prereq 3235, 3341 or #; A-F only)

ECE 4321. COMPUTER NETWORKS.
(3 cr; prereq 3341, Stat 3611; A-F only)

ECE 4501. POWER SYSTEMS.
(4 cr; prereq 2006; no Grad School credit; A-F only)

ECE 4781. TELECOMMUNICATIONS.
(3 cr; prereq 3445; no Grad School credit; A-F only)

ECE 4899. SENIOR DESIGN PROJECT I.

(1 cr; prereq §4951; 3341, BSECE candidate, #; no Grad School credit; A-F only)

ECE 4951. DESIGN WORKSHOP.

(4 cr; prereq §4899, §4999; Comp 3130, BSECE candidate, 100 cr or #; no Grad School credit; A-F only)

ECE 4991. INDEPENDENT STUDY.

(1-3 cr; prereq #; does not qualify as ECE technical elective; no Grad School credit; A-F only)

ECE 4999. SENIOR DESIGN PROJECT II.

(3 cr; prereq §4951; 4899, BSECE candidate, #; no Grad School credit; A-F only)

ECE 5151. DIGITAL CONTROL SYSTEM DESIGN.

(3 cr; prereq 3151, 3341, §4151; A-F only)

ECE 5211. ADVANCED ANALOG INTEGRATED CIRCUIT DESIGN.

(3 cr; prereq 3235; A-F only)

ECE 5315. MULTIPROCESSOR BASED SYSTEM DESIGN.

(3 cr; prereq 3341, § 4315; A-F only)

ECE 5477. ANTENNAS AND TRANSMISSION LINES.

(3 cr; prereq 3445, §4477; A-F only)

ECE 5501. ENERGY CONVERSION SYSTEMS.

(3 cr; A-F only)

ECE 5741. DIGITAL SIGNAL PROCESSING.

(3 cr; prereq 2111 §4741; A-F only)

ECE 5765. MODERN COMMUNICATION.

(4 cr; prereq 2111, 3235; A-F only)

ECE 5801. INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS.

(3 cr; prereq CS 1521, Math 3280, Stat 3611, or #, §4801; A-F only)

ECE 5813. TOOLS AND METHODS OF DESIGN AUTOMATION.

(3 cr; prereq 3341, §4813; A-F only)

ECE 5831. FUZZY SET THEORY AND ITS APPLICATIONS.

(3 cr; prereq CS 1521, Math 3280, §4831; A-F only)

ECE 5765. MODERN COMMUNICATION.

(4 cr; prereq 2111, 3235; A-F only)

ECE 5995. SPECIAL TOPICS (Various titles to be assigned).

(1 to 3 cr; [max 3 cr]; prereq #; A-F only)

Open to Graduate Students Only

ECE 8151. LINEAR SYSTEMS AND OPTIMAL CONTROL.

(3 cr; ECE 3151, A-F)

ECE 8315. EMBEDDED SYSTEMS AND MICROCOMPUTER INTERFACES DESIGN.

(4 cr; 2325, 3341, CS 1511, CS 2521)

ECE 8611. SEMICONDUCTOR DEVICE DESIGN, FABRICATION, AND ANALYSIS.

(3 cr; ECE 3611 or Physics 4021 and Math 3280, A-F)

ECE 8741. DIGITAL IMAGE PROCESSING.
(4 cr; ECE 4741, A-F)

ECE 8765. DIGITAL COMMUNICATIONS.
(3 cr; 4765, A-F)

ECE 8831. SOFT COMPUTING.
(3 cr; prereq: the student is expected to have knowledge of linear algebra and computer programming; A-F only)

ECE ELECTIVES

ECE 4305. COMPUTER ARCHITECTURE (4)

ECE 4311. DESIGN OF VERY LARGE SCALE INTEGRATED CIRCUITS (3)

ECE 4321. COMPUTER NETWORKS (3)

ECE 4501. POWER SYSTEMS (4)

ECE 4781. TELECOMMUNICATIONS (3)

ECE 4991. INDEPENDENT STUDY (3)

ECE 5151. DIGITAL CONTROL SYSTEM DESIGN (3)

ECE 5211. ADVANCED ANALOG INTEGRATED CIRCUIT DESIGN (3)

ECE 5315. MULTIPROCESSOR BASED SYSTEM DESIGN (3)

ECE 5351. INTRO TO ROBOTICS AND MOBILE ROBOT CONTROL ARCHITECTURES (3)

ECE 5477. ANTENNAS AND TRANSMISSIONS LINES (3)

ECE 5501. ENERGY CONVERSION SYSTEMS (3)

ECE 5741. DIGITAL SIGNAL PROCESSING (3)

ECE 5765. MODERN COMMUNICATION (4)

ECE 5801. INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS (3)

ECE 5813. TOOLS AND METHODS OF DESIGN AUTOMATION (3)

ECE 5831. FUZZY SET THEORY AND ITS APPLICATIONS (3)

ECE 5995. SELECTED ADVANCED TOPICS OR SEMINAR (3)

ELECTRICAL AND COMPUTER ENGINEERING UNDERGRADUATE COURSES

KEY TO SYMBOLS: § = Credit will not be granted if credit has been received for the course listed after this symbol
 ¶ = Concurrent registration is allowed in the course listed after this symbol
 # = Consent of the instructor is required for registration
 € = Consent of the department is required for registration

ECE 1001. INTRODUCTION TO ELECTRICAL & COMPUTER ENGINEERING.

(2 cr; prereq Pre-engr, ChE, CS, ECE, IE majors only; A-F only)

Definition and description of electrical and computer engineering. Digital and analog systems. Electrical and computer engineering lab equipment and software. Selected specialties. (2 hrs lect)

ECE 1315. DIGITAL SYSTEM DESIGN.

(4 cr; prereq Pre-engr, ChE, CS, ECE, IE majors only; A-F only)

Binary number system and digital coding techniques. Boolean algebra, combinational logic circuits, and minimization techniques. Synchronous sequential circuits and state reduction techniques. Medium Scale Integration (MSI) combinational components. (3 hrs lect, 3 hrs lab)

ECE 1501. FRESHMAN SEMINAR HONORS: RENEWABLE ENERGY.

