B S DEGREE
PROGRAM BOOKLET

ELECTRICAL ENGINEERING

AT

THE PENNSYLVANIA STATE UNIVERSITY

ORANGE PROGRAM

PROGRAM YEAR: 2017

Electrical Engineering
Educational Objectives of the BSEE Program

Goal Statement

The mission of our undergraduate program is to provide a high-quality education in electrical engineering for our students and to instill in them the attitudes, values, and vision that will prepare them for lifetimes of success, continued learning, and leadership in their chosen careers. A combination of required and elective courses ensures that students acquire a broad knowledge base in electrical circuits, digital systems, electronic devices, electromagnetics, and linear systems, as well as expertise in one or more areas of specialization. Additional problem-solving skills and practical experience are developed through design projects and laboratory assignments, which also provide opportunities for developing team-building and technical communication skills.

Program Educational Objectives

The BSEE Program provides undergraduates with a broad technical education important for employment in the private or public sector, and it teaches them the fundamentals, current issues, and creative problem solving skills essential for future years of learning. At three to five years after graduation, we foresee our graduates able to accomplish the following:

1. **Electrical engineering practice in technical assignments such as design, product development, research, manufacturing, consulting, testing, sales, and management;**
2. **Participation and leadership on teams comprised of individuals with diverse professional and cultural backgrounds;**
3. **Continued learning and professional development through such activities as graduate school, distance education, professional training, and membership in professional societies.**

Student Outcomes

Outcome #1. Graduates will attain the fundamental background in mathematics, physical sciences (physics and chemistry), and computer programming necessary for further study in electrical engineering.

Outcome #2. Graduates will have a broad knowledge base in both the quantitative and physical aspects of electrical engineering.

Outcome #3. Graduates will develop the design skills necessary for electrical engineering practice.

Outcome #4. Graduates will be able to apply their electrical engineering knowledge base to the solution of more advanced engineering problems.

Outcome #5. Graduates will have good interpersonal and communication skills.

Outcome #6. Graduates will develop the perspective of electrical engineering as a profession.

THE BSEE DEGREE IN ELECTRICAL ENGINEERING

For Juniors in Program Year 2017

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WELCOME JUNIORS! August, 2017

Now that you have officially achieved status of “Electrical Engineering major”, we are happy to welcome you to the BSEE program. This booklet has been prepared for your use as a guide for your studies and as a means of providing you with much of the information that you may need as you continue to work towards your BSEE degree. We hope that you read it carefully, and we invite your inquiries about any of the questions or issues that are related to your program. The Academic Affairs staff in 121 Electrical Engineering East is here to serve you.

Please watch the bulletin boards and monitors in the lobby of Electrical Engineering East for announcement of special courses, news related to scheduling or textbooks, and other special opportunities. We will also keep in contact with you about many important matters via a departmental email list.

Again, welcome to Electrical Engineering. We wish you well in your studies and offer our services to assist you.

Tom LaPorta
Director of School of Electrical Engineering and Computer Science

Kultegin Aydin
Electrical Engineering Department Head

A. David Salvia
Director of Academic Affairs, School of Electrical Engineering and Computer Science

Mark Mahon
Undergraduate Advisor, School of Electrical Engineering and Computer Science

I. DEPARTMENTAL INFORMATION

I. 1. Degree Programs

The Department of Electrical Engineering at University Park offers BS, MS, and PhD degrees in Electrical Engineering. This booklet has been assembled to provide program information specifically for undergraduate EE students.

The Electrical Engineering B.S. degree emphasizes a foundation in science and mathematics that is followed by required Electrical Engineering course work and concludes with the student's selection from nearly 40 specialty courses offered to juniors and seniors. The program is broadened by courses in communication skills, arts, humanities, social sciences, and other engineering disciplines. Electrical Engineering electives are classified generally in the areas of electronic materials and devices, electronic circuit design, remote sensing and space systems, applied electromagnetics and wave propagation, control systems, signal and image processing, electro-optical devices and systems, power systems, communications, and computer engineering.

I. 2. Academic Affairs Office Personnel

The Academic Affairs Office Suite (121 EE East) is where initial questions and issues related to the program and graduation requirements should be brought.

Prof. Mark Mahon is the *Undergraduate Advisor* in the Electrical Engineering Department. He is your main source of information for short-term and long-term schedule planning, career guidance, and assistance with selection of Electrical Engineering electives. He has two offices – 113 Electrical Engineering East and W304 Westgate (formerly IST) Building. He can be reached at 867-5396 or through email at **mpm114@psu.edu**.

Prof. David Salvia is the *Director of Academic Affairs* in the Electrical Engineering Department. He is in charge of approving student petitions and is the person you would need to contact regarding EE course enrollment issues (prerequisites, getting into full classes, etc.). He is also the person you would deal with for more serious academic issues such as academic integrity violations or other issues related to University policy. His office is 114 Electrical Engineering East. He can be reached at 865-7227 or through email at **dsalvia@psu.edu**.

Mrs. Gabi Rhinehart, the *Undergraduate Program Staff Assistant,* is located in 115 Electrical Engineering East. Your main interaction with her will be dealing with audits, graduation checks, university policies, updating your schedule, and questions related to graduation. She is also a good source for obtaining office phone numbers, office addresses, or other information of that sort. If you don't know *whom* to contact when you have a problem or concern, Mrs. Rhinehart is a good place to start. Her phone number is 865-7272 and her email: **gbr6@psu.edu**.

I. 3. Student Organizations

A majority of students in the program choose to join the student branch of IEEE (Institute of Electrical and Electronics Engineers). Regular meetings and special events are scheduled throughout the year, and in addition, members receive subscriptions to Spectrum, Potentials, and The Institute. Potentials carries articles and advertisements prepared specifically for a student audience, whereas the other two are distributed to all members of IEEE. Watch for sign-up tables in the lobby of EE East early in the fall semester and watch for the newsletter published by the local chapter. Professor Tim Kane is the faculty adviser. You may visit the IEEE web page at: **http://sites.psu.edu/psuieee/.** The IEEE office is located in Room 222 Electrical Engineering East and the telephone number is 865-2393.

The Eta Kappa Nu Association (EE honor society) promotes scholarship and serves the EE students and Department through such activities as its tutoring program, open houses, and SRTE surveys. Founded in 1905, Penn State's Epsilon Chapter is the fifth oldest member of this international honor society for electrical engineering students. Membership is extended by invitation to EE majors ranked in the top fourth of their junior class or the top third of their senior class. Further information about Eta Kappa Nu can be obtained from its faculty adviser, Professor Julio Urbina. To receive updated information on Eta Kappa Nu, you may browse their web page at: **http://sites.psu.edu/hkneecs/**. The Eta Kappa Nu office is located in Room 222 Electrical Engineering East and the telephone number is 865-2393.

I. 4. Laboratory Operations

The BSEE curriculum contains eight required courses with laboratory components: CMPEN 270 (4 cr), EE 200 (3 cr), EE 210 (4 cr), EE 300W (3 cr), EE 310 (4 cr), EE 340 (4 cr), EE 350 (4 cr), and EE 403W (3 cr). Additional laboratory work is included in several of the senior elective courses.

The laboratory facilities for the required courses are located on the third floor of EE West, and are supervised from the stockroom. You are welcome to use these facilities when they are not scheduled for formal class work; a schedule of lab use is posted near the stockroom and includes some evening hours. Some test equipment is permanently located in each of the laboratory rooms, and additional instruments, test leads, and components may be signed out (with your I.D. card) for use in the labs areas.

For most labs, students are required to purchase components either from the Penn State Bookstore or the Department office and to possess a breadboard unit which facilitates the assembly and carryover of test circuits. More detailed information on laboratory operations is in the detailed course outlines for each laboratory course.

The EE Department also has a PC lab in 208 Engineering Unit B that has 24/7 access with your student ID. Software packages used in various EE courses are available in the PC lab. Printers are also available to print out course-related material.

I. 5. Financial Aid and Scholarships

There are 2 types of undergraduate scholarships: **Internal** (where the money and selection process are controlled by PSU) and **External** (money/selection not controlled by PSU completely). In addition, there are graduate fellowships if you are considering graduate school.

Internal Scholarships

The EE Department provides both merit and need-based scholarships for undergraduate students. Each summer a scholarship committee reviews student records for disbursement of scholarships to eligible recipients. Although you do not have to apply for these scholarships individually, you must file a free Application for Federal Student Aid through the Office of Student Aid, located in 314 Shields Building, to be considered for any of the need-based scholarships (see **http://studentaid.psu.edu)**. Aid forms should be filed early in the spring semester.

On rare occasions, an internal scholarship may require a separate application. You would be notified by the EE Department via the EE Undergraduate listserv of any such scholarship opportunities.

External Scholarships

There are numerous ways to find out about the numerous external scholarships available to you. The College of Engineering maintains a website that lists some appropriate Engineering-related scholarships. Visit **http://www.engr.psu.edu/scholarships** for this list**.** This list is constantly being updated, so check it often. In addition, the University Fellowship Office has a list of some of the more prominent general scholarships. Visit **http://ufo.psu.edu** for more information. You may also want to use the web to search for other external scholarships.

Graduate Fellowships

If you are considering graduate school, you should start looking for fellowship opportunities while you are still a Junior. As with undergraduate scholarships, the graduate fellowships are divided between internal and external fellowships. Contact the schools to which you are applying for information about internal fellowships and other funding opportunities. The University Fellowship Office has a list of some of the more prominent external graduate fellowships. Visit **http://ufo.psu.edu** for more information.

Wage Payroll Jobs

The EE Department hires graders, lab assistants, lab operators and others on an hourly, wage-payroll basis. To be considered for these positions you will need to fill out an on-line application with the EE department at the beginning of each semester. Information regarding this process is available at
http://www.eecs.psu.edu/Students/Graduate/EECS-Students-Job-Opportunities.aspx
For other financial aid information, (loans, etc.) please visit the PSU Financial Aid website at **http://studentaid.psu.edu.**

I. 6. Academic Integrity

Recognizing not only the value of integrity in the academic environment, but also its value for the practicing engineer and for the society at large, we in the Department of Electrical Engineering urge you to act as a responsible professional while you are a student. Academic integrity is defined in senate rule 49-20 as follows:

> ***Academic integrity is the pursuit of scholarly activity free from fraud and deception and it is an educational objective of this institution. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating of information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students.***

Each instructor should clarify specific standards for each course.

