Texas Higher Education Coordinating Board

Making Opportunity Affordable in Texas:

A Student-Centered Approach

Tuning of Electrical Engineering

Texas Higher Education Coordinating Board

Austin, Texas

with grant support from

Lumina Foundation for Education

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* Prerequisite Flowchart on page 26 revised 11/15/2013.

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Electrical Engineering Committee

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Table of Contents

Definition of Tuning

"Tuning" is a faculty-led pilot project designed to define what students must know, understand, and be able to demonstrate after completing a degree in a specific field, and to provide an indication of the knowledge, skills, and abilities students should achieve prior to graduation at different levels along the educational pipeline – in other words, a body of knowledge and skills for an academic discipline in terms of outcomes and levels of achievement of its graduates.

Tuning provides an expected level of competency achievement at each step along the process of becoming a professional: expectations at the beginning of pre-professional study, at the beginning of professional study, and at the transition to practice. It involves seeking input from students, recent graduates, and employers to establish criterion-referenced learning outcomes and competencies by degree level and subject areas. Through Tuning, students have a clear "picture" of what is expected and can efficiently plan their educational experience to achieve those expectations. The objective is not to standardize programs offered by different institutions, but to better establish the quality and relevance of degrees in various academic disciplines. An overview of Lumina Foundation for Education's "Tuning USA" Initiative is available at: http://www.luminafoundation.org/; an overview of Tuning work to date in Texas is available at: http://www.thecb.state.tx.us/tuningtexas.

Definition of the Electrical Engineering Discipline

in terms of outcomes for successful preparation for students

Electrical engineers design, develop, test, and supervise the manufacture, installation, maintenance, and operation of electrical and electronic equipment and systems. Some of this equipment includes electric motors; machinery controls, lighting, and wiring in buildings; radar and navigation systems; communication systems; computers and computer-related equipment; and power generation, control, and transmission devices used by electric utilities. Electrical engineers also design the electrical systems for automobiles and aircraft. Electrical engineers utilize the tools of mathematics, physics, and other natural sciences (i.e. biology and chemistry) to solve technical problems and satisfy the needs of society.

Electrical engineers specialize in areas such as power systems engineering; electrical equipment manufacturing; computer hardware; signal processing; control systems; electronic devices and systems; virtual reality; biomedical devices; Micro-Electromechanical Systems (MEMS); semiconductor devices; communication systems; renewable energy; reconfigurable logic and memory; optical computing; quantum computing; and computer systems.

Source: BLS Occupational Outlook Handbook, 2010-2011

Electrical Engineering Expertise and Employment Profile

Expertise Profile Description

The expertise profile lists more than seven types of course work necessary for the completion of a baccalaureate degree in electrical engineering. Note: general undergraduate degree requirements, i.e., the core curriculum, are not considered for the purpose of tuning electrical engineering and this report.

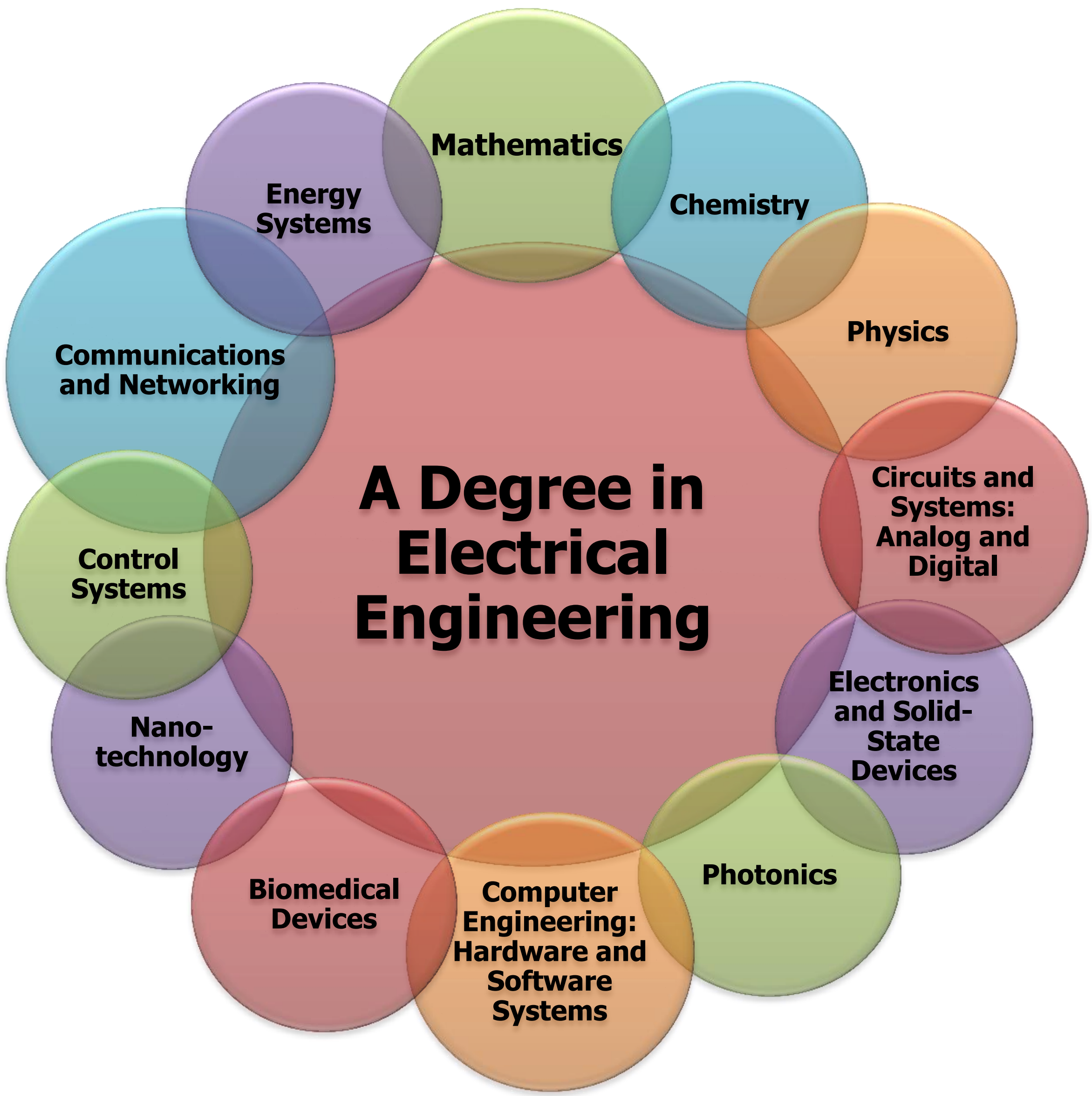
A degree in Electrical Engineering includes the following scientific and technical subject areas:

1. Mathematics: arithmetic, algebra, geometry, trigonometry, calculus, (differential, integral, and multivariate), differential equations, discrete, optimization, probability, random variables, statistics, set theory, numerical methods, vector analysis, linear algebra, and complex variables
2. Chemistry and Physics (calculus-based)
3. Circuits and Systems: Analog and Digital
4. Communications and Signal Processing: Analog and Digital
5. Electronics and Solid-State Devices
6. Electromagnetics
7. Computer Engineering: Hardware and Software Systems

A degree in Electrical Engineering may include the following specialized subject areas (typically found at the upper division level):

1. Energy Systems
2. Computer Engineering, including Discrete Mathematics and Architecture
3. Communications and Networking
4. Control Systems
5. Nanotechnology
6. Biomedical Devices
7. Photonics

Expertise Profile Diagram