(3 cr; A-F only)

Introduces energy resource and consumption patterns and current issues on global and local levels. Consider how social, political, financial and technological aspects of renewable energy related to climate change and resource constraints. Exploration of energy's impact on all aspects of human life through discussion, selected readings and guest lectures.

ECE 2006. ELECTRICAL CIRCUIT ANALYSIS.

(4 cr; prereq ¶Math 3280, ¶Phys 2012; A-F only)

Basic circuit analysis: resistive circuits, voltage and current sources - independent and dependent. Nodal and mesh analysis. Network theorems. Energy storage elements. RC, RL, and RLC transient and steady state analysis, phasors. SPICE analysis. (3 hrs lect, 3 hrs lab)

ECE 2111. LINEAR SYSTEMS AND SIGNAL ANALYSIS.

(4 cr; prereq 2006; A-F only)

Signal and system modeling concepts, system analysis in time domain, Fourier series and Fourier transform. Discrete time domain signals and systems, Z transform, applications. (3 hrs lect, 3 hrs lab)

ECE 2212. ELECTRONICS I.

(4 cr; prereq 2006; A-F only)

Diodes, BJTs, FETs, ideal operational amplifiers, DC analysis, small signal models and analysis; single-stage circuits design; power amplifiers. (3 hrs lect, 3 hrs lab)

ECE 2325. MICROCOMPUTER SYSTEM DESIGN.

(4 cr; prereq 1315; A-F only)

Microcomputer components. Instruction set, machine and assembly language programming. Addressing modes. Signed/unsigned arithmetic. Stack uses. Assembly-level translation of high level language constructions. Input/Output interfacing. Interrupt programming. Microcomputer system hardware. (3 hrs lect, 3 hrs lab)

ECE 3151. CONTROL SYSTEMS.

(3 cr; prereq 2111; A-F only)

System mathematical modeling: differential equations, Laplace transform, block diagrams, signal flow graphs. System performance characteristics: time response, sensitivity, steady-state error. Stability analysis: Routh-Hurwitz, root locus and Nyquist. State variables. Compensation design, software tools. (3 hrs lect)

ECE 3235. ELECTRONICS II.

(4 cr; prereq 2212; A-F only)

Multistage circuits, frequency analysis, non-ideal operational amplifiers, feedback and stability, oscillators, filters. (3 hrs lect, 3 hrs lab)

ECE 3341. DIGITAL COMPUTER CIRCUITS.

(4 cr; prereq 2325; A-F only)

Digital logic family characteristics. Medium Scale Integration (MSI) components and applications. Programmable Logic Devices (PLDs). Alternative clocking techniques. Computer arithmetic circuits and memory design. Fundamental mode asynchronous finite-state machine design. (3 hrs lect, 3 hrs lab)

ECE 3445. ELECTROMAGNETIC FIELDS.

(3 cr; prereq Math 3280, Math 3298, Phys 2012; A-F only)

Fundamentals of electromagnetic analysis. Electrostatic and Magnetostatic fields. Introductory numerical analysis of electromagnetic fields. Time-varying fields and potentials. Maxwell's equations and their applications. (3 hrs lect)

CE 3611. INTRODUCTION TO SOLID STATE SEMICONDUCTORS.

(3 cr; prereq Phys 2012; A-F only)

Fundamentals of solid-state semiconductors and devices. Quantum mechanical concepts and atomic states, solid state structure, band structure, semiconductor statistics, and transport. (3 hrs lect)

ECE 4305. COMPUTER ARCHITECTURE.

(4 cr; prereq 3341; A-F only)

Advanced assembly language programming techniques. Memory design principles. Virtual memory. Cache memory. Processor design. Pipelined and Reduced Instruction Set Computers (RISC). Advanced microprocessor features. (3 hrs lect, 3 hrs lab)

ECE 4311. DESIGN OF VERY LARGE-SCALE INTEGRATED CIRCUITS.

(3 cr; prereq 3235, 3341 or #; A-F only)

Philosophy of and techniques for designing VLSI circuits in CMOS technology. Full- and semi-custom design techniques. Digital, analog, and hybrid CMOS circuits and systems. Substantial design project required. (3 hrs lect)

ECE 4321. COMPUTER NETWORKS.

(3 cr; prereq 3341, Stat 3611; A-F only)

Network classification and services. Protocol and communication architectures. Hardware components: multiplexers, concentrators, bridges, routers, access servers. (3 hrs lect)

ECE 4501. POWER SYSTEMS.

(4 cr; prereq 2006; no Grad School credit; A-F only)

Fundamentals of rotating machines: DC, synchronous, and induction machines. Transformers. Power system representation. Transmission lines. Power system analysis: stability and dynamic performance. Balanced and unbalanced faults. Power system protection. (3 hrs lect, 3 hrs lab)

ECE 4781. TELECOMMUNICATIONS.

(3 cr; prereq 3445; no Grad School credit; A-F only)

Topics in switching theory, transmission, networking, traffic engineering, and associated engineering problems and solutions. (3 hrs lect)

ECE 4899. SENIOR DESIGN PROJECT I

(1 cr; prereq §4951; 3341, BSECE candidate, #; no Grad School credit; A-F only)

Selection and completion of team project approved and supervised by faculty. (See also ECE 4999.)

ECE 4951. SENIOR DESIGN WORKSHOP.

(4 cr; prereq §4899, §4999; Comp 3130, BSECE candidate, 100 cr or #; no Grad School credit; A-F only)

Study of a selected topic; its application to a design project, completed in a small group. Focuses on a different method each semester offered. Completion satisfies the requirement for a senior design project.

ECE 4991. INDEPENDENT STUDY.

(1-3 cr; prereq #; does not qualify as ECE technical elective; no Grad School credit; A-F only)

Special projects not available in regular curriculum. Independent investigation, research studies, or survey of selected projects or problems.

ECE 4999. SENIOR DESIGN PROJECT II.

(3 cr; prereq §4951; 4899, BSECE candidate, #; no Grad School credit; A-F only)

Students present senior design project results in formal written and oral reports after making refinements. Complete documentation of results in professional manner required. Results must be presented in an oral report with other senior project team members. ECE 4899 and ECE 4999 must be completed within one year for credit.

ECE 5501. ENERGY CONVERSION SYSTEMS.

