ELECTRICAL ENGINEERING DEGREE

FOCUS AREAS GUIDE

2006-2007

UNIVERSITY OF MINNESOTA, MINNEAPOLIS

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ELECTRICAL ENGINEERING DEGREE FOCUS AREAS GUIDE

TABLE OF CONTENTS

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1. INTRODUCTION

Electrical Engineering is a very broad discipline, possibly the broadest of all engineering disciplines. Consequently, electrical engineering has many subfields. This Guide includes a list of subfields (focus areas) and the corresponding electives within each focus area that are offered through the Department of Electrical and Computer Engineering. These electives provide a good background relating to a particular specialty and also serve as an introduction to specializations in graduate study. Since these courses are designed to compliment the undergraduate curriculum, they will not give highly specialized knowledge in any particular subfield.

Please note that the courses listed in this Guide are not required for graduation. The courses listed under a particular focus area are simply suggested electives that will provide some concentration in a selected focus area. Consult the EE Curriculum Guide for the EE degree requirements.

Selection of elective courses permits some specialization in the following areas:

- Biomedical Engineering
- Communications / Digital Signaling Processing
- Computer Systems
- Control Systems
- Electric Energy Systems / Power Electronics
- Fields, Magnetics, and Optics
- Integrated Circuits / VLSI
- Microelectronics / Materials

Guidance in selecting elective courses can be obtained from your academic adviser or any faculty member in your area of interest. A list of faculty with interests in the various focus areas is given in Section 2.

2. FACULTY AREAS OF INTEREST/ADDRESSES

Biomedical Engineering

Holte, James	612-625-0811	EE/CS 4163	holte@ece.umn.edu
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Communications/Digital Signal Processing

Ebbini, Emad	612-625-1852	EE/CS 6163	emad@ece.umn.edu
Giannakis, Georgious	612-626-7781	EE/CS 6165	georgios@ece.umn.edu
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Kieffer, John	612-625-8574	EE/CS 6179	kieffer@ece.umn.edu
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Parhi, Keshab	612-624-4116	EE/CS 6181	parhi@ece.umn.edu
Tewfik, Ahmed	612-625-6024	EE/CS 6177	tewfik@ece.umn.edu

Control Systems

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Jovanovic, Mihailo	612-626-7204	EE/CS 5183	mihailo@ece.umn.edu
Sapiro, Guillermo	612-625-1343	EE/CS 5159	guille@ece.umn.edu

Computer Systems

Bazargan, Kiaresh	612-625-4588	EE/CS 4159	kia@ece.umn.edu
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Harjani, Ramesh	612-625-4032	EE/CS 4165	harjani@ece.umn.edu
Kim, Chris	612-625-2346	EE/CS 4161	chriskim@ece.umn.edu
Kinney, Larry	612-625-4359	EE/CS 6121	kinney@ece.umn.edu
Lilja, David	612-625-5007	EE/CS 6109	lilja@ece.umn.edu
Riedel, Marc	612-625-6086	EE/CS 4167	mriedel@umn.edu
Roychowdhury, Jaijeet	612-626-7203	EE/CS 4155	jaijeet@ece.umn.edu
Sapatnekar, Sachin	612-625-0025	EE/CS 4153	sachin@ece.umn.edu
Sobelman, Gerald	612-625-8041	EE/CS 4157	sobelman@ece.umn.edu

Microelectronics/Materials

Campbell, Stephen	612-625-5876	EE/CS 5129	campbell@ece.umn.edu
Cohen, Philip	612-625-5517	EE/CS 5131	cohen@ece.umn.edu
Gopinath, Anand	612-625-3054	EE/CS 6123	gopinath@ece.umn.edu
Higman, Ted	612-624-4170	EE/CS 6125	higman@ece.umn.edu
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Polla, Dennis	612-624-8005	EE/CS 1165	polla@ece.umn.edu
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Oh , Sang-Hyun	612-625-0125	EE/CS 5119	
Talghader, Joseph	612-625-4524	EE/CS 5165	joey@ece.umn.edu
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Fields/Magnetics/Optics