It is commonly accepted that people learn better if they can interact, discuss, and assist each other in solving problems and understanding concepts. However, persons submitting identical homework papers, computer programs, lab reports or projects overstep the bounds of beneficial interaction. Clearly, professionals share ideas, but they should not use others' work without clear acknowledgement of who did the work. The College of Engineering has online resources related to academic integrity at **http://www.engr.psu.edu/AcademicIntegrity/**.

II. DEGREE REQUIREMENTS FOR THE BSEE PROGRAM -- PROGRAM YEAR 2017

II. 1. Program Requirements Summary Chart

This chart is a suggested curriculum timetable. With careful planning you may arrange courses in many different ways. For example, the arts, humanities, and social sciences (AHS) may be moved to accommodate technical electives. **However, when moving courses, be careful to meet all prerequisites.**

FIRST SEMESTER		**SECOND SEMESTER**	
♦ MATH 140 Calc w/Analytical Geom	(4)____	♦ MATH 141 Calc w/Analytical Geom II	(4)____
♦ PHYS 211 Mechanics	(4)____	♦ PHYS 212 Electricity & Magnetism	(4)____
ENGL 15/30 Rhetoric & Composition	(3)____	EDSGN 100 Engineering Design	(3)____
♦ CHEM 110 Chemical Principles	(3)____	CMPSC 201 Programming with C++	(3)____
CHEM 111 Experimental Chemistry	(1)____	ECON 102/104 Micro/Macro Econ	(3)____
1st-year Seminar	(1)____	**TOTAL**	**(17)**
TOTAL	**(16)**		
THIRD SEMESTER		**FOURTH SEMESTER**	
♦ EE 210 Circuits and Devices	(4)____	EE 200 Design Tools	(3)____
♦ CMPEN 270 Logic Desgn: Thy&Prac	(4)____	♦ EE 310 Electronic Circuit Design	(4)____
MATH 220 Matrices	(2)____	MATH 230 Calc & Vector Analysis	(4)____
♦ MATH 250 Ordinary Differential Eqns	(3)____	CAS 100 A/B Effective Speech	(3)____
PHYS 213 Fluids and Thermal Phys	(2)____	* AHS elective	(3)____
PHYS 214 Waves and Quantum Phys	(2)____	**TOTAL**	**(17)**
TOTAL	**(17)**		
FIFTH SEMESTER		**SIXTH SEMESTER**	
♦ EE 330 Electromagnetics	(4)____	EE 300W Design Process	(3)____
♦ EE 340 Intro Nanoelectronics	(4)____	& EE/CMPEN 300 level elective	(3)____
♦ EE 350 Continuous-time Linear Sys	(4)____	& EE/CMPEN 300 level elective	(3)____
* AHS elective	(3)____	ENGL 202C Technical Writing	(3)____
Health & Physical Activity (GHA)	(1.5)___	* AHS elective	(3)____
TOTAL	**(16.5)**	**TOTAL**	**(15)**

SEVENTH AND EIGHTH SEMESTERS

The order in which you take these courses may vary. Please consult your adviser.

EE 403W Capstone Design	(3)____	& EE/CMPEN 400 level elective	(3)____
& EE/CMPEN 300/400 level elective	(3)____	& EE/CMPEN 400 level elective	(3)____
@ Statistics elective	(3)____	♣ Engineering/Science elective	(3)____
* AHS elective	(3)____	* AHS elective	(3)____
% Related elective	(3)____	% Related elective	(3)____
Health & Physical Activity (GHA)	(1.5)___		

TOTAL (BOTH SEMESTERS) (31.5)

TOTAL PROGRAM CREDITS: 130

♦ This course requires a grade of "C" or better for graduation from Electrical Engineering. The course should be repeated the next time offered if this condition is not satisfied.

& EE/CMPEN technical electives are to be chosen from the list on page 16

@ The statistics elective is to be chosen from the list on page 17

♣ The engineering/science elective is to be chosen from the list on page 17

% The related elective may include ROTC, co-op credits and other credits as specified on the list on pages 18

* Arts, Humanities, and Social Science Electives: see pages 19-20

II. 2. Course Descriptions, Prerequisites and Frequency of Offering

EE/CMPEN REQUIRED COURSES

EE 200 DESIGN TOOLS (3)
A working knowledge of electrical engineering design tools and hardware realization of electrical engineering systems.
Prerequisites: EE 210, CMPEN 270 or 271/275, CMPSC 201 or 121. Prerequisite or concurrent: EE 310. Offered FA, SP.

EE 210 CIRCUITS AND DEVICES (4) (Grade of C or better required)
Introduction to electrical circuit analysis, electronic devices, and time-domain transient analysis.
Prerequisite: PHYS 212. Prerequisite or concurrent: MATH 250. Offered FA, SP, SU.

EE 300W DESIGN PROCESS (3)
Introduction to the electrical engineering design process, project teaming and management, and technical communication.
Prerequisite: EE 200. Prerequisite or concurrent: ENGL 202C. Offered FA, SP.

EE 310 ELECTRONIC CIRCUIT DESIGN I (4) (Grade of C or better required)
Properties of fundamental electronic devices; analysis of DC, AC small-signal and nonlinear behavior; analog and digital circuit design applications.
Prerequisite: EE 210. Offered FA, SP.

EE 330 ENGINEERING ELECTROMAGNETICS (4) (Grade of C or better required)
Static electric and magnetic fields; solutions to static field problems; Maxwell's equations; electromagnetic wave boundary conditions; engineering applications.
Prerequisites: EE 210, MATH 230. Offered FA, SP, SU.

EE 340 INTRODUCTION TO NANOELECTRONICS (4) (Grade of C or better required)
Introduction to the physics and technology of nanoelectronic devices.
Prerequisites: PHYS 214, EE 210. Offered FA, SP.

EE 350 CONTINUOUS-TIME LINEAR SYSTEMS (4) (Grade of C or better required)
Introduction to continuous-time linear system theory; differential equation models, sinusoidal steady-state analysis, convolution, Laplace transform and Fourier analysis.
Prerequisites: EE 210, MATH 220, MATH 250. Offered FA, SP.

EE 403W CAPSTONE DESIGN (3)
Design projects in the various areas and subdisciplines of electrical engineering, with an emphasis on technical communication skills.
Prerequisites: EE 300W, ENGL 202C. Offered FA, SP.

CMPEN 270 DIGITAL DESIGN: THEORY AND PRACTICE (4) (Grade of C or better required)
Introduction to digital systems and their design. Topics include combinational and sequential devices and circuits, modern design tools and design practices.
Prerequisite: PHYS 212. Offered FA, SP.

Note: At non-University Park locations, CMPEN 270 is often taught as 2 separate courses, CMPEN 271 (3 credits) and CMPEN 275 (1 credit).

EE/CMPEN 300-LEVEL TECHNICAL ELECTIVE COURSES

EE 311 ELECTRONIC CIRCUIT DESIGN II (3)
Electronic circuit design with consideration to single and multi-device subcircuits, frequency response characteristics, feedback, stability, efficiency, and IC techniques.
Prerequisites: EE 310, EE 350. Offered FA, SP.

EE 320 INTRODUCTION TO ELECTRO-OPTICAL ENGINEERING (3)
An introduction covering several fundamental areas of modern optics, optical processes, and devices.
Prerequisite: EE 330. Offered FA, SP.

EE 351 DISCRETE-TIME LINEAR SYSTEMS (3)
Introduction to discrete-time signal processing: sampling, linear time-invariant systems, discrete-time fourier transform and discrete fourier transform, Z transform.
Prerequisite: EE 350. Offered FA, SP.

EE 360 COMMUNICATION SYSTEMS I (3)
Generic communication system; signal transmission; digital communication systems; amplitude modulation; angle modulation.
Prerequisite: EE 350. Offered FA, SP.

EE 362 COMMUNICATION NETWORKS (3)
Data transmission, encoding, link control techniques; communication network architecture, design; computer communication system architecture, protocols.
Prerequisites: CMPEN 270 or 271, STAT 401 or STAT 418. Offered FA, SP.

EE 380 LINEAR CONTROL SYSTEMS (3)
State variables; time-domain and frequency-domain design and analysis; design of feedback control systems; root locus. **Course contains a significant laboratory component.**
Prerequisites: EE 350, MATH 220. Offered FA.

EE 387 ENERGY CONVERSION (3)
Electromechanical energy conversion; magnetic circuits; transformers; transducers; commutators; synchronous, induction, and D.C. machines.
Prerequisite: EE 350. Offered FA, SP.

CMPEN 331 COMPUTER ORGANIZATION AND DESIGN (3)
Introduction to major components of a computer system, how they function together in executing a program, how they are designed. **Course contains a significant programming component.**
Prerequisites: CMPSC 121 or CMPSC 201, CMPEN 270 or 271. Offered FA, SP.

EE/CMPEN 400-LEVEL TECHNICAL ELECTIVE COURSES

EE 410 LINEAR ELECTRONIC DESIGN (3)
Linear circuit design via integrated circuit processes; A/D converters, switched capacitor filters, phase lock loops, multipliers, and voltage-controlled oscillators. **Course contains a significant laboratory component.**
Prerequisite: EE 311. Offered SP.

EE 413 POWER ELECTRONICS (3)
Switch-mode electrical power converters. Electrical characteristics and thermal limits of semiconductor switches. **Course contains a significant laboratory component.**
Prerequisites: EE 310, EE 350. Offered FA.

EE 416 (CMPEN) DIGITAL INTEGRATED CIRCUITS / VLSI DESIGN (3)
Design and analysis of digital integrated circuits employed in very large scale integrated (VLSI) chips. **Course contains a significant laboratory component.**
Prerequisite: EE 310, CMPEN 270 or CMPEN 271. Offered FA.