(3 cr; A-F only)

Theory, design and operation of conventional and alternative electrical energy conversion systems. Carbon dioxide cycle, Earth/Sun radiation balance, and environmental impacts. Power delivery systems and integration of conversion systems with the grid. Development of generation portfolios. Impact of energy policies and current energy issues. Case studies.

ECE 5151. DIGITAL CONTROL SYSTEM DESIGN.

(3.0 cr; prereq 3151, 3341, § 4151; A-F only)

Digital control system characteristics: transient and steady-state responses, frequency response, stability. Digital control system design using transform techniques. Controllability and observability. Design of digital control systems using state-space methods: pole placement and observer design, multivariable optimal control. Implementation issues in digital control.

ECE 5211. ADVANCED ANALOG INTEGRATED CIRCUIT DESIGN.

(3 cr; prereq 3235; A-F only)

This course aims to provide ECE students with fundamental analysis and design skills for transistor-level analog integrated circuits, such as operational amplifiers, transconductance amplifiers, bandgap references, amplifier-based filters, analog-to-digital converters, digital-to-analog converters and phase-locked loop. The course is project-oriented with a focus on transistor-level design of analog circuits from transistor sizing to layout in an integrated circuit environment such as Cadence tool sets. The expected outcomes are that students are able to design an analog system of medium complexity at transistor-level.

ECE 5315. MULTIPROCESSOR-BASED SYSTEM DESIGN.

(3.0 cr; prereq 3341, § 4315 ; A-F only)

Parallelism, interconnection networks, shared memory architecture, principles of scalable performance, vector computers, multiprocessors, multicomputers, dataflow architectures, and supercomputers.

ECE 5351. INTRODUCTION TO ROBOTICS AND MOBILE CONTROL ARCHITECTURES

(3 cr; prereq 3151, CS 1521; no Grad School credit; A-F only)

Basic concepts and tools for the analysis, design, and control of robotic mechanisms. Topics include basic robot architecture and applications to dynamical systems, mobile mechanisms, kinematics, inverse kinematics, trajectory and motion planning, mobile robots, collision avoidance, and control architectures.

ECE 5477. ANETNNAS AND TRANSMISSION LINES

(cr; prereq 3445; A-F only)

Concepts and theory of antennas and transmission lines; emphasis on design and applications. Topics: nonlinear source and loads, cross talk, interconnecting circuits, line characteristics, radiation, measurements. EM propagation, scattering and antenna design techniques. Numerical analysis of wire, aperture, reflector antennas, diffraction theory.

ECE 5741. DIGITAL IMAGE PROCESSING.

(3.0 cr; prereq 2111, § 4741 ; A-F only)

The fundamentals of two-dimensional signal processing techniques, discrete image analysis, and image quality measures.

ECE 5765. MODERN COMMUNICATION.

(4 cr; prereq 2111, 3235; A-F only)

Design and analysis of modern communication systems; evaluation of analog and digital modulation techniques. (3 hrs lect, 3 hrs lab)

ECE 5801. INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS.

(3.0 cr; prereq CS 1521, Math 3280, Stat 3611 or #,§ 4801 ; A-F only)

General techniques and theory of neural networks, their applications and limitations. The course particularly addresses the design issues and learning algorithms for diverse areas of applications.

ECE 5813. TOOLS AND METHODS OF DESIGN AUTOMATION.

(3.0 cr; prereq 3341, § 4813; A-F only)

Methods and techniques for designing electronic systems based on top-down strategy. Emphasis on high-level synthesis techniques and tools. Automated design of large, electronic systems. Design project using electronic design automation tools available in the ECE department.

ECE 5831. FUZZY SET THEORY AND ITS APPLICATION.

(3.0 cr; prereq CS 1521, Math 3280, §4831 ; A-F only)

Fuzzy sets and operations on fuzzy sets. Fuzzy relations and the extension principle. Linguistic variable and fuzzy IF-THEN rules. Fuzzy arithmetic. Fuzzy logic and approximate reasoning. Design of Fuzzy Systems from I/O data. Fuzzy logic--based control. Pattern Classifications.

ECE 5995. SPECIAL TOPICS: (Various titles to be assigned).

(1.0-3.0 cr; 3.0 max cr; prereq #; A-F only)

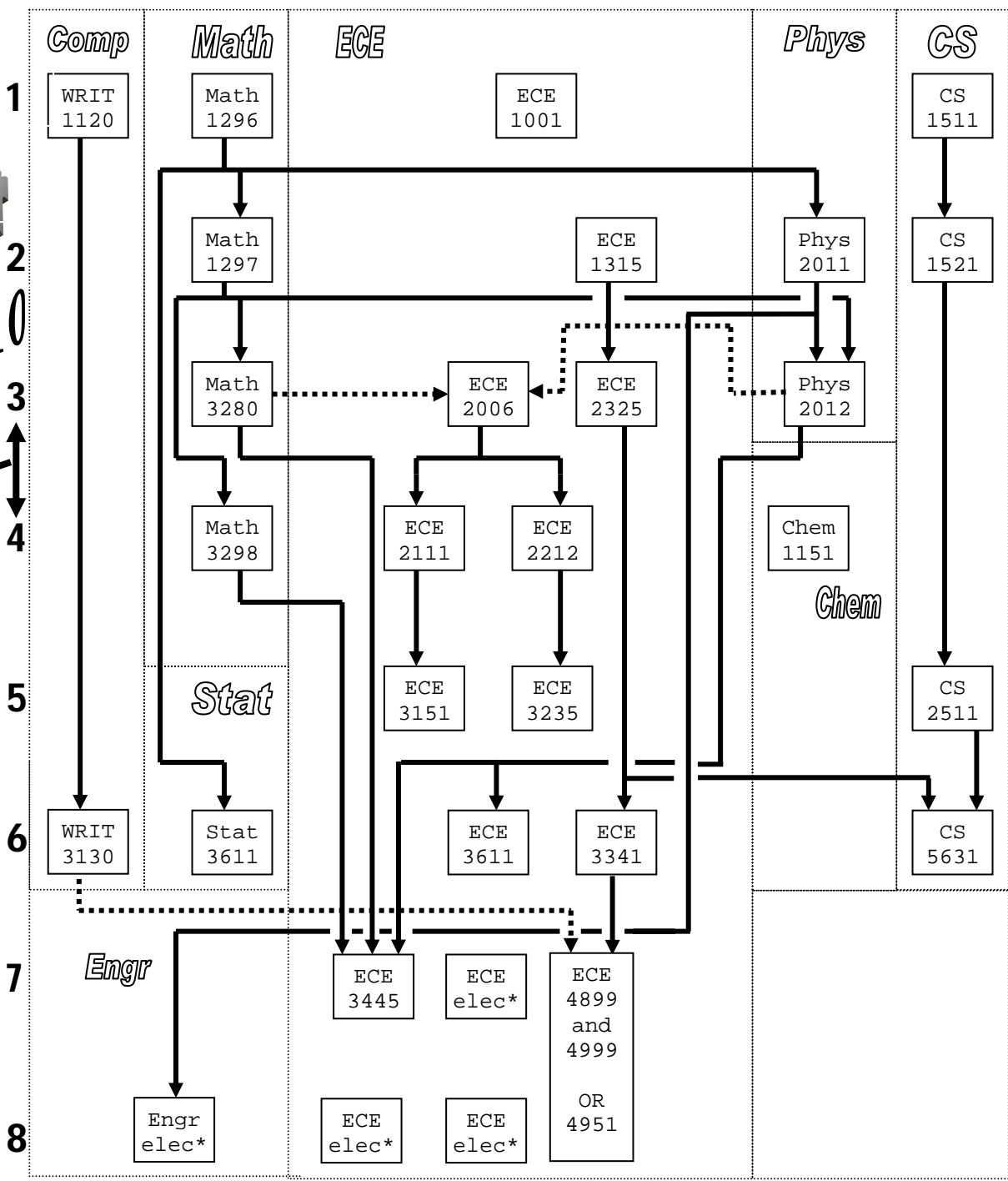
Current problems and research. Discussions, selected reading, and/or invited speakers.