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Jacobs, Heiko	612-626-7193	EE/CS 5163	hjacobs@ece.umn.edu
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Victora, Randall	612-625-1825	EE/CS 6157	victora@ece.umn.edu
Wang, Jian Ping	612-625-9509	EE/CS 6153	jpwang@ece.umn.edu

Integrated Circuits/VLSI

Harjani, Ramesh	612-625-4032	EE/CS 4165	harjani@ece.umn.edu
Parhi, Keshab	612-624-4116	EE/CS 6181	parhi@ece.umn.edu
Sobelman, Gerald	612-625-8041	EE/CS 4157	sobelman@ece.umn.edu

Electric Energy Systems/Power Electronics

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3. EE DEGREE FOCUS AREA DESCRIPTIONS

Electrical and electronics engineering comprises many disciplines and specialties that draw from a range of knowledge areas. Some specialty areas, such as power engineering, are associated with specific industries. Others, such as signal processing, have applications in many industries. The Department of Electrical and Computer Engineering offers the following optional focus areas for undergraduates. Regardless of interest area, the degree will still be listed as Bachelor of Electrical Engineering (BEE).

3.1. Biomedical Engineering

Biomedical engineering is an interdisciplinary field that merges the interests of engineering and the biological/medical sciences. Working with other health care professionals, biomedical engineers think of biology in new ways in order to develop innovative tools for diagnosing disease and to repair or replace diseased organs. Pacemakers, blood analyzers, cochlear implants, medical imaging, lasers, prosthetic implants, and life support systems are just a few of the results of the team efforts of biomedical engineers and health professionals. In addition, this focus area provides an excellent preparation for students planning to enter Medical School.

3.2. Communications/Digital Signal Processing

The field of communications encompasses transmission of information by electromagnetic signals through wired and wireless links and networks. The information may be voice, images (still photographs and drawings), video, data, software, or text messages. Communications engineers design and develop equipment and systems for a great variety of applications, including digital telephony, cellular telephony, broadcast TV and radio, satellite communications, optical fiber communications, deep space communications, local-area networks, and Internet and World Wide Web communications.

Signal processing is a closely related field that involves manipulating electromagnetic signals so that they can be transmitted with greater accuracy, speed, reliability, and efficiency. Signal processing engineers direct their attention to data compression, modulation systems, radar, sonar, computer-aided tomography (CAT), ultrasound imaging, and magnetic resonance imaging (MRI).

3.3. Computer Systems

Computer systems have traditionally referred to large mainframe or supercomputers that solve complex scientific or large data processing problems. Since large-scale integrated circuits and "computer-on-a-chip" devices (microprocessors, etc.) have placed computer systems in virtually every application area imaginable, a broad understanding of network hardware and software is valuable. Protocols, physical network properties, queuing and network performance, and network security are among the many topics included.

Students who want more specialization in computers than is possible by incorporating a computer focus area within the standard EE curriculum should consider Computer Engineering. For more information, consult the Computer Engineering Curriculum Guide.

3.4. Control Systems

The field of automatic control spans a wide range of technologies, from aerospace to health care. The main goal of automatic control technology is to automatically guide or regulate a system under both steady-state and transient conditions, using feedback to adapt to unknown or changing conditions. Electrical engineers design and develop automatic control systems to guide aircraft and spacecraft. They apply control technology to automatically adjust processes and machinery in manufacturing such diverse products as chemicals, pharmaceuticals, automobiles, and integrated circuits. For the healthcare industry, electrical engineers design controls for medical assistance devices such as medication-injection machines and respirators.

3.5. Electric Energy Systems/Power Electronics

The electrical power field is concerned with the generation, transmission, and distribution of electrical energy. Electrical power engineers design and develop equipment and systems to provide electricity in homes, offices, stores, and factories. Power engineers also design power systems for aircraft and spacecraft; provide computer-controlled energy management systems that conserve energy in manufacturing facilities; and design electrical motors for applications ranging from appliances to processing plants. Electric energy systems have many applications besides generation of electricity including electrical propulsion, electromagnetic suspension, and electric drives for various pumps, grinders, and presses.