EE 417 (CMPEN) DIGITAL DESIGN USING FIELD PROG. DEVICES (3)
Field programmable device architectures and technologies; rapid prototyping using top down design techniques; quick response systems.
Prerequisite: CMPEN 331. Offered SP.

EE 420 ELECTRO OPTICS – PRINCIPLES AND DEVICES (3)
Spatially linear system and transform. Diffraction theory, partial coherence theory, optical image detection, storage and display, holography.
Prerequisite: EE 320. Offered FA.

EE 421 OPTICAL FIBER COMMUNICATIONS (3)
(Sometimes offered as EE 497: Applications of Optics in Communications & Lighting)
Operational principles of optical components, including sources, fibers and detectors, and the whole systems in optical fiber communications.
Prerequisites: EE 350, EE 320, E SC 314 or EE 340. Offered FA.

EE 422 OPTICAL ENGINEERING LABORATORY (3)
Hands-on experience covering areas of optical transforms, electro-optics devices, signal processing, fiber optics transmission, and holography. **Course contains a significant laboratory component.**
Prerequisite: EE 320. Offered FA.

EE 424 PRINCIPLES AND APPLICATIONS OF LASERS (3)
Principles of lasers--generation, propagation, detection and modulation; applications in fiber optics communication, remote sensing, holography, optical switching and processing.
Prerequisite: EE 330. Offered SP.

EE 430 PRINCIPLES OF ELECTROMAGNETIC FIELDS (3)
Laws of electrodynamics, boundary value problems, relativistic effects, waves in dielectrics and ferrites, diffraction and equivalence theorems.
Prerequisite: EE 330. Offered SP.

EE 432 UHF AND MICROWAVE ENGINEERING (3)
Transmission line and wave guide characteristics and components; design of UHF-microwave amplifiers, oscillators, and filters; measurement techniques; design projects. **Course contains a significant laboratory component.**
Prerequisites: EE 330, EE 310. Offered FA.

EE 438 ANTENNA ENGINEERING (3)
Radiation from small antennas, linear antenna characteristics, arrays of antennas, impedance concepts and measurements, multifrequency antennas, and aperture antennas. **Course contains a significant laboratory component.**
Prerequisite: EE 330. Offered FA.

EE 442 SOLID STATE DEVICES (3)
The physics of semiconductors as related to the characteristics and design of solid state electronic devices.
Prerequisites: EE 310, E SC 314 or EE 340. Offered FA.

EE 453 FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING (3)
Design of FIR and IIR filters; DFT and its computation via FFT; applications of DFT; filter implementation, finite arithmetic effects. **Course contains a significant laboratory component.**
Prerequisite: EE 351. Offered FA, SP.

EE 454 (CMPEN) FUNDAMENTALS OF COMPUTER VISION (3)
Introduction to topics such as image formation, segmentation, feature extraction, shape recovery, object recognition, and dynamic scene analysis. **Course contains a significant programming component.**
Prerequisites: MATH 230, CMPSC 201 or CMPSC 121. Offered FA.

EE 455 (CMPEN) INTRODUCTION TO DIGITAL IMAGE PROCESSING (3)
Overview of digital image processing techniques and their applications; image sampling, enhancement, restoration, and analysis; computer projects. **Course contains a significant programming component.**
Prerequisites: CMPSC 201 or CMPSC 121, EE 350. Offered FA.

EE 460 COMMUNICATION SYSTEMS II (3)
Probability fundamentals, digital/analog modulation/demodulation, system noise analysis, SSNR and BER calculations, optimal receiver design concepts, introductory information theory.
Prerequisite: EE 360. Offered FA.

EE 471 (AERSP)(NUC E) INTRODUCTION TO PLASMAS (3)
Plasma oscillations; collisional phenomena; transport properties; orbit theory, typical electric discharge phenomena.
Prerequisite: EE 330. Offered FA.

EE 472 (AERSP) SPACE ASTRONOMY & INTRO TO SPACE SCIENCE (3)
The physical nature of the objects in the solar system; the earth's atmosphere, ionosphere, radiation belts, magnetosphere, and orbital mechanics.
Prerequisite: EE 330. Offered SP.

EE 474 SATELLITE COMMUNICATIONS (3)
Overview of satellite communications systems, principles, space platforms, orbital mechanics, up/down links and link budgets, modulation techniques.
Prerequisite: EE 330, EE 360. Offered SP.

EE 477 (**METEO**) **FUNDAMENTALS OF REMOTE SENSING (3)**
The review of fundamental physical properties leads into discussions of various techniques, including imaging, spectroscopy, radiometry, and active sensing.
Prerequisite: EE 330. Offered FA.

EE 482 INTRODUCTION TO DIGITAL CONTROL SYSTEMS (3)
Sampling and hold operations; A/D and D/A conversions; modeling of digital systems; response evaluation; stability; basis of digital control; examples. **Course contains a significant laboratory component.**
Prerequisites: EE 380, EE 351. Offered SP.

EE 487 ELECTRIC MACHINERY AND DRIVES (3)
Analysis of variable-speed drives comprised of AC electric machines, power converters, and control systems. **Course contains a significant laboratory component.**
Prerequisite: EE 387. Offered SP.

EE 488 POWER SYSTEMS ANALYSIS I (3)
Fundamentals, power transformers, transmission lines, power flow, fault calculations, power system controls.
Prerequisite: EE 387. Offered SP.

CMPEN 431 INTRODUCTION TO COMPUTER ARCHITECTURE (3)
Principles of computer architecture: memory hierarchies and design, I/O organization and design, CPU design and advanced processors. **Course contains significant programming component.**
Prerequisite: CMPEN 331. Offered FA, SP.

CMPEN 472 MICROPROCESSORS AND EMBEDDED SYSTEMS (3)
Microprocessors; architecture, design, assembly language, programming, interfacing, bus structure, and interface circuits and their use in embedded systems.
Prerequisite: CMPEN 331. Offered FA, SP.

CMPEN 473 MICROCOMPUTER LABORATORY (3)
Design of digital system using microprocessors. **Course contains a significant laboratory component.**
Prerequisite: CMPEN 472. Offered SP.

Note on Frequency of Offering of Electrical Engineering Courses

Although the EE Department attempts to offer every course during its planned semester(s) of offering as listed above, we can **only** guarantee that **required** courses are offered every Fall and Spring semester**.** Due to possible unforeseen circumstances (sabbaticals, faculty departures, budget concerns, etc.), the offering of elective courses and the summer offering of *all* courses is subject to change without warning.

Electrical Engineering Departmental Statement on Prerequisites

The Electrical Engineering Department takes course prerequisites very seriously. The EE core courses and subsequent electives are highly inter-related, as indicated in the numerous prerequisites listed for the various courses. For this reason, students are expected to successfully master material in prerequisite courses before attempting any follow-up courses that build on this material. Note: In the case of courses that require a "C" to graduate, successful mastery of the material means earning a "C" or better, not merely passing the course.

Student responsibilities regarding prerequisites:

1. Students are expected to be aware of and abide by the prerequisites for each class. The course prerequisites will be clearly indicated on the course syllabus.
2. If a student does not earn a required grade in a course (which is a "C" or better in the case of most core courses), the student is expected to retake the course immediately (the next semester that it is available). Also, the student is expected to remove from his/her schedule any course which has the course in question as a prerequisite.
3. Students who (knowingly or unknowingly) violate prerequisites in an EE class will be notified of this violation during the first 2 class periods. The student is then required to immediately remove the course from his/her schedule.

If a student does not fix the prerequisite problem as required, he/she will be disenrolled from the violating course by the Electrical Engineering Department and be notified of such action. This action will be done during the drop/add period so as to give the student plenty of time to find a replacement course. This action is authorized under Faculty Senate Policy 34-60.

ELECTRICAL ENGINEERING UNDERGRADUATE COURSE PREREQUISITE LIST

Course	Title	Prerequisite	Prerequisite or Concurrent
CAS 100A/B	Effective Speech		
CHEM 110	Chemical Principles	Satisfactory Placement Test	
CHEM 111	Experimental Chemistry		CHEM 110
EDSGN 100	Engineering Design		
ENGL 15 or 30	Rhetoric and Composition	Satisfactory Placement Test	
ENGL 202C	Technical Writing	ENGL 15 or 30 - 4th Semester Standing	
I E 424	Process Quality Engineering	MATH 141, 220	
MATH 140	Calculus I	Algebra and Trig	
MATH 141	Calculus II	MATH 140	
MATH 220	Matrices	MATH 140	
MATH 230	Calculus III	MATH 141	
MATH 250	Differential Equations	MATH 141	
PHYS 211	Mechanics		MATH 140
PHYS 212	Electricity and Magnetism	PHYS 211	MATH 141
PHYS 213	Fluids and Thermal Physics	PHYS 211	MATH 141
PHYS 214	Wave Motion and Quantum Physics	PHYS 212, MATH 141	
PHYS 410	Quantum Mechanics	MATH 250, PHYS 237	
STAT 401	Experimental Methods	MATH 141	
STAT 414	Probability Theory	MATH 230	
STAT 418	Probability	MATH 230	
CMPSC 201	Programming for Engineers	MATH 140	MATH 141
CMPEN 270	Digital Design: Theory and Practice	PHYS 212	
CMPEN 271	Digital Systems		PHYS 212
CMPEN 275	Digital Design Lab		CMPEN 271
CMPEN 331	Computer Org. a nd Design	CMPEN 270 or 271, CMPSC 201 or 121	
CMPEN 431	Computer Architecture	CMPEN 331	
CMPEN 472	Microprocessors and Embedded Systems	CMPEN 331	
CMPEN 473	Microcomputer Laboratory	CMPEN 472	
E E 200	Design Tools	EE 210, CMPEN 270 or 271/275, CMPSC 201 or 121	EE 310
E E 210	Circuits and Devices	PHYS 212	MATH 250
E E 300W	Design Process	E E 200	ENGL 202C
E E 310	Electronic Circuit Design I	E E 210	
E E 311	Electronic Circuit Design II	E E 310, 350	
E E 320	Introduction to Electro-Optical Eng	E E 330	
E E 330	Engineering Electromagnetics	E E 210, MATH 230	
E E 340	Intro to Nanoelectronics	E E 210, PHYS 214	
E E 350	Continuous-time Linear Systems	E E 210, MATH 220, 250	