See page 30 for 8xxx courses.



2009-2010

Semester #



Lib. Ed.

Cat #7	Phil 3242
Cat #9	Cat #9/10
Econ 1022	Econ 1023

1022 ← OR → 1023

Lib. Ed. Courses must include at least . . .

- Econ 1022 or Econ 1023 (Category 6)
- one Category 7 course
- Phil 3242 (Category 8)
- one Category 9 course
- one Category 10 course or 2nd Category 9 with a different course designator
- one international perspective course
- one cultural diversity course

(In Lib. Ed., a "course" is at least 2 credits with the same course designator)

* ECE electives must include at least one course selected from ... ECE 4305, ECE 5315

Arrows indicate prerequisite structure

Dotted arrows indicate concurrent registration is allowed

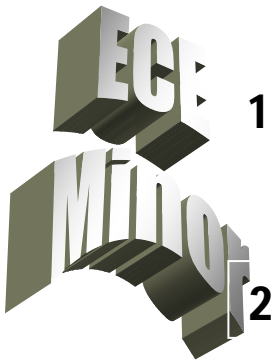
Total semester credits = 128.

ECE major program includes minor in Computer Science.

ECE major program includes minor in Math by completing one additional Math 3xxx or above course.

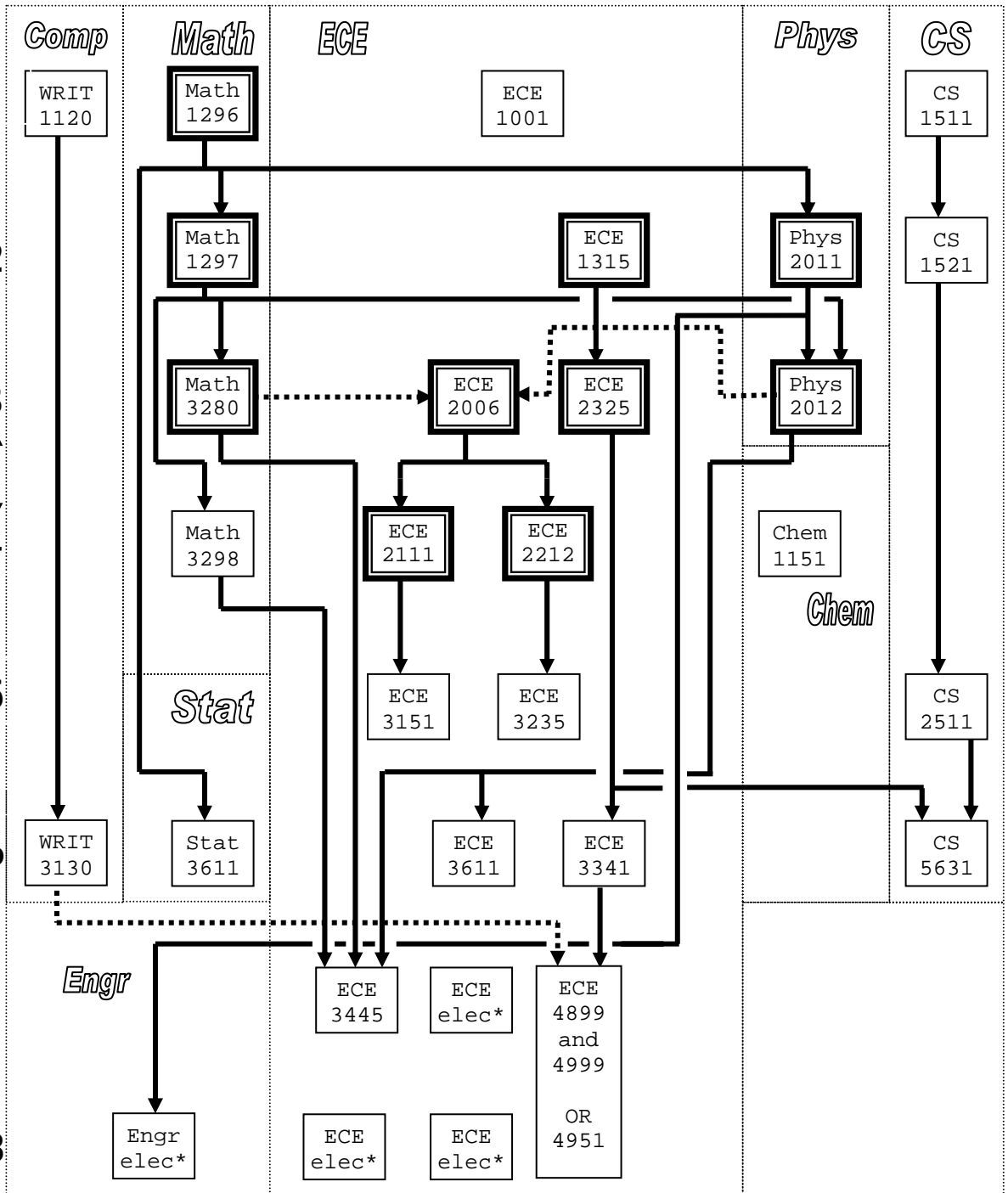
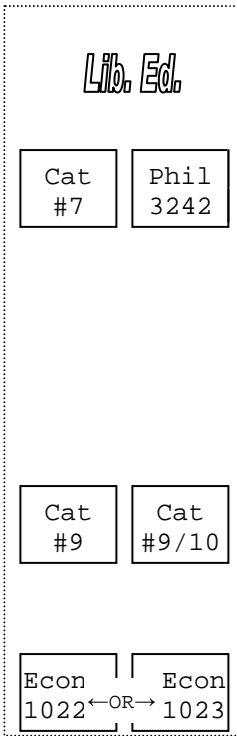
Engineering-outside-ECE requirement is met by taking one of the following courses: Engr 2015, Engr 2110, ChE 2001, ChE 2011, ChE 2111