3.6. Fields, Magnetics, and Optics

Electromagnetics is the basic physical and mathematical foundation for electric, magnetic, and electromagnetic field phenomena. Electromagnetics are applied in many fields of electrical engineering such as optical-fiber communications, radio broadcasting, wireless communications, coaxial cable systems, radar, antennas, sensors, and microwave generators and detectors. It is one of the most analytical fields of electrical engineering in that it relies heavily on mathematics to express physical effects such as the complex relationships among electric and magnetic intensities and flux densities and material properties in space and time.

3.7. Integrated Circuits and VLSI Circuits

Integrated circuits (ICs) are the devices used in all electrical engineering application areas. An IC is the implementation of a system on a single piece of semiconductor material, which is packaged in a single very small package. The number of electronic devices on an IC can range from 100's of devices to 10's of millions of devices; the larger ICs are called Very Large Scale Integrated (VLSI) Circuits. Until recently, ICs contained only electronic circuits. As they are now fabricated, ICs also contain very small mechanical devices, resulting in a micro-electro-mechanical system (MEMS). Purely electronic ICs include digital logic, computers such as personal computer processors, processors for dedicated applications such as communication processors or signal processors, and numerous electronic systems that contain analog circuitry such as analog-to-digital and digital-to-analog converters. Examples of MEMS devices are pressure and acceleration sensors for industrial and automotive applications and many sensors and mechanical devices for medical applications.

Since all applications use electronics made from integrated circuits, an IC engineer faces any number of design system challenges. The design and fabrication of an IC occurs at several 'levels:' the processing of the semiconductor materials, the construction of digital and analog electronic devices from the semiconductor materials, and the implementation of the system from the devices. The first two levels relate to the fabrication of the IC and are described in the next focus area (Microelectronics / Materials). The third level is the IC/VLSI focus area and it, in turn, can be divided into many different design problems. One problem is the design of the system from smaller parts. For example, a computer or special purpose processor is typically divided into memory, arithmetic unit, controller, and input/output sections, and these parts are designed from logic gates and memory elements. A second problem in this level of design is the placement of the system parts on the IC circuit and the routing of interconnections between the parts. Both of these subproblems require the use of computer-aided design programs.

3.8. Microelectronics / Materials

Microelectronics and Materials are concerned with part of the overall design of an integrated circuit. (See the discussion of the IC focus area.) This focus area includes the study of the mechanical, chemical, and electric properties of materials used in integrated circuits and the development of materials with particular properties. The implementation of various electronic devices (such as diodes and transistors) from the semiconductor materials, and the chemical and mechanical processing of the materials required to fabricate an integrated circuit are also studied.

4. EE DEGREE FOCUS AREA COURSE SUGGESTIONS

4.0. Course Suggestions

Listed below are suggested courses to take if you are primarily interested in a particular focus area. Note that it is **not** necessary to follow any one of these to obtain the BEE degree; the degree requirements are as specified in the EE Curriculum Guide. The course lists are simply suggestions from faculty of courses relevant to a particular focus area.

A given student may not be able to take all the courses in the student's focus area of interest. The student may need to take other courses to satisfy some requirement or the student may not be qualified to take some of the courses. The latter situation may occur if the student does not have the prerequisites for the course or, in the case of 5000 level courses, the requisite gpa to take the course. 5000 level courses are intended primarily for graduate students and, in general, an undergraduate can take a 5000 level course only if their gpa is 3.2 or larger. See the EE Curriculum Guide for the procedure required to register for a 5000 level course.

Also, students should consider that, during their career, they are likely to have many different jobs and work in many different areas of EE. In order to prepare for this diversity of work, it may be best to select courses from several different areas rather than trying to specialize in the undergraduate program. Specialization can be obtained after graduation through graduate work, company courses, etc.

Note that the credit requirements listed are for students who entered the University of Minnesota **Fall 2006 or later**.