Course	Title	Prerequisite	Prerequisite or Concurrent
E E 351	Discrete-time Linear Systems	E E 350	
E E 360	Communication Systems I	E E 350	
E E 362	Communication Networks	CMPEN 270 or 271, STAT 401 or 418	
E E 380	Linear Control Systems	E E 350, MATH 220	
E E 387	Energy Conversion	E E 350	
E E 403W	Capstone Design	E E 300W, ENGL 202C	
E E 410	Linear Electronic Design	E E 311	
E E 413	Power Electronics	E E 310, 350	
E E 416	Digital Integrated Circuits/VLSI	E E 310, CMPEN 270 or CMPEN 271	
E E 417	Digital Design Using Field Programmable Devices	CMPEN 331	
E E 420	Electro-Optics: Principles & Devices	E E 320	
E E 421	Optical Fiber Communications	E E 350, 320, E SC 314 or E E 340	
E E 422	Optics Laboratory	E E 320	
E E 424	Principles and Applications of Lasers	E E 330	
E E 430	Electromagnetic Fields	E E 330	
E E 432	UHF and Microwaves	E E 310, 330	
E E 438	Antennas	E E 330	
E E 441	Semiconductor Integrated Circuit Technology	E E 310, E SC 314 or E E 340	
E E 442	Solid State Devices	E E 310, E SC 314 or E E 340	
E E 453	Digital Signal Processing	E E 351	
E E 454	Computer Vision	MATH 230, CMPSC 201 or 121	
E E 455	Image Processing	E E 350, CMPSC 201 or 121	
E E 460	Communication Systems II	E E 360	
E E 471	Plasmas	E E 330	
E E 472	Space Sciences	E E 330	
E E 474	Satellite Communications	E E 330, E E 360	
E E 477	Remote Sensing	E E 330	
E E 482	Digital Control Systems	E E 351, 380	
E E 487	Electric Machinery and Drives	E E 387	
E E 488	Power Systems Analysis I	E E 387	

II. 3. Selection of EE/CMPEN Technical Electives &

The five EE/CMPEN technical electives (15 credits total) may be chosen from the following lists. Choose only courses for which you have prerequisites. Many of these courses are offered only one time a year, so plan carefully to achieve your objectives. You may replace up to 3 credits of a 400-level technical elective with courses EE 494H (Honors Thesis) and EE 497 (special topics) that are directed by members of the Department faculty. Note: The EE 497 Statistics course is not accepted as a 400-level EE elective.

300-Level EE/CMPEN Technical Electives (6-9 credits required)

EE 311 Electronic Circuit Design II	EE 360 Communication Systems I	EE 387 Energy Conversion
EE 320 Intro to Electro-Optical Eng	EE 362 Communication Networks	CMPEN 331 Computer Org/Design
EE 351 Discrete-time Systems	EE 380 Linear Control Systems	

400-Level EE/CMPEN Technical Electives (6 – 9 credits required)

EE 410 Linear Electronic Design	EE 432 UHF and Microwave Engineering	EE 472 Space Astronomy and Introduction to Space Sciences
EE 413 Power Electronics	EE 438 Antenna Engineering	EE 474 Satellite Communications
EE 416 Digital Integrated Circuits/VLSI	EE 441 Semiconductor Integrated Circuit Device Technology	EE 477 Fundamentals of Remote Sensing Systems
EE 417 Digital Design using Field Programmable Devices	EE 442 Solid State Devices	EE 482 Introduction to Digital Control Systems
EE 420 Electro-optics: Principles & Devices	EE 453 Fundamentals of Digital Signal Processing	EE 487 Electric Machinery and Drives
EE 421 Optical Fiber Communications	EE 454 Fundamentals of Computer Vision	EE 488 Power Systems Analysis I
EE 422 Optical Engineering Laboratory	EE 455 Introduction to Digital Image Processing	CMPEN 431 Computer Architecture
EE 424 Principles and Applications of Lasers	EE 460 Communication Systems II	CMPEN 472 Microprocessors and Embedded Systems
EE 430 Principles of Electromagnetic Fields	EE 471 Introduction to Plasmas	CMPEN 473 Microcomputer Laboratory

II. 4. Selection of Engineering/Science Technical Elective ♣

This 3 credit course should be chosen from the following:
Any additional course from the EE/CMPEN technical elective list
CMPSC 122, CMPSC 221 or any technical 300 – 400 level CMPSC course
Any technical 400-level CMPEN course
E SC 312, E SC 313 or any technical 400-level E SC course except E SC 400H
Any technical course from I E except I E 302, 303, or 452
Any technical course from M E except M E 445, 455,
Any technical course from NUC E except NUC E 445
Any technical course from A B E, A E, AERSP, ACS, BIOE, CHEM E, C E, E MCH
Any technical 400-level ASTRO course
BIOL 141 or any technical 400-level BIOL course
Any technical CHEM course beyond CHEM 110 except CHEM 400
Any technical 400-level EGEE course
Any technical 400-level MATH course except MATH 470, 471, 475
Any technical 400-level MATSE course
METEO 300 or any technical 400-level METEO course
Any technical 400-level MNG course
Any technical 400-level P N G course
PHYS 230 or PHYS 237 or any technical 400-level PHYS course except PHYS 400, 401, 402, 444, 457, 458
Any technical 400-level STAT course not being used to meet the Statistics elective requirement (STAT 414 and STAT 418 cannot both be taken for credit)

II. 5. Selection of Statistics Elective @

Take one 3-credit statistics course from the following list:

STAT 418 - Probability - This elective, taught by the Statistics Department, provides adequate probability and statistics background for EE students. This is one of the two statistics elective alternatives (also see EE 497B below) that is **strongly recommended** for students planning to take signal processing, control, communications or networking electives, and/or those planning to attend graduate school in Electrical Engineering. It is also the most appropriate statistics elective if you are planning to get a math minor because it counts as a 400-level math course.

STAT 414 - Probability Theory - This course is similar to STAT 418, but intended for STAT majors. Compared to STAT 418, it will have more emphasis on theory rather than application.

E E 497B - Probability and Random Processes for Electrical Engineers - This is the only statistics elective taught by Electrical Engineering professors, and has a strong emphasis on electrical engineering applications. This is one of the two statistics elective alternatives (also see STAT 418 above) that is **strongly recommended** for students planning to take signal processing, control, communications or networking electives, and/or those planning to attend graduate school in Electrical Engineering. This course is offered only in the Spring semester.

PHYS 410 - Quantum Mechanics - This statistics elective is ideal for students interested in device physics or who are planning to get a physics minor. Note: This course is 4 credits.

I E 424 - Process Quality Engineering - This is a more applied statistics elective for students interested in quality control and industrial/manufacturing applications. This course does not cover some of the very important material covered by the electives described above. It is **not** recommended that you take this course as your statistics elective if you're planning to take signal processing, control, communications or networking electives, and/or planning to attend graduate school in Electrical Engineering.

STAT 401 - Experimental Methods - It is **not** recommended that you take this course as your statistics elective. It does not cover material that is useful for typical Electrical Engineering students.

II. 6. Selection of Related Electives %

The Related elective is a 6-credit requirement aimed at broadening the knowledge base of our students through additional EE technical electives or courses in some other field that complements the EE Degree, or through professional development. There are numerous ways that this elective can be satisfied – additional technical courses, non-technical Engineering courses (leadership, green engineering, etc.), business courses, language courses, minor courses, ROTC credits, or Co-operative Education credits.

Note: Any courses not listed here require prior approval of the Director of Academic Affairs.

These 6 credits are to be selected from the following:
Any additional course from the EE Technical Elective lists (300 or 400 level)
Any additional course from the Engineering/Science Technical Elective list
Any EE 496 course
Any Engineering leadership, entrepreneurship, ethics, or Green Engineering course
Co-op credit (ENGR 295, 395, 495)
ROTC credit (only if you complete the ROTC program; 3 credits maximum)
Any World Language course
Any approved business course (see list below for suggestions)
Any course that is used for the completion of a minor

Suggested business courses for use as related electives:
ACCT 211, B A 243, B A 250, B A 301, B A 302, B A 303, B A 304, B LAW 243, FIN 100, FIN 108, I B 303, MGMT 100, MKTG 221.

COURSES NOT ALLOWED TO MEET ANY GRADUATION REQUIREMENTS:

Remedial courses, 2-year and 4-year technology degree courses, and courses that closely resemble other courses taken cannot be used to meet graduation requirements in the BSEE program. This list includes, but is not necessarily limited to, the following courses:

All engineering tech courses (EE T, etc.); ME 445, 455, NUC E 445; All SC courses; EE 211, 212, 353; E SC 314 and all E SC courses below 300 level; English 004, 005; I E 452; All PL ET courses; PHYS 001-200, 250-400, 401, 402, 444, 457, 458; ENGR 195 (Internship Credit); MATH 001-111, 200, 318-319, 470, 471, 475

IF THERE IS ANY QUESTION ABOUT WHETHER A COURSE CAN MEET GRADUATION REQUIREMENTS, CONTACT THE DIRECTOR OF ACADEMIC AFFAIRS.

II. 7. Selection of General Education AHS Electives

(Arts, Humanities, Social Sciences & Diversity Courses)
All PSU students are required to take 18 credits of Arts (GA), Humanities (GH), and Social and Behavioral Science (GS) courses (AHS courses). Normally, these 18 credits are distributed so that students take 6 credits in each of the 3 areas. For engineering students, 3 of the 6 GS credits must be either Econ 102 or Econ 104.