Senior project is EITHER ECE 4951 OR both ECE 4899 AND ECE 4999



2009-2010

Semester #



KEY

Double boxes indicate courses required for the ECE minor.

Single boxes indicate additional courses required for the ECE major.

Arrows indicate prerequisite structure.

Dotted arrows indicate concurrent registration is allowed.

Semester credits = 42

CS Majors substitute CS 2521 for ECE 2325

FALL SEMESTER 2009 ECE COURSE OFFERINGS

Updated August 21, 2009

COURSE	TIME	DAYS	ROOM	CREDIT	INSTRUCTOR	ENROLLMENT CAP	
ECE 1001 INTRO TO ECE	09:00-09:50	TTh	LSCi 185	2	S. BURNS	100	
ECE 1315-1 DIGITAL SYS. DESIGN	10:00-10:50	MWF	MWAH 191	4	S. NORR	40	
2-Lab	09:00-12:00	T	MWAH 55		E. BRANSON	20	
3-Lab	01:00-04:00	T	MWAH 55		S. BUTT	20	
ECE 1315-6 DIGITAL SYS. DESIGN	01:00-01:50	MWF	MWAH 191	4	S. NORR	40	
8-Lab	01:00-04:00	Th	MWAH 55		S. VANG	20	
ECE 2006 ELEC CIRCUIT ANALYSIS	11:00-11:50	MWF	HH 216	4	S. NORR	40	
2-Lab	09:00-12:00	T	MWAH 391		N. AHMED	20	
3-Lab	01:00-04:00	T	MWAH 391		N. AHMED	20	
ECE 2006 ELEC CIRCUIT ANALYSIS	04:00-05:15	TTh	MWAH 191	4	J. BAI	40	
5-Lab	04:00-07:00	M	MWAH 391		S. BUTT	20	
6-Lab	04:00-07:00	W	MWAH 391		N. ADHUPATI	20	
ECE 2111 LIN SYS & SIGNALS	04:00-05:15	MW	HH 216	4	I. HAYEE	40	
2-Lab	09:00-12:00	Th	MWAH 393		Y. LIU	20	
3-Lab	01:00-04:00	Th	MWAH 393		Y. LIU	20	
ECE 2212 ELECTRONICS I	11:00-11:50	MWF	CHEM 251	4	H. TANG	40	
2-Lab	10:00-01:00	Th	MWAH 391		B. MAITEPE	20	
3-Lab	02:00-05:00	Th	MWAH 391		B. MAITEPE	20	
ECE 2325 MICROPRO SYS	09:00-09:50	MWF	CHEM 251	4	C. CARROLL	40	
2-Lab	ARR.	T	MWAH 355		C. CARROLL	40	
ECE 3151 CONTROL SYSTEMS	03:00-03:50	MWF	HH 216	3	J. YANG	40	
ECE 3235 ELECTRONICS II	04:00-04:50	MWF	MWAH 191	4	H. TANG	20	
3-Lab	09:00-12:00	Th	MWAH 293		P. LI	10	
4-Lab	01:00-04:00	Th	MWAH 293		P. LI	10	
ECE 3341 DIGIT COMPUTER CIRC	08:00-08:50	MWF	MWAH 191	4	C. CARROLL	40	
2-Lab	ARR.	M	MWAH 355		C. CARROLL	40	
ECE 3445 ELECTROMAG FIELDS	09:00-09:50	MWF	MWAH 191	3	M. HASAN	30	
ECE 4305 COMPUTER ARCHITEC	08:00-08:50	MWF	HH 216	4	T. KWON	30	
2-Lab	ARR.	Th	MWAH 355		T. KWON	30	
ECE 4899 SR DESIGN PROJECT I	ARR.	ARR.	1 credit	1-S. BURNS 2- I. HAYEE 3- C. CARROLL	4-J. YANG 5-T. KWON 6-H. TANG	7- M. HASAN 8-M. STACHOWICZ 9-S. NORR	10-J. BAI
ECE 4991 INDEPENDENT STUDY	ARR.	ARR.	1-3 credit	1-S. BURNS 2-I. HAYEE 3-C. CARROLL	4-J. YANG 5-T. KWON 6-H. TANG	7-M. HASAN 8-M. STACHOWICZ 9-S. NORR	10-J. BAI
ECE 4999 SR DESIGN PROJECT II	ARR.	ARR.	3 credits	1-S. BURNS 2-I. HAYEE 3-C. CARROLL	4-J. YANG 5-T. KWON 6-H. TANG	7- M. HASAN 8- M. STACHOWICZ 9- S. NORR	10-J. BAI
ECE 5501 ENERGY CONVERSION SYS	03:00-03:50	MWF	MWAH 191	3	T. FERGUSON	15	
ECE 5765 MODERN COMMUNICATIONS	05:30-08:00	M	MWAH 191	4	I. HAYEE	15	
2-Lab	ARR.	ARR.	MWAH 60	4	B. ROODELL		
ECE 5801 NEURAL NETWORKS	02:00-02:50	MWF	MWAH 191	3	T. KWON	15	
ECE 5831 FUZZY SETS	02:00-03:15	TTh	CHEM 153	3	M. STACHOWICZ	15	
ECE 5995 ALTERNATIVE ENERGY	02:00-03:15	TTh	ABAH 245	3	W. MULARIE	15	
ECE 8741 DIGITAL IMAGE PROCESSING	03:30-04:45	TTh	CHEM 153	3	M. HASAN	15	
ECE 8777 THESIS CREDITS: Masters	1-S. BURNS 2- I. HAYEE	3-C. CARROLL 4. J. YANG	5-T. KWON 6. H. TANG	7- M. HASAN 8- M. STACHOWICZ	9-S. NORR 10-J. BAI		