4. EE DEGREE FOCUS AREA COURSE SUGGESTIONS

4.1. Biomedical Engineering (At least 34 credits)*

Suggested EE Electives 22-34 credits

One of the following is required:

EE 4951W - Senior Design Project (4 credits)
EE 4981H-4982V - Senior Honors Project I-II (2 credits each)

Highly Recommended EE Electives:

EE 5811 - Biomedical Instrumentation (3 credits)
EE 5821 - Biomedical System Modeling and Analysis (3 credits)

Other recommended EE electives:

EE 4231 - Linear Control Systems (3 credits),
EE 4233 - State Space Control System Design (3 credits)
EE 4235 - Linear Control Systems Laboratory (1 credit)
EE 4237 - State Space Laboratory (1 credit)
EE 4301 - Digital Design with Programmable Logic (4 credits)
EE 4341 - Microprocessor & Microcontroller System Design (4 credits)
EE 4541 - Digital Signal Processing (3 credits),
EE 5545 - Real-Time Digital Signal Processing Laboratory (2 credits)

Suggested Non-EE Electives 0-12 credits

BMEn 5401 – Adv Functional Biomedical Imaging 93 credits)

CSci 2031 - Introduction to Numerical Computing (4 credits) [check prerequisites]
CSci 4041 - Algorithm & Data Structures (4 credits) [check prerequisites]
CSci 4061 - Intro to Operating Systems (4 credits) [check prerequisites]
CSci 5211 - Data Communications & Computer Networks (3 credits) [check prerequisites]
CSci 5521 - Pattern Recognition (3 credits) [check prerequisites]

Phsl 3061 - Principles of Physiology (4 credits)

Phys 5401 - Physiological Physics (4 credits) [check prerequisites]
Phys 5402 - Radiological Physics (4 cr)

* This guide gives suggestions for selecting elective courses to provide some specialization in the EE Degree Program. It does not list requirements for the degree; please see the EE Curriculum Guide for the degree requirements.

4. EE DEGREE FOCUS AREA COURSE SUGGESTIONS

4.2. Communications/Digital Signal Processing (At least 34 credits)*

Suggested EE Electives 22-34 credits

One of the following is required:

EE 4951W - Senior Design Project (4 credits)
EE 4981H-4982V - Senior Honors Project I-II (2 credits each)

Highly recommended EE electives:

EE 4501 - Communication Systems (3 credits)
EE 4505 - Digital Communications Laboratory (1 credit)
EE 4541 - Digital Signal Processing (3 credits)
EE 5545 - Real-Time Digital Signal Processing Laboratory (2 credits)

Other recommended EE electives:

EE 4231 - Linear Control Systems (3 credits)
EE 4235 - Linear Control Systems Laboratory (1 credit)
EE 4233 - State Space Control System Design (3 credits),
EE 4237 - State Space Laboratory (1 credit)
EE 4301 - Digital Design with Programmable Logic (4 credits)
EE 4341 - Microprocessor & Microcontroller System Design (4 credits)
EE 5501 - Digital Communication (3 credits)
EE 5542 – Adaptive Digital Signal Processing (3 credits)
EE 5545 - Real-Time Digital Signal Processing Laboratory (2 credits)
EE 5549 – Digital Signal Processing Structures for VLS (3 credits)
EE 5581 - Information Theory and Coding (3 credits)
EE 5585 - Data Compression (3 credits)

Suggested Non-EE Electives 0-12 credits

CSci 2031 - Intro to Numerical Computing (4 credits) [check prerequisites]
CSci 4061 - Intro to Operating Systems (4 credits) [check prerequisites]
CSci 5211 - Data Communications & Computer Networks (3 credits) [check prerequisites]
CSci 5302 - Analysis of Numerical Algorithms (3 credits) [check prerequisites]
CSci 5521 - Pattern Recognition (3 credits) [check prerequisites]
Math 4242 - Applied Linear Algebra (4 credits)

Stat 5101-5102 - Theory of Statistics I-II (4 credits each) [check prerequisites]

* This guide gives suggestions for selecting elective courses to provide some specialization in the EE Degree Program. It does not list requirements for the degree; please see the EE Curriculum Guide for the degree requirements.