In addition, all PSU students must take at least one 3-credit United States Cultures (**US**) course and at least one 3-credit International Cultures (**IL**) course. These US/IL cultures courses are typically chosen so then they can double-dip as GA/GH/GS electives. Courses that are listed as both US and IL can be used to meet EITHER requirement, but cannot be used to satisfy BOTH requirements simultaneously. Two distinct courses are needed to satisfy the US and IL requirements.

A list of acceptable GA, GH, GS and US/IL courses is available at:
http://www.psu.edu/bulletins/bluebook/general_education.cfm

Exceptions That Require Department Petitions

From time to time, students request exceptions to these requirements. Any petition should be accompanied by a complete list of all courses you have taken and will take in this group, including the exception. **YOUR PETITION MUST BE FILED PRIOR TO THE SEMESTER WHEN YOU PLAN TO GRADUATE.** Petitions are submitted online at **http://coursesub.psu.edu.**

1. 3-6-9 option: Students may complete the 18 AHS credits in an unbalanced way (e.g. 3 credits of GH, 6 credits of GS, 9 credits of GA). The student needs to submit a petition in which they specify how they will redistribute the 18 credits. **Note that students may only redistribute 3 credits.**

2. Foreign Language option: Students who have earned credit for a level 3 (or higher) foreign language (e.g. Spanish 3, French 3) may use 3 credits of this language to count towards any one of the groups above (GA, GH, or GS). The student needs to submit a petition in which they specify which category (GA, GH, or GS) for which the language is being used.

3. Any course that does not carry the GA, GH, or GS general education label, including courses offered at other universities, requires a petition to be considered as an AHS elective. A course syllabus must be included with the petition.

The following table may be used to assist you in planning your AHS courses. Note that either ECON 102 or 104 is required for graduation and counts as a GS elective.

GA	_____
GA	_____
GH	_____
GH	_____
GS	_____
GS	ECON 102 or 104

Please note: At least one of these courses must be a US cultures course and at least one must be an IL cultures course.

II. 8. Transfer Student Degree Requirements

Transfer students are defined as:

- Advanced Standing students transferring from another university
- Dual Degree Program students (formerly 3-2 Program)

Students transferring into the BSEE program from another program need to be extra careful about graduation requirements. The courses that you need to graduate will vary from student to student. You **must** meet with the Director of Academic Affairs, Mr. David Salvia, upon acceptance into the EE program to determine what courses are still needed for graduation. **Failure to do so may lead to improper course selection and subsequent delay in your graduation.**

II. 9. Schreyer Honors College Degree Requirements

Students in the Schreyer Honors College can have certain graduation requirements waived/substituted with the support of their honors adviser, if they can show that the change(s) is (are) in the best interest of their overall academic plan. Honors students are assigned an honors adviser when they are first accepted into the honors program. Honors advisers in the EE Department are Professors Sven Bilén, William Higgins, Thomas Jackson, Timothy Kane, Jeff Schiano and Julio Urbina.

Participation is by invitation only and continuation in the honors program depends upon the meeting of program standards. Enrollment in H sections of courses is limited to people in this program.

II. 10. Petitions and Special Needs

Any exceptions made to the degree requirements set forth in this section must be approved and documented by the authorized persons, often through the use of College petition forms. **You must file petitions before your last semester!** Generally speaking, any problem you may have should be brought to the attention of the Office of Academic Affairs. If we can't help you, we can find out whom you should see. Some requests we can handle, some go to the Dean, and some go to the Senate. We can make referrals regarding personal as well as academic problems. Some phone numbers representing typical referrals are given inside the front cover.

Department and College petitions can be submitted electronically at **http://coursesub.psu.edu.** Any petition involving a course taken somewhere other than PSU must include a course syllabus. Likewise any petition involving a PSU Special Topics Course (x97) must include a course syllabus.

II. 11. Degree Audits

As you progress through the requirements for your degree, you should check periodically to be sure that your course selections will satisfy the degree requirements. At any time, you may make an appointment with Gabi Rhinehart, the *Undergraduate Program Staff Assistant*, Room 115 E E East, in the Office of Academic Affairs to review (audit) your record. Following each semester we receive computer-printed summaries (Degree Audits) of courses you have completed, and we can provide you with a copy. You can obtain an updated copy directly on-line by visiting the student portal in LionPATH. Please be aware, however, that these computer-generated degree audits may not necessarily reflect petitions/exceptions that have recently been approved by the EE Department. If you have any questions about your audit form, please contact Gabi Rhinehart, the *Undergraduate Program Staff Assistant.*

The semester before you graduate, you should make an appointment to meet with Mrs. Rhinehart, the *Undergraduate Program Staff Assistant,* in 115 E E East (865-7272) for a final senior audit. You may write (gbr6@psu.edu) or call her for an appointment.

Though we will help as much as we can, we cannot accept responsibility for your decisions. Senate rules state that the **student has the final responsibility for selecting courses and meeting degree requirements.**

III. CAREER GUIDANCE AND ADVISING

Penn State provides many sources of advising/guidance of many different types. Which office/person you should contact depends on the type of advice being sought.

Within the Department, most advising issues are handled through the Academic Affairs office in 121 EE East. These include routine inquiries for information that are often handled by the office staff, reviews of progress toward a degree that are conducted in the office by appointment, discussions about career goals and related issues, and assistance with problems. See section I. 2. (p.3) for a discussion pertaining to Academic Affairs Office personnel.

Students often seek advice about many things not necessarily related to the Department, and problems with grades are seldom tied to lack of ability, but usually to some personal matter. For that reason we provide you with a partial list of University facilities as shown on the inside of the back cover of this booklet.

III. 1. Faculty Advisers

Dr. Mark Mahon, the Undergraduate Advisor, is the primary academic advisor for all EE Undergraduates except for Schreyer Scholars. He will be available to assist you with short- or long-term schedule planning, assistance with selection of EE electives, guidance in handling academic problems, help with adding/dropping/changing courses, and job placement information. Dr. Mahon is located within the Academic Affairs Office in Room 113 E E East.

You are welcome to ask him such questions as:

- -- How heavy a load should I take?
- -- Should I specialize or should I take electives in several areas?
- -- Is it worthwhile to obtain a minor and in what area?
- -- Which courses provide a good preparation for graduate study?
- -- Will certain courses be of special interest to prospective employers?

Looking ahead to graduation, you may have questions such as:

- -- When should I start interviewing?
- -- How many should I interview and how do I prepare?
- -- Does a particular technology have a strong future?
- -- Where can I learn about opportunities for continuing education?

Faculty teaching courses will also set up hours for consultation. They will be very knowledgeable about courses and career opportunities in their areas of specialization. They can help you sort out electives and expand upon the brief notes in the next section that describe technical interest areas.

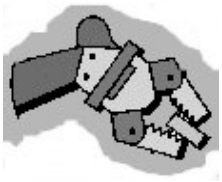
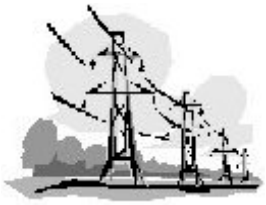
Students in the University Scholars Program are assigned an academic adviser who they should meet with regularly to plan their courses and thesis work.

III. 2. Choosing Areas of Specialization

The BSEE program allows students to informally choose an area of specialization by selecting technical electives in a structured way. Students **are not** required to officially select an area of specialization when selecting their technical electives, however.

The following pages identify which courses relate to each general technical interest area (shown below). Some of you may wish to specialize in an area, but there have been many cases where people who specialize in one area find a job in another. Especially for the undergraduate, we recommend a sampling of two or three areas because professional careers often move in unexpected directions.

AREAS OF SPECIALIZATION WITHIN ELECTRICAL ENGINEERING

COMMUNICATIONS 	**COMPUTER HARDWARE** 	**COMPUTER SOFTWARE** 
CONTROL SYSTEMS 	**ELECTROMAGNETICS** 	**ELECTRONIC DESIGN** 
GRAD SCHOOL PREPARATION 	**OPTICS** 	**POWER SYSTEMS** 
SEMICONDUCTOR DEVICES 	**SIGNAL & IMAGE PROCESSING** 	**SPACE SCIENCES** 

COMMUNICATIONS

Overview

The transmission of information in a fast, reliable, and secure way is a necessity in the world that we live in. Study in communications involves the analysis and design of information transmission systems. Principles such as different modulation schemes (such as AM and FM), noise suppression, various transmission media and computer networking are discussed in detail. Different examples of some communications systems include radio, television, the telephone system, computer networks, GPS satellite systems, and microwave transmission lines.

Pertinent Required Courses

- EE 350 -- Continuous-time Linear Systems
- EE 330 -- Engineering Electromagnetics
- A statistics course (STAT 418 or EE 497B recommended)

Suggested Electives

Because communications is such a broad-based industry, we can identify several technical specialties that are relevant. It is probably not feasible to take all of the communications-related courses, due to the sheer number of courses available. Rather, students need to decide on which aspect(s) of communications to focus.

First, we include the communication theory courses that focus on systems aspects of communications:

- EE 360 – Communication Systems I: a junior-level elective which provides a broad introduction to both analog and digital communication systems and modulation schemes
- EE 362 – Communication Networks: studies data encoding, network architecture, and the routing of data streams, which are important in the computer communication industry
- EE 460 – Communication Systems II: a follow-up to EE 360 which focuses on the design of communication systems in the presence of noise and the corresponding statistics-based theoretical analysis

Next, we may identify those courses that deal with the transmission of communication signals:

- EE 421 -- Optical Fiber Communications: a follow-up to EE 320 which provides students with a fundamental understanding of the operation of fiber optic systems, including transmitters, receivers, as well as the fibers themselves
- EE 432 -- UHF and Microwave Engineering: discusses the analysis and design of microwave transmission lines, amplifiers and filters, which are key elements in many communications systems
- EE 438 -- Antenna Engineering: analysis and design of many types of antennas, with laboratory work in AM/FM antenna and array design
- EE 474 -- Satellite Communications: a follow-up to EE 360 which provides an overview of satellite communication systems, including modulation schemes, satellite components, satellite link design and orbital mechanics

Other courses that are tangentially related to communications are the following:

- EE 424 -- Lasers: Principles and Applications: a follow-up to EE 320 covering the operation of lasers as well as applications such as optical signal processing, holography, spectroscopy, remote sensing (LIDAR), and optical communications
- EE 351 -- Discrete-time Systems: a junior-level elective follow-up to EE 350 which provides a mathematical foundation for subsequent study in digital signal processing, digital control systems, and image processing
- EE 453 -- Digital Signal Processing: a follow-up to EE 351 that covers both the theory and application of DSP, including A/D and D/A conversion, digital filter design, and implementation of the Discrete Fourier Transform via the Fast Fourier Transform algorithm

COMPUTER HARDWARE

Overview

With the proliferation of digital electronics, most electrical engineering systems will include computer hardware as an integral part of the system. Computer hardware courses are equally split between the Electrical Engineering and Computer Engineering majors. These courses are generally accessible to EE students who have no advanced software courses.