SPRING SEMESTER 2010 ECE COURSE OFFERINGS

TENTATIVE

Updated June 10, 2009

COURSE	TIME	DAYS	ROOM	CREDIT	INSTRUCTOR	ENROLLMENT CAP
ECE 1315-1 DIG SYS DESIGN	10:00-10:50	MWF	MWAH 191	4	S. NORR	40
2-Lab	09:00-12:00	T	MWAH 393		S. NORR	20
3-Lab	01:00-04:00	T	MWAH 393		S. NORR	20
ECE 2006 ELEC CIRC ANALYSIS	04:00-05:15	TTh	CHEM 251	4	M. HASAN	40
2-Lab	09:00-12:00	T	MWAH 391		M. HASAN	20
3-Lab	01:00-04:00	T	MWAH 391		M. HASAN	20
ECE 2006 ELEC CIRC ANALYSIS	03:00-03:50	MWF	MWAH 191	4	J. BAI	40
5-Lab	04:00-07:00	M	MWAH 391		J. BAI	20
6-Lab	04:00-07:00	W	MWAH 391		J. BAI	20
ECE 2111 LIN SYS/SIGNALS	04:00-05:15	MW	BOHH 108	4	I. HAYEE	30
2-Lab	09:00-12:00	Th	MWAH 41		I. HAYEE	15
3-Lab	01:00-04:00	Th	MWAH 41		I. HAYEE	15
ECE 2212 ELECTRONICS I	01:00-01:50	MWF	HH 216	4	S. BURNS	40
2-Lab	10:00-01:00	Th	MWAH 391		S. BURNS	20
3-Lab	02:00-05:00	Th	MWAH 391		S. BURNS	20
ECE 2325 MICROPRO SYS DES	12:00-12:50	MWF	CHEM 155	4	C. CARROLL	30
2-Lab	ARR.	ARR.	MWAH 355		C. CARROLL	30
ECE 3151 CONTROL SYSTEMS	04:00-05:15	TTh	MWAH 191	3	M. STACHOWICZ	30
ECE 3235 ELECTRONICS II	11:00-11:50	MWF	ENGR 290	4	H. TANG	16
2Lab	09:00-12:00	Th	MWAH 293		H. TANG	8
3Lab	01:00-04:00	Th	MWAH 293		H. TANG	8
ECE 3341 DIG COMP CIRC	08:00-08:50	MWF	MWAH 191	4	C. CARROLL	30
2-Lab	ARR.	M	MWAH 393		C. CARROLL	30
ECE 3611 SEMICONDUCTORS	02:00-02:50	MWF	MWAH 191	3	J. BAI	30
ECE 4501 POWER SYSTEMS	05:30-06:45	TTh	MWAH 191	4	S. NORR	15
2-Lab	ARR.	ARR.	MWAH 43		S. NORR	15
ECE 4899 SR DESIGN PROJECT I	ARR.	ARR.		1		
ECE 4991 INDEPENDENT STUDY	ARR.	ARR.		1-3		
ECE 4951 DESIGN WORKSHOP	08:00-08:50	TTh	HH 216	4	M. STACHOWICZ	12
	04:00-04:50	F	MWAH 175			
ECE 4999 SR DESIGN PROJECT II	ARR.			3		
ECE 5151 DIGITAL CONTROL SYS DESIGN	03:00-04:15	TTh		3	J. YANG	15
ECE 5315 MULTIPROCESSOR BASED SYSTEM DESIGN	03:00-03:50	MWF		3	T. KWON	15
ECE 5741 SIGNAL PROCESSING	11:00-12:15	TTh		3	M. HASAN	20
ECE 8765 DIGITAL COMMUNICATIONS	05:30-06:45	MW		3	I. HAYEE	15
ECE 8777 GRADUATE THESIS						

MASTER OF SCIENCE IN ELECTRICAL AND COMPUTER ENGINEERING

The University of Minnesota Duluth (UMD), Department of Electrical and Computer Engineering (ECE) welcomes applications from students interested in pursuing a graduate degree at the master's level. The ECE Department has active research programs in several major research areas that include communications and signal processing, VLSI and nanoscale optoelectronics, medical instrumentation and control systems, intelligent transportation systems.

The MSECE degree combines scholarship and research in a program oriented towards students and engineering practitioners in the private and public sectors who are interested in advanced coursework and applied research. The program requires 31 credits of graduate coursework and applied research focusing on core departmental strengths of communications, signal processing, control systems, VLSI and digital systems learning experience solving technical problems preferably teaming up with an industry counterpart.

In our department, faculty and students have a close working relationship. We strive for research that balances laboratory and theoretical studies. Although most of the candidates will have completed a bachelor's degree in electrical engineering, computer engineering, or related fields, students in other engineering fields, physics or mathematical sciences are encouraged to apply.

Requirements

The Master of Science in Electrical and Computer Engineering degree requires at least 31 credits beyond the baccalaureate. It is offered under two plans, Plans A and B. Plan A involves writing a thesis and Plan B involves additional course work and a project in lieu of the thesis.

Plan A Students must complete a minimum of 31 semester credits in graduate courses. At least 15 credits must be electrical and computer engineering courses with at least 6 credits in courses numbered 4xxx or higher, 6 credits in courses numbered 5xxx or higher, and at least 3 credits in courses at 8xxx. An additional 6 credits must be in a related field outside of ECE or minor. The remaining 10 credits should be thesis credits.