4.3. Computer Systems (At least 34 credits)*

Suggested EE Electives 22-34 credits

One of the following is required:

EE 4951W - Senior Design Project (4 credits)
EE 4981H-4982V - Senior Honors Project I-II (2 credits each)

Highly Recommended EE Electives:

EE 4301 - Digital Design with Programmable Logic (4 credits)
EE 4341 - Microprocessor & Microcontroller System Design (4 credits)
EE 4363 - Computer Architecture and Machine Organization (4 credits)
EE 4609 – Digital Signal Integrity (3 credits)
EE 5301 - VLSI Design Automation I (3 credits)
EE 5302 - VLSI Design Automation II (3 credits) [prerequisite 5301]
EE 5323 - VLSI Design I (3 credits)
EE 5324 - VLSI Design II (3 credits) [prerequisite 5323]
EE 5327 - VLSI Design Laboratory (3 credits)
EE 5364 - Advanced Computer Architecture (3 credits)
EE 5371 - Comp Sys Performance Measurement & Evaluation (3 credits)

Other Recommended EE Electives:

EE 4231 - Linear Control Systems: Designed by I/O Methods (3 credits)
EE 4235 - Linear Control Systems Laboratory (1 credit)
EE 4233 - State Space Control System Design (3 credits),
EE 4237 - State Space Laboratory (1 credit)
EE 4501 - Communication Systems (3 credits)
EE 4505 - Communication Systems Laboratory (1 credit)
EE 4541 - Digital Signal Processing (3 credits)
EE 5545 - Real-Time Digital Signal Processing Laboratory (2 credits)

Suggested Non-EE Electives 0-12 credits

CSci 4011 - Formal Languages & Automata Theory (4 credits) [check prerequisites]
CSci 4061 - Into to Operating Systems (4 credits) [check prerequisites]
CSci 5106 - Programming Languages (3 credits) [check prerequisites]
CSci 5211 - Data Communications & Computer Networks (3 credits) [check prerequisites]
CSci 5283 - Computer-Aided Design I (3 credits) [check prerequisites]
CSci 5801-5802 - Software Engineering I-II (3 credits each) [check prerequisites]

* This guide gives suggestions for selecting elective courses to provide some specialization in the EE Degree Program. It does not list requirements for the degree; please see the EE Curriculum Guide for the degree requirements.

4. EE DEGREE FOCUS AREA COURSE SUGGESTIONS

4.4. Control Systems (At least 34 credits)*

Suggested EE Electives 22-34 credits

One of the following is required:

EE 4951W - Senior Design Project (4 credits)
EE 4981H-4982V - Senior Honors Project I-II (2 credits each)

Highly recommended EE electives:

EE 4231 - Linear Control Systems: Designed by I/O Methods (3 credits)
EE 4233 - State Space Control System Design (3 credits)
EE 4235 - Linear Control Systems Laboratory (1 credit)
EE 4237 - State Space Laboratory (1 credit)
EE 4541 - Digital Signal Processing (3 credits)

Other recommended EE electives:

EE 4301 - Digital Design with Programmable Logic (4 credits)
EE 4341 - Microprocessor & Microcontroller System Design (4 credits)
EE 4701 - Electric Drives (3 credits)
EE 4703 - Electric Drives Laboratory (1 credit)
EE 5231 - Linear Systems and Optimal Control (3 credits)
EE 5235 - Robust Control System Design (3 credits)
EE 5545 - Real-Time Digital Signal Processing Laboratory (2 credits)

Suggested Non-EE Electives 0-12 credits

CSci 4061 - Intro to Operating Systems (4 credits) [check prerequisites]
CSci 5302 - Analysis of Numerical Algorithms (3 credits) [check prerequisites]
CSci 5304 - Computational Aspects of Matrix Theory (3 credits) [check prereqs]
CSci 5511 - Artificial Intelligence (3 credits) [check prerequisites]
CSci 5512W - Artificial Intelligence II (3 credits) [check prerequisites]
CSci 5521 - Pattern Recognition (3 credits) [check prerequisites]
Math 4567 - Introduction to Fourier Analysis (4 credits)
Math 4512 - Differential Equations with Applications (3 credits)
Math 4242 – Applied Linear Algebra (4 credits)
Math 4457-4458 – Methods of Applied Mathematics I & II (4 credits each)
Math 5525 – Intro: to Ordinary Differential Equations (4 credits)
Math 5583 - Complex Analysis (4 credits)
Stat 5101-5102 - Theory of Statistics I-II (4 credits each) [check prerequisites]

* This guide gives suggestions for selecting elective courses to provide some specialization in the EE Degree Program. It does not list requirements for the degree; please see the EE Curriculum Guide for the degree requirements.