Pertinent Required Courses

- CMPEN 270 -- Digital Design: Theory and Practice
- EE 200 -- Design Tools

Suggested Electives

- EE 362 -- Communication Networks: studies data encoding, network architecture, and the routing of data streams, which are important in the computer communication industry.
- EE 416 – Digital Integrated Circuits/VLSI: looks at the design of very large scale integrated chips, with a focus on logic gates, volatile and non-volatile memories, and sequential elements
- EE 417 -- Field Programmable Devices: a digital hardware course that teaches the fundamentals of programmable gate arrays (PGA's) and the VHDL programming language
- CMPEN 331 -- Computer Organization and Design: a junior-level introduction to computer architecture which discusses how the microprocessor, memory, I/O, etc. interact with each other.
- CMPEN 431 -- Introduction to Computer Architecture: a follow-up to CMPEN 331 which deals more with design issues in computer architecture
- CMPEN 472 -- Microprocessors and Embedded Systems: a follow-up to CMPEN 331 which teaches the basics of microprocessor programming and interfacing and using embedded microprocessors in larger systems
- CMPEN 473 – Microcomputer Laboratory: a follow up to CMPEN 472 in which students design a variety of digital circuits using embedded microprocessors.

COMPUTER SOFTWARE

Overview

Like computer hardware, computer software is used, to some extent, by almost all electrical engineers. Many EE courses use specialty software packages to assist in the analysis/design of various electrical engineering systems. In addition, however, courses SPECIFICALLY related to computer software are available. For the most part, these courses are taught by the Computer Science and Engineering (CSE) Department, for Computer Science and Computer Engineering majors. EE students, however, are allowed to take these courses on a space available basis.

Computer software courses can be divided into 2 areas -- programming courses and applications courses. Electrical Engineering students will generally be able to take the applications courses only with prior study of intermediate or advanced programming courses. Programming experience in itself is not a sufficient prerequisite.

Pertinent Required Courses

- CMPSC 201 -- Programming for Engineers With C++

OR

- CMPSC121 – Introduction to Programming Techniques

Suggested Electives

General Programming Courses (NOTE: These courses DO NOT count as EE technical electives. They count only as ENGINEERING electives or RELATED electives):

- CMPSC 122 -- Intermediate Programming: a follow-up to CMPSC 201 which teaches Python
- CMPSC 221 – Object-oriented Programming: a follow-up to CMPSC 122 that teaches web-based programming using JAVA
- CMPSC 311 – Introduction to System Programming: a follow-up to CMPSC 221 which focuses on operating system (UNIX) level programming
- CMPSC 442 – Introduction to Artificial Intelligence: a follow-up to CMPSC 122 which covers the theory, implementation, and application of artificial intelligence
- CMPSC 450 – Concurrent Scientific Programming: a follow-up to CMPSC 201 which teaches the solution to problems encountered with synchronization and concurrent execution in distributed systems
- CMPSC 451 -- Numerical Computations: covers algorithm development for Fourier Transforms, interpolation, numerical integration, differential equation solutions, etc.
- CMPSC 455 -- Introduction to Numerical Analysis: similar to CMPSC 451 but a bit more mathematical. Students can NOT take both CMPSC 451 and CMPSC 455 for credit

Programming Application Courses (NOTE: These courses DO count as EE technical electives):

- EE 454 -- Fundamentals of Computer Vision: discusses topics such as object recognition, feature extraction from an image, and dynamic image analysis
- EE 455 -- Digital Image Processing: overview of image processing techniques and applications such as image enhancement and restoration

CONTROL SYSTEMS

Overview

Control systems are encountered every day, from temperature/climate control systems in buildings to navigational control systems in vehicles. Control systems are also an integral part of any manufacturing process -- electronics are used to monitor and regulate assembly lines. A control systems specialization provides students with the necessary mathematical and computer programming background to analyze and design both analog and digital control systems. Associated lab work helps illustrate the control algorithms learned in the classes.

One sub-category of control systems is robotics. At Penn State, robotics is covered more in industrial or mechanical engineering. However, a controls background, in addition to courses in **SIGNAL AND IMAGE PROCESSING**, provides students with many of the fundamentals needed for future work in robotics.

Pertinent Required Courses

- EE 350 -- Continuous-time Linear Systems
- A statistics course (STAT 418 or EE 497B recommended)

Suggested Electives

Basic control theory is covered in a 2-course sequence (EE 380/482) following junior-level linear systems courses which provide the mathematical background (EE 350/351):

- EE 351 -- Discrete-time Systems: a junior-level elective follow-up to EE 350 which provides a mathematical foundation for subsequent study in digital signal processing, digital control systems, and image processing
- EE 380 -- Linear Control Systems: introductory course, with lab, which provides a theoretical and practical overview of classical analog control methods such as PID control and lag-lead control
- EE 482 -- Digital Control Systems: a follow-up to both EE 351 and EE 380 which focuses on modern digital control techniques and the corresponding A/D conversion

Other courses that are tangentially related to control systems are the following:

- EE 387 -- Energy Conversion: modeling and analysis of motors and generators, electromechanical energy conversion machines that are integral parts of industrial applications and other control systems
- EE 413 -- Power Electronics: studies high-power semiconductors that interface with mechanical systems or convert electric power between different forms
- EE 454 -- Fundamentals of Computer Vision: discusses topics such as object recognition, feature extraction from an image, and dynamic image analysis
- ME/IE 456 -- Industrial Robot Applications: introduction to robots, with an emphasis on robot selection, programming, and economic justification for manufacturing applications
  (Note #1: This course has prerequisites that are not normally taken by EE majors.)
  (Note #2: This course counts as an ENGINEERING elective or RELATED elective, not an EE technical elective.)

ELECTROMAGNETICS

Overview

There are many applications of electromagnetics within the electrical engineering field. This area is good for students pursuing careers in antenna design, microwave communications, and in the study of wave propagation. Throughout this area, there is a strong emphasis on Maxwell's equations, Faraday's laws, and wave phenomena, which are often understood much more easily when time varying visual simulations replace equations and static diagrams.

Pertinent Required Courses

- EE 330 -- Engineering Electromagnetics

Suggested Electives

- EE 430 -- Principles of Electromagnetic Fields: a follow-up to EE 330 which discussed E/M in theoretical detail, along with applications such as transmission lines, wave guides, and signal propagation
- EE 432 -- UHF and Microwave Engineering: discusses the analysis and design of microwave transmission lines, amplifiers and filters, which are key elements in many communications systems
- EE 438 -- Antenna Engineering: analysis and design of many types of antennas, with laboratory work in AM/FM antenna and array design
- EE 471 -- Introduction to Plasmas: gives students a basic introduction to electromagnetic properties of plasmas, primarily in astrophysical and geophysical contexts
- EE 477 -- Fundamentals of Remote Sensing: studies various techniques for atmospheric measuring using both radio frequency approaches (RADAR, radiometry) and optical approaches (LIDAR -- laser radar, spectroscopy)

ELECTRONIC DESIGN

Overview

Although almost every electrical engineering sub-discipline uses electronics to some extent, the term electronic design is generally understood to mean the assembly of basic electronic components to accomplish some fundamental task that is replicated many times over in a practical system. The field of electronic design ranges from the basic design of IC's using discrete semiconductor devices to the fabrication of complex circuits on a single IC chip using VLSI techniques.

Pertinent Required Courses

- EE 200 -- Design Tools
- EE 210 -- Circuits and Devices
- EE 310 -- Electronic Circuit Design I
- EE 340 -- Nanoelectronics
- CMPEN 270 – Digital Design: Theory and Practice

Suggested Electives

- EE 311 -- Electronic Circuit Design II: a follow-up to EE 310 which focuses on multi-stage amplifier design, feedback, and frequency response characteristics of electronic circuits
- EE 410 -- Analog Integrated Circuits: looks at the design of analog integrated circuit building blocks such as operational amplifiers, voltage regulators, current sources, and amplifiers
- EE 413 -- Power Electronics: studies high-power semiconductors that interface with mechanical systems or convert electric power between different forms
- EE 416 – Digital Integrated Circuits/VLSI: looks at the design of very large scale integrated chips, with a focus on logic gates, volatile and non-volatile memories, and sequential elements
- EE 417 – Field Programmable Devices: a digital hardware course that teaches the fundamentals of programmable gate arrays (PGA's) and the VHDL programming language
- CMPEN 472-- Microprocessors and Embedded Systems: a follow-up to CMPEN 331 which teaches the basics of microprocessor programming and interfacing and using embedded microprocessors in larger systems
- CMPEN 473 – Microcomputer Laboratory: a follow up to CMPEN 472 in which students design a variety of digital circuits using embedded microprocessors.