Plan B Students must complete a minimum of 31 credits in graduate courses including project credits. The project credits should be at least 1 and at most 3. A total of 6 credits must be in a related field outside of ECE or minor. The remaining 22 or 24 credits must be ECE courses with at least 6 credits in courses numbered 4xxxx or higher, 6 credits in courses numbered 5xxx or higher, and at least 3 credits in courses at 8xxxx.

Goals

The goal of the MSECE program at UMD is to provide ECE graduate students and practicing engineers the opportunity to expand their knowledge in the field of electrical and computer engineering. The department is committed to offering research and knowledge development recognizing the importance of collaboration between students and faculty to solve complex engineering problems.

Admission Requirements

Students wishing to major in electrical and computer engineering at the master's level should have completed an undergraduate degree in electrical, computer, electrical and computer engineering, or a related discipline, and must meet the general admission requirements of the Graduate School of the University of Minnesota Duluth, namely: a preferred performance level of 3.0/4.0 GPA from an accredited U.S. institution or foreign equivalent, and two letters of recommendation concerning the student's readiness for graduate education, and academic abilities.

For applicants whose native language is not English, the preferred performance level on the TOEFL is a score of at least 213 on the computer-based test. GRE score is recommended but not required by ECE.

Industrial experience and professional licensure will be considered for admittance to the MSECE program. Previous graduate-level coursework completed after receiving baccalaureate degree may qualify for transfer credit upon recommendation and approval by the MSECE program's Director of Graduate Studies at ece@d.umn.edu or (218) 726-6147, or visit the website at www.d.umn.edu/ece

MSECE program Director of Graduate Studies

Dr. Imran Hayee
Electrical and Computer Engineering Department
University of Minnesota Duluth
278 MWAH, 1023 University Drive
Duluth, MN 55812
Phone: (218) 726-6743
Email: ihayee@d.umn.edu

Application Deadlines

Applicants are encouraged to apply for admission well in advance of the term in which they wish to enter the Graduate School, but no more than one year in advance of the proposed entry date. The Graduate School application, completed with all required materials, must be submitted by the following deadlines:

- Fall Semester – July 15
- Spring Semester – November 1
- Summer Session – May 1

Online Application System

Effective the week of September 22, 2008 all applications for admission for Fall 2009 and beyond will be submitted online rather than in paper form. Please check the web page www.d.umn.edu/grad for details.

Request Application Materials, Forms, and Resources from:

Graduate School
University of Minnesota Duluth
431 Darland Administration Building
Duluth, MN 55812
Phone: (218) 726-7523
Email: mjleone@d.umn.edu
www.d.umn.edu/grad

**MASTER OF SCIENCE IN ELECTRICAL AND COMPUTER ENGINEERING
(M.S.E.C.E.) COURSES**

ECE 8151. LINEAR SYSTEMS AND OPTIMAL CONTROL.
(3.0 cr; prereq 3151)

ECE 8315. Embedded SYSTEMS AND MICROCOMPUTER INTERFACES DESIGN.
(4 cr; 2325, 3341, CS 1511, CS 2521)

ECE 8611. SEMICONDUCTOR DEVICE DESIGN, FABRICATION, AND ANALYSIS.
(3 cr; ECE 3611 or Physics 4021 and Math 3280, A-F)

ECE 8741. DIGITAL IMAGE PROCESSING.
(4 cr; ECE 4741, A-F)

ECE 8765. DIGITAL COMMUNICATIONS.
(3 cr; 4765, A-F)

ECE 8831. SOFT COMPUTING.
(3 cr; prereq: the student is expected to have knowledge of linear algebra and computer programming; A-F only)

PART III
MISCELLANEOUS

ACADEMIC CALENDAR

FALL SEMESTER, 2009 (72 instructional days)

Date	Day	Milestone
August 31	Monday	Academic appointments begin
September 4-7	Friday-Monday	Welcome Week & Bulldog Bash (required for all new freshmen)
September 7	Monday	Holiday - campus closed
September 8	Tuesday	Fall semester classes begin
November 26	Thursday	Holiday - campus closed
November 27	Friday	Floating holiday* - campus closed
December 16	Wednesday	Last day of fall semester classes
December 17-22	Thursday-Tuesday	Final exams
December 24	Thursday	Floating holiday* - campus closed
December 25	Friday	Holiday - campus closed
December 28	Monday	Floating holiday* - campus closed
December 31	Thursday	Floating holiday* - campus closed
January 1	Friday	Holiday- campus closed

SPRING SEMESTER, 2010 (74 instructional days)

Date	Day	Milestone
January 18	Monday	Holiday - campus closed
January 19	Tuesday	Spring semester classes begin
March 12	Friday	Last day of classes before spring break
March 15-19	Monday-Friday	Spring break
March 22	Monday	Classes resume
May 7	Friday	Last day of spring semester classes
May 10-14	Monday-Friday	Final exams
May 13	Thursday	Graduate School commencement
May 15	Saturday	Undergraduate commencement
May 30	Sunday	Academic appointments end
May 31	Monday	Holiday - campus closed

MAY SESSION, 2010 (13 instructional days)

Date	Day	Milestone
May 17	Monday	May session classes begin
May 31	Monday	Holiday - campus closed
June 4	Friday	Final exams; end of May session

SUMMER SESSION, 2010 (38 instructional days)

Date	Day	Milestone
June 7	Monday	Summer term classes begin
July 5	Friday	Holiday - campus closed
July 30	Friday	Final exams; end of summer term

* Floating holidays are set in consultation with civil service employees (bargaining unit and non-bargaining unit) and are subject to change.

Page Coordinator: Academic Administration (726-7103).

UNIVERSITY OF MINNESOTA

ePORTFOLIO

<https://portfolio.umn.edu/portfolio/index.jsp>

What is Portfolio?

Portfolio is a secure web site at the University of Minnesota (U of M) for saving, organizing, viewing, and selectively sharing personal educational records.

Who can use Portfolio?

All current U of M students, faculty, and staff may use Portfolio to:

- Enter and view personal educational records
- Share selected Portfolio elements with one or more individuals
- View other people's Portfolios to which they have been granted access

Individuals outside of the University Community may:

- View Portfolios to which they have been granted access by individuals at the U of M

How do I get started using Portfolio?

- Your first step is to Login to Portfolio using the web address the top of this page
- Using either the U of M login (enter your Internet ID and Password), or the Guest login (enter your full e-mail address and the password sent in the notification e-mail message) to access Portfolio

How do I logout of Portfolio?

When you are finished using Portfolio remember to Logout

- U of M users in the Login window click the Logout button
- Guest users should click the Logout link in the upper right corner
- Both U of M and Guest users should close all browser windows

If I have questions or problems who should I contact?

Contact portfolio@umn.edu or your campus help desk

GRADUATION PLANNER

<https://onestop2.umn.edu/gradplanner/home.jsp>

Graduation Planner is an interactive planning tool for University of Minnesota students on all campuses. Use Graduation Planner to:

- Explore the requirements for majors and minors
- Discover what courses you need to take, and when you should take them
- Make a plan that will help you stay on track for graduation

Your adviser will be able to review and comment on the plans you create. Be sure to work with your adviser as you plan for your degree. Some majors or programs have application procedures or special requirements, and your adviser is the best source for this information.

APPENDIX

TABLE 1: ECE PROGRAM OBJECTIVES AND OUTCOMES

PROGRAM EDUCATIONAL OBJECTIVES ARE TO:	PROGRAM OUTCOMES STUDENTS SHALL DEMONSTRATE:
(a) Teach students the core disciplines of mathematics, science, and engineering	An ability to apply knowledge of mathematics, science, and engineering
(b) Educate students on how to design and conduct experiments, as well as to analyze and interpret data	An ability to design and conduct experiments, as well as to analyze and interpret data
(c) Provide opportunities and guidance so that students can design a system, component, or process to meet desired needs	An ability to design a system, component, or process to meet desired needs
(d) Provide opportunities and guidance for students to function on multi-disciplinary teams	An ability to function on multi-disciplinary teams
(e) Train students to identify, formulate, and solve engineering problems	An ability to identify, formulate, and solve engineering problems
(f) Expose students to an understanding of their professional and ethical responsibility	An understanding of professional and ethical responsibility
(g) Instruct students on the techniques to communicate effectively in writing and orally	An ability to communicate effectively in writing and orally
(h) Expose students to the broad education necessary to understand the impact of engineering solutions in a global and societal context	The broad education necessary to understand the impact of engineering solutions in a global and societal context
(i) Instill in students a recognition of the need for, and an ability to engage in life-long learning	A recognition of the need for, and an ability to engage in life-long learning
(j) Expose students to the knowledge of contemporary issues	A knowledge of contemporary issues
(k) Train students to use the techniques, skills, and modern engineering tools necessary for engineering practice	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
(l) Provide students with in-depth knowledge of computer software and hardware which then supports the Computer Science Minor embedded in the BSECE program	A knowledge of computer software and hardware as demonstrated by the Computer Science Minor embedded in the program
(m) Provide students with in-depth knowledge of mathematics which supports students obtaining a Math Minor with an appropriate selection of an advanced math course	A knowledge of mathematics as demonstrated by students obtaining a Math Minor with an appropriate selection of an advanced math course
(n) Tutor and guide students to work in the hands-on laboratories associated with most of the required courses.	An ability to work in a hands-on laboratory in most of the required courses

TABLE 2: ECE COURSE OUTCOMES – REQUIRED COURSES

PROGRAM OUTCOMES	A	B	C	D	E	F	G	H	I	J	K	L	M	N
ECE Introduction ECE 1001 Introduction to Electrical and Computer Engineering	X			X		X		X		X				
ECE Digital (with labs) ECE 1315 Digital System Design ECE 2325 Microcomputer System Design ECE 3341 Digital Computer Circuits ECE 4305 Computer Architecture	X	X	X		X						X	X		X
	↓	↓	↓		↓						↓	↓		↓
ECE Systems (with labs) ECE 2006 Electrical Circuit Analysis ECE 2111 Linear Systems and Signal Analysis	X	X	X		X						X			X
	X	X	X		X						X			X
ECE Systems (no labs) ECE 3151 Control Systems	X		X		X						X			
ECE Electronics (with labs) ECE 2212 Electronics I ECE 3235 Electronics II	X	X	X		X		X				X			X
	X	X	X		X		X				X			X
ECE Engineering Physics ECE 3445 Electromagnetic Fields ECE 3611 Introduction to Solid State Semiconductors	X		X	X	X						X			
	X		X	X	X			X			X			
ECE Capstone Design (with labs) ECE 4899 Senior Project I ECE 4951 Design Workshop ECE 4999 Senior Project II	X	X	X	X	X	X	X	X	X	X	X			X
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓			↓
Basic Sciences (with labs) Phys 2011 Mechanics (Physics I) Phys 2012 Electricity, Magnetism, Optics (Physics II) Chem 1151 General Chemistry I	X	X												X
	↓	↓												↓
Computer Science CS 1511 Computer Science I CS 1521 Computer Science II CS 2511 Software Analysis and Design CS 5631 Operating Systems	X	X	X									X		X
	↓	↓	↓									↓		↓
Mathematics/Statistics Math 1296 Calculus I Math 1297 Calculus II Math 3280 Differential Equations with Linear Algebra Math 3298 Calculus III Stat 3611 Introduction to Probability and Statistics	X												X	
	↓												↓	
Composition WRIT 1120 College Writing WRIT 3130 Advanced Writing- Engineering							X							
							X							

Professional Society IEEE						X			X	X				
Internships	X	X	X	X	X	X	X	X	X	X	X			
UROP and Undergraduate Research	X	X	X	X	X	X	X	X	X	X	X			

1. Liberal education electives chosen to meet UMD campus requirements.
2. Engineering breadth elective (3 credits): choose one of the specified five courses.
3. ECE technical electives (9 credits): Electives must include at least one of the following courses: ECE 4305 (4 cr), ECE 5315 (3 cr). Electives may not include ECE 4899, 4951, or 4999.
4. 5XXX courses are open to both undergraduate and first year graduate students.
5. Course outcomes vary with the topics offered.
6. Effective Spring 2008, the "Applied Mathematics" Minor no longer exists. ECE students need to take one additional 3xxx level (or above) mathematics course to earn a "Mathematics" Minor.