4. EE DEGREE FOCUS AREA COURSE SUGGESTIONS

4.5. Electric Energy Systems/Power Electronics (At least 34 credits)*

Suggested EE Electives 22-34 credits

One of the following is required:

EE 4951W - Senior Design Project (4 credits)
EE 4981H-4982V - Senior Honors Project I-II (2 credits each)

Highly recommended EE elective:

EE 4701 - Electric Drives (3 credits)
EE 4703 - Electric Drives Laboratory (1 credit)
EE 4721 - Introduction to Power System Analysis (3 credits)
EE 4722 - Power System Analysis Laboratory (1 credit)
EE 4724 - Power System Planning and Operation (3 credits)
EE 4741 - Power Electronics (3 credits)
EE 4743 - Switch-Mode Power Electronics Laboratory (1 credit)

Other recommended EE electives:

EE 5705 - Advanced Electric Drives (3 credits)
EE 5721 - Power Generation Operation & Control (3 credits)
EE 5725 - Power Systems Engineering (3 credits)
EE 5741 - Advanced Power Electronics (3 credits)

Suggested Non-EE Electives 0-12 credits

CSci 4041 - Algorithm & Data Structures (4 credits) [check prerequisites]
CSci 5302 - Analysis of Numerical Algorithms (3 credits) [check prerequisites]
CSci 5304 - Computational Aspects of Matrix Theory (3 credits)

Math 4242 - Applied Linear Algebra (4 credits)
Math 4457-4458 - Methods of Applied Mathematics I-II (4 credits each) [check prerequisites]
Math 4512 - Differential Equations with Applications (3 credits)
Math 4567 - Intro to Fourier Analysis (4 credits)
Math 5525 - Intro: Ordinary Differential Equations (4 credits each
Math 5583 - Complex Analysis (4 credits)
Math 5485-5486 - Intro to Numerical Methods I-II (4 cr each) [check prereqs]

Stat 5101-5102 - Theory of Statistics I-II (4 credits each)

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4. EE DEGREE FOCUS AREA COURSE SUGGESTIONS

4.6. Fields / Magnetics / Optics (At least 34 credits)*

Suggested EE Electives 22-34 credits

One of the following is required:

EE 4951W - Senior Design Project (4 credits)
EE 4981H-4982V - Senior Honors Project I-II (2 credits each)

Highly recommended EE electives:

EE 4301 - Digital Design with Programmable Logic (4 credits)
EE 4341 - Microprocessor & Microcontroller System Design (4 credits)
EE 4541 - Digital Signal Processing (3 credits)
EE 4609 – Digital Signal Integrity (3 credits)
EE 5545 - Real-Time Digital Signal Processing Laboratory (2 credits)

Other recommended EE electives:

EE 4111 – Advanced Analog Electronics Design (4 credits)
EE 5141 - Integrated Sensors & Transducers (4 credits)
EE 5171 - Microelectronic Fabrication (4 credits)

Fields:

EE 5601 - Introduction to RF/Microwave Engineering (3 credits)
EE 5602 - RF/Antenna Circuit Design (3 credits)
EE 5607 – Wireless Hardware System Design (3 credits)
EE 5611 - Plasma-Aided Manufacturing (4 credits)
EE 5613 - RF/Microwave Circuit Design Laboratory (2 credits)
EE 5616 - Antenna Theory and Design (3 credits)

Magnetics:

EE 5653 - Physical Principles of Magnetic Materials (3 credits)
EE 5655 - Magnetic Recording (3 credits)
EE 5657W - Principles of Thin Film Technology (4 credits)

Optics:

EE 5621 - Physical Optics (3 credits)
EE 5622 - Physical Optics Laboratory (1 credit)
EE 5624 - Optical Electronics (4 credits)
EE 5627 - Optical Fiber Communication (3 credits)
EE 5628 – Fiber Optics Laboratory (1 credit)
EE 5629 - Optical System Design (2 credits)

Suggested Non-EE Electives 0-12 credits

MatS 3011 - Intro: Materials Science & Engineering (3 credits) [check prerequisites]

ME 3321 - Thermodynamics (4 credits) [check prerequisites]
ME 3322 - Heat Transfer & Fluid Flow (4 credits) [ME upper div, 3321]

Math 4457- 4458 - Methods of Applied Mathematics I & II (4 credits each) (4 credits) [check prerequisites]
Math 4512 - Differential Equations with Applications (3 credits)
Math 4567 - Intro to Fourier Analysis (4 credits)

Phys 2201 - Intro Thermal & Statistical Physics (2 credits) [check prerequisites]
Phys 2601 - Quantum Physics (4 credits) (4 credits) [check prerequisites]
Phys 2605-– Quantum Physics Laboratory (3 credits) [check prerequisites]
Phys 4101 - Quantum Mechanics (4 credits) [check prerequisites]
Phys 4201 - Statistical & Thermal Physics (3 credits) [check prerequisites]

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4. EE DEGREE FOCUS AREA COURSE SUGGESTIONS

4.7. Integrated Circuits / VLSI (At least 34 credits)*

Suggested EE Electives **22-34 credits**

One of the following is required:

EE 4951W - Senior Design Project (4 credits)
EE 4981H-4982V - Senior Honors Project I-II (2 credits each)

Highly recommended EE electives:

EE 4609 – Digital Signal Integrity (3 credits)
EE 5121 - Transistor Device Modeling for Circuit Simul (3 credits)
EE 5141 - Fundamentals of Microelectromechanical Systems (4 credits)
EE 5323 - VLSI Design I (3 credits)
EE 5324 - VLSI Design II (3 credits)

Other recommended EE electives:

EE 4011 - Instrumentation & Control Electronics (4 credits)
EE 4301 - Digital Design with Programmable Logic (4 credits)
EE 4341 - Microprocessor & Microcontroller System Design (4 credits)
EE 5333 - Analog Integrated Circuit Design (3 credits)
EE 5361 - Digital Computer Systems (3 credits)
EE 5381 - Advanced Computer Networks (3 credits)
EE 5549 - Digital Signal Processing Structures for VLSI (3 credits)

Suggested Non-EE Electives **0-12 credits**

AEM 2021 - Statics and Dynamics (4 credits)
AEM 3031 - Deformable Body Mechanics (4 credits) [check prerequisites]
AEM 4201 - Intro: Engineering Fluid Mechanics (4 credits)

CE 3502 - Fluid Mechanics (4 credits)

Math 4242 – Applied Linear Algebra (4 credits)

MatS 2001 – Intro: Science of Engineering Materials (4 credits)
MatS 3011 - Intro: Materials Science & Engineering (3 credits) [check prerequisites]

ME 3321 - Thermodynamics (4 credits) [check prerequisites]

CSci 4041 - Algorithm & Data Structures (4 credits) [check prerequisites]
CSci 5302 - Analysis of Numerical Algorithms (3 credits) [check prereqs]
CSci 5304 - Computational Aspects of Matrix Theory (3 credits) [check prereqs]

* This guide gives suggestions for selecting elective courses to provide some specialization in the EE Degree Program. It does not list requirements for the degree; please see the EE Curriculum Guide for the degree requirements.

4. EE DEGREE FOCUS AREA COURSE SUGGESTIONS

4.8. Microelectronics / Materials (At least 34 credits)*

Suggested EE Electives **22-34 credits**

One of the following is required:

EE 4951W - Senior Design Project (4 credits)
EE 4981H-4982V - Senior Honors Project I-II (2 credits each)

Highly recommended EE electives:

EE 4111 – Advanced Analog Electronics Design (4 credits)
EE 5171 - Basic Microelectronics (4 credits)
EE 5173 - Basic Microelectronics Laboratory (1 credit)

Other recommended EE electives:

EE 4301 - Digital Design with Programmable Logic (4 credits)
EE 4341 - Microprocessor Interfacing/System Design (4 credits)
EE 4609 – Digital Signal Integrity (3 credits)
EE 5141 - Integrated Sensors & Transducers (4 credits)

Suggested Non-EE Electives **0-12 credits**

AEM 2021 - Statics and Dynamics (4 credits)
AEM 3031 - Deformable Body Mechanics (3 credits) [check prerequisites]

MatS 2001 - Intro: Science of Engineering materials (4 credits)

* This guide gives suggestions for selecting elective courses to provide some specialization in the EE Degree Program. It does not list requirements for the degree; please see the EE Curriculum Guide for the degree requirements.