Other courses that are tangentially related to electronic design are:

- EE 441 -- Semiconductor Integrated Circuit Technology: a practical study of the fabrication of MOS integrated circuits, with a strong laboratory component in which students become familiar with clean room equipment
- EE 442 -- Solid State Devices: a follow-up to EE 340 which focuses on the physics of semiconductors and the modeling/design of various semiconductors using BJT, JFET, CMOS, NMOS, and BiCMOS technologies
- EE 432 -- UHF and Microwave Engineering: discusses the analysis and design of microwave transmission lines, amplifiers and filters, which are key elements in many communications systems

GRAD SCHOOL PREPARATION

Overview

Unless you know exactly what you are going to do in graduate study, the recommended strategy for an undergraduate intending to study beyond the baccalaureate level is to take a series of foundation courses covering several different areas of technology. Specialization can then come at the graduate level. Two reasons for doing this are 1) most graduate programs have some sort of breadth requirement which requires technical courses in multiple sub-disciplines of electrical engineering and 2) exposing yourself to many facets of electrical engineering as an undergraduate may help you decide WHAT to specialize in during your graduate program.

Pertinent Required Course

It is strongly recommended that you take STAT 418 or EE 497B as your statistics elective if you are contemplating graduate study.

Suggested Electives

- Any of the theory-based 300-level EE Electives (EE 311, 320, 351, 360, 362, 380, 387)
- EE 420 -- Electro-optics: Principles and Devices: a follow-up to EE 320 that covers the topics more in-depth, with an emphasis on holography
- EE 430 -- Principles of Electromagnetic Fields: a follow-up to EE 330 which discussed E/M in theoretical detail, along with applications such as transmission lines, wave guides, and signal propagation
- EE 442 -- Solid State Devices: a follow-up to EE 340 which focuses on the physics of semiconductors and the modeling/design of various semiconductors using BJT, JFET, CMOS, NMOS, and BiCMOS technologies
- EE 453 -- Digital Signal Processing: a follow-up to EE 351 that covers both the theory and application of DSP, including A/D and D/A conversion, digital filter design, and implementation of the Discrete Fourier Transform via the Fast Fourier Transform algorithm
- EE 460 – Communication Systems II: a follow-up to EE 360 which focuses on the design of communication systems in the presence of noise and the corresponding statistics-based theoretical analysis
- Other courses that are listed in the Graduate Bulletin as prerequisites for 500-level courses

OPTICS

Overview

Optical systems have become increasingly popular for manipulating information (optical signal processing), transmitting information (fiber optics), and remote measurement of electrical properties (LIDAR). Furthermore, electro-optical devices, such as liquid crystal displays (LCDs) are a mainstay in high-tech electronic gadgets and laptop computers. The broad field of optics provides students with knowledge about the many building blocks within an optical system.

Pertinent Required Courses

- EE 330 -- Engineering Electromagnetics
- EE 340 -- Nanoelectronics

Suggested Electives

- EE 320 -- Introduction to Electro-optical Engineering: an introductory course in optics/electro-optics which covers lenses, mirrors, polarization, lasers, diffraction, wave motion, and geometric optics
- EE 420 -- Electro-optics: Principles and Devices: a follow-up to EE 320 that covers the topics more in-depth, with an emphasis on holography
- EE 421 -- Optical Fiber Communications: a follow-up to EE 320 which provides students with a fundamental understanding of the operation of fiber optic systems, including transmitters, receivers, as well as the fibers themselves
- EE 422 -- Optical Engineering Laboratory: a laboratory-oriented follow-up to EE 320 providing students with hands-on exposure to lenses, lasers, diffraction, holograms, and other optical devices

- EE 424 -- Lasers: Principles and Applications: a follow-up to EE 320 covering the operation of lasers as well as applications such as optical signal processing, holography, spectroscopy, remote sensing (LIDAR), and optical communications

Other courses that are tangentially related to optics are the following:

- EE 477 -- Fundamentals of Remote Sensing: studies various techniques for atmospheric measuring using both radio frequency approaches (RADAR, radiometry) and optical approaches (LIDAR -- laser, radar, spectroscopy)

POWER SYSTEMS

Overview

Once the bread and butter of electrical engineering, the power systems field deals with the generation of electrical power on both the large scale and small scale. Large-scale power system study involves the understanding of how power is generated at the power plant and then transmitted to homes, businesses, and factories. On the smaller scale, power systems studies motors and generators, which convert energy from electrical to mechanical form and vice versa, and the associated power electronics

Pertinent Required Courses

- EE 210 -- Circuits and Devices
- EE 310 -- Electronic Circuit Design I
- EE 350 -- Continuous-time Linear Systems

Suggested Electives

- EE 387 -- Energy Conversion: modeling and analysis of motors and generators, electromechanical energy conversion machines that are integral parts of industrial applications and other control systems
- EE 413 -- Power Electronics: studies high-power semiconductors that interface with mechanical systems or convert electric power between different forms
- EE 487 -- Electric Machinery and Drives: builds on EE 387 by discussing machinery that is used for industrial automation
- EE 488 -- Power Systems Analysis I: an overview of the entire power system process: transformers, transmission lines, power system control, power flow, stability

Other courses that are tangentially related to power systems are the following:

- any course in **CONTROL SYSTEMS**
- AE 311 -- Fundamentals of Electrical and Illumination Systems for Building: a fundamental coverage of electrical and illumination systems in modern buildings
- AE 456 -- Solar Energy Building System Design: teaches analysis and design of solar radiation collection systems
- NUC E 401 – Introduction to Nuclear Engineering: Provides an overview of Nuclear Engineering (including reactor physics and fission) for non-NUC E majors

  (Note: These three courses above count as ENGINEERING electives or RELATED electives, not EE technical electives.)

SEMICONDUCTOR DEVICES

Overview

Because semiconductors are the active components inside nearly all modern electronic devices, all advances in electronics ultimately come down to making better semiconductor devices and understanding how they work. Silicon is the basic ingredient in most devices and the primary material studied at the undergraduate level, though the principles are easily extended to other materials.

Pertinent Required Courses

- EE 210 -- Circuits and Devices
- EE 310 -- Electronic Circuit Design I
- EE 340 – Nanoelectronics

Suggested Electives

- EE 441 -- Semiconductor Integrated Circuit Technology: a practical study of the fabrication of MOS integrated circuits, with a strong laboratory component in which students become familiar with clean room equipment
- EE 442 -- Solid State Devices: a follow-up to EE 340 which focuses on the physics of semiconductors and the modeling/design of various semiconductors using BJT, JFET, CMOS, NMOS, and BiCMOS technologies
- EE 416 – Digital Integrated Circuits/VLSI: looks at the design of very large scale integrated chips, with a focus on logic gates, volatile and non-volatile memories, and sequential elements.

Other courses that are tangentially related to semiconductor devices are the following:

- any course in **ELECTRONIC DESIGN**
- E SC 312 and E SC 313; courses that deal with fabrication and application of nano technology. (Note: These courses count as ENGINEERING or RELATED electives, not as EE technology electives.)

SIGNAL & IMAGE PROCESSING

Overview

Signals -- both 1-D signals such as speech and audio signals, and 2-D signals such as images and video signals -- represent information. Processing these signals means extracting certain parameters from that information, filtering it to remove undesired components, coding it for efficient transmission, or many other operations. Because digital technology supports extensive manipulation and interpretation of signal/image data, signal processing is increasingly becoming digital. Therefore, a basic understanding of the effects of analog to digital conversion is key in understanding the design of modern signal processing algorithms. The signal and image processing field is a programming-intensive one in which various algorithms to perform these tasks are implemented.

Pertinent Required Courses

- EE 350 -- Continuous-time Linear Systems
- CMPSC 201 -- Programming for Engineers with C++
- A statistics course (STAT 418 or EE 497B recommended)

Suggested Electives

- EE 351 -- Discrete-time Systems: a junior-level elective follow-up to EE 350 which provides a mathematical foundation for subsequent study in digital signal processing, digital control systems, and image processing
- EE 453 -- Digital Signal Processing: a follow-up to EE 351 that covers both the theory and application of DSP, including A/D and D/A conversion, digital filter design, and implementation of the Discrete Fourier Transform via the Fast Fourier Transform algorithm
- EE 454 -- Fundamentals of Computer Vision: Discusses topics such as object recognition, feature extraction from an image, and dynamic image analysis
- EE 455 -- Digital Image Processing: overview of image processing techniques and applications such as image enhancement, deblurring, and restoration

Other courses that are tangentially related to signal/image processing are the following:

- EE 360 – Communication Systems I: a junior-level elective which provides a broad introduction to both analog and digital communication systems and modulation schemes
- EE 460 – Communication Systems II: a follow-up to EE 367 which focuses on the design of communication systems in the presence of noise and the corresponding statistics-based theoretical analysis
- CMPSC 442 -- Introduction to Artificial Intelligence: a programming-intensive course which provides the foundations for developing computer algorithms capable of decision making
  (Note: This course counts as an ENGINEERING elective or RELATED elective, not an EE technical elective.)

REMOTE SENSING AND SPACE SYSTEMS

Overview

For many years, the largest research group in the EE Department at Penn State, the Communications and Space Sciences Laboratory (CSSL), has studied the ionosphere and related effects such as weather and thunderstorms. Problems of interest include the design of instrumentation as well as the study of natural phenomena. The research interests have influenced undergraduate courses in many ways, especially in COMMUNICATIONS, ELECTROMAGNETICS, and OPTICS. In addition, courses specifically in the area of space sciences have also been developed.

Pertinent Required Courses

- EE 330 -- Engineering Electromagnetics

Suggested Electives

- EE 471 -- Introduction to Plasmas: gives students a basic introduction to electromagnetic properties of plasmas, primarily in astrophysical and geophysical contexts
- EE 472 -- Introduction to Space Sciences: introduces students to the fundamentals of space sciences by providing a background in the physical/chemical properties of the atmosphere and ionosphere and discussing other topics such as solar wind and sun-trapped particle belts

- EE 474 -- Satellite Communications: a follow-up to EE 360 which provides an overview of satellite communication systems, including modulation schemes, satellite components, satellite link design and orbital mechanics
- EE 477 -- Fundamentals of Remote Sensing: studies various techniques for atmospheric measuring using both radio frequency approaches (RADAR, radiometry) and optical approaches (LIDAR -- laser radar, spectroscopy)

III. 3. Minors and Certificates

Minors are secondary areas of study intended to complement a student's major. Some popular/appropriate minors for EE students are: Engineering Leadership, Entrepreneurship and Innovation, Electronic and Photonic Materials, Math, Music Technology, Nanotechnology, Physics, Bioengineering, Business/LA, Product Realization, Environmental Engineering, and Information Science and Technology. Foreign language minors are also appropriate for EE students. Other available minors are listed in the Undergraduate Bulletin. You will usually, but not always, have to take extra courses to meet the requirements of the minor. Registration for a minor is done through the department or program that offers the minor. They will set forth a list of courses, which fulfill the requirements, and then you will seek several signatures on the application form. A minor consists of at least 18 credits with at least 6 of those credits being at the 400-level.

A Certificate Program, like a minor, is a collection of classes that are related in some way. Certificates, however, require even fewer courses than a minor, so they are usually very easy to obtain. Currently, the College of Engineering offers certificate programs in Space Systems Engineering, International Engineering, Engineering Design, Housing, Nanotechnology, and Engineering and Community Engagement.

Go to **http://www.ee.psu.edu/undergraduate/minors.aspx** for more information on available minors and certificates.

III. 4. Engineering Co-operative Education Program

This is an organized program in which a student alternates periods of academic study and full-time employment with an approved employer. The program calls for entry usually at the beginning of the junior year, and for a cumulative work experience of 3 semesters (and/or summers) before graduation.

Students in the Co-op program can earn up to 6 credits to count as related electives. One credit is awarded for the first co-op rotation, two credits are awarded for the second co-op rotation and three credits are awarded for the third co-op rotation.

For more information on the Co-op program, contact the College of Engineering Career Resources office at 863-1032 or visit: **http://www.engr.psu.edu/career**. You may also contact the Co-op Adviser, Dr. Mike Pusateri, for more information, and/or to plan your work and study schedules.

If you are not a formal Co-op student, you may still take summer jobs with engineering companies. However, you may not claim Co-op credits for jobs you arrange outside of the formal program.

III. 5. Concurrent Degrees

A student may, with the permission of both departments, simultaneously earn bachelor degrees in two majors. This concurrent degree program (previously called simultaneous degrees or multiple majors), requires careful planning with your faculty adviser. For additional details visit the following website:
http://handbook.psu.edu/content/Concurrent-majors-program

III. 6. Professional Licensure

Engineers who complete a series of standardized examinations and meet other requirements can obtain a Professional Engineer (or PE) license. Whether or not licensure will be important for your career is hard to predict, but certainly many EE's do become licensed. Much depends on the nature of your job and your employer.

The PE license process should be started while you are still a student and fresh from your academic studies. The first step is the FE exam (previously EIT exam), for Fundamentals of Engineering. By itself, it does not qualify you to be licensed, but it starts the process which can then be completed with a practice-oriented exam at a later time. The FE exam is computer-based, and will be offered at Pearson VUE testing centers throughout the United States.

For more information about the FE exam and professional licensure and to register for the FE exam, visit the *National Council of Examiners for Engineering* web page at **http://ncees.org.**

Useful information is also available from **http://www.pcshq.com.**

III. 7. Finding Jobs

There are multiple resources to assist you in finding employment after graduation. It is suggested that you utilize all of these resources.

- **Career Development Placement Service –** Visit Career Services (Bank of America Career Service Center) well in advance of when you plan to start interviewing. Learn their procedures and what services they provide. (e.g., career counseling, information about employers and interview techniques, interest inventory tests, and a computer database on career options.) Over 1000 employers schedule 30-minute interviews from September through April. Their website is http://studentaffairs.psu.edu/career.

- **College of Engineering Career Resource Office –** Located in 205 Hammond Building, this office provides engineering specific career guidance. They handle full-time, co-op and internship placements. The Engineering Career Resource Office also manages an online

resource, e-career, that connects students with prospective employers. Their website is **http://www.engr.psu.edu/career**.

•**Career Fairs** – PSU hosts a large career fair every fall and spring. Smaller career fairs also appear from time to time. Watch for notices in the Collegian, in the Department office and via the EE listserv.

•**EE Job Listserv** – The EE Department will occasionally alert students about job opportunities, via the EE job Listserv, which students can subscribe/unsubscribe to by visiting **http://www.ee.psu.edu/undergraduate/listserv.html**

III. 8. Applying for Graduate School

If you are considering graduate study, consult with your adviser about research specialty areas and courses that you might take in preparation for entering graduate school. Ask about opportunities elsewhere as well as at Penn State. Once a year in the fall, the American Society of Engineering Education publishes a special issue devoted to graduate school programs and opportunities. Many faculty members will have a copy, and it is also available in the Engineering Library. Peterson's publishes a helpful printed graduate studies guide and a web page **(http://www.petersons.com)** with links to individual schools. Also check the Graduate Program file cabinet kept in the Academic Affairs Office. Finally, Career Services has information on graduate school as well. Go to **http://studentaffairs.psu.edu/career/students/further_education.shtml**.

Most commonly, people apply for fall admission, and to be considered for whatever financial aid is available, they will normally have their application materials on file by the end of the previous fall semester. At Penn State, a student's file will consist of an application, letters of reference, official copies of all transcripts, and general GRE scores from exams taken in early fall. (Inquire in Kern Building at the beginning of the fall semester to schedule an examination). Include a personal statement regarding your background and technical interests to assist the admissions committee in evaluating your application and possibly identifying professors whose interests match your own.

In general, an undergraduate GPA of 3.0 or above is required for admission, although there are exceptions to this rule.

THE DEPARTMENT OF ELECTRICAL ENGINEERING
FACULTY

Aydin, Kultegin
k-aydin@psu.edu

Bilen, Sven
sbilen@psu.edu

Breakall, James
jimb@psu.edu

Cadambe, Viveck
viveck.cre.gmail.com

Chaudhuri, Nilanjan
nvc88@psu.edu

Doherty, John
jfdoherty@psu.edu

Ebrahimi, Aidi
sue66@psu.edu

Ghosh, Swaroop
szg212@psu.edu

Giebink, Christopher
ncg2@psu.edu

Guan, Weihua
wguan@psu.edu

Gupta, Sumeet
skgupta@psu.edu

Higgins, William
weh2@psu.edu

Huang, Shengxi
sjh5899@psu.edu

Jackson, Thomas
tnj1@psu.edu

Kane, Tim
tjk7@psu.edu

Kesidis, George
gik2@psu.edu

Khoo, Iam-Choon
ick1@psu.edu

Kiani, Mehdi
mkiani@gmail.com

Lagoa, Constantino
lagoa@engr.psu.edu

Liu, Yanxi
yul11@psu.edu

Liu, Zhiwen
zzl1@psu.edu

Mahon, Mark
mpm114@psu.edu

Mathews, John
jdm9@psu.edu

Miller, David J.
millerdj@ee.psu.edu

Monga, Vishal
vmonga@engr.psu.edu

Narayanan, Ram
ram@ee.psu.edu

Ni, Xingjie
zxn10@psu.edu

Pasko, Victor
vpasko@psu.edu

Pusateri, Michael
map244@psu.edu

Ruzyllo, Jerzy
jxr6@psu.edu

Salvia, David
dsalvia@psu.edu

Schiano, Jeffrey
jls32@psu.edu

Tadigadapa, Srinivas
srinivas@engr.psu.edu

Uchino, Kenji
kenjiuchino@psu.edu

Urbina, Julio
urbina@psu.edu

Werner, Douglas
dhw@psu.edu

Wheeler, Timothy
tfw1@psu.edu

Yang, Jing
juy157@psu.edu

Yener, Aylin
yener@ee.psu.edu

Yin, Shizhuo
sxy105@psu.edu

Zhang, Qiming
qimingzhang@psu.edu

Zhu, Minghui
muz16@psu.edu

REFERENCE LIST OF PHONE NUMBERS

CAREER DEVELOPMENT AND
PLACEMENT SERVICES
865-2377
101 Bank of America Career Service Center

COLLEGE OF ENGINEERING
ASSISTANT DEAN FOR STUDENT SERVICES
865-6674
204 Hammond Building

CENTER HELP
237-5855
410 S Frazer St.

COUNSELING & PSY SERVICES (CAPS)
863-0395
501 Student Health Center

DIV. OF UNDERGRADUATE STUDIES
865-7576
118 Grange Building

ELECTRICAL ENGINEERING ACADEMIC
AFFAIRS OFFICE (MAIN OFFICE)
865-7667
121 Electrical Engineering East

ELECTRICAL ENGINEERING
UNDERGRADUATE PROGRAM OFFICES
865-7272
114-115 Electrical Engineering East

ENGINEERING ADVISING CENTER
863-1033
208 Hammond Building

ENGINEERING CAREER RESOURCES AND
EMPLOYER RELATIONS (formerly CO-OP)
863-1032
205 Hammond Building

ESCORT SERVICES
865-WALK
32 Eisenhower Parking Deck

HEALTH SERVICES
865-6556
Student Health Center

LEARNING RESOURCE CENTER
865-1841
220 Boucke Building

MULTICULTURAL ENGINEERING PROGRAM
865-7138
208 Hammond Building

MULTICULTURAL RESOURCE CENTER
865-1773
220 Grange Building

OFFICE OF GLOBAL PROGRAMS
865-6348
410 Boucke Building

POLICE SERVICES
863-1111
(Emergency -911)
Eisenhower Parking Deck

PSYCHOLOGICAL CLINIC
865-2191
337 Moore Building

STUDENT AFFAIRS (Vice President of)
865-0909
210 Old Main

STUDENT AID, OFFICE OF
865-6301
314 Shields Building

UNDERGRADUATE ADMISSIONS
865-5471
201 Shields Building

UG ADMISSIONS WORLD CAMPUS
800-252-3592
128 OUTREACH

VETERANS PROGRAMS, OFFICE OF
863-0465
325 Boucke Building

WOMEN STUDENTS, CENTER OF
863-2027
204 Boucke Building

WOMEN IN ENGINEERING PROGRAM
863-1080
208 Hammond Building

WORLD CAMPUS
865-5403
128 Outreach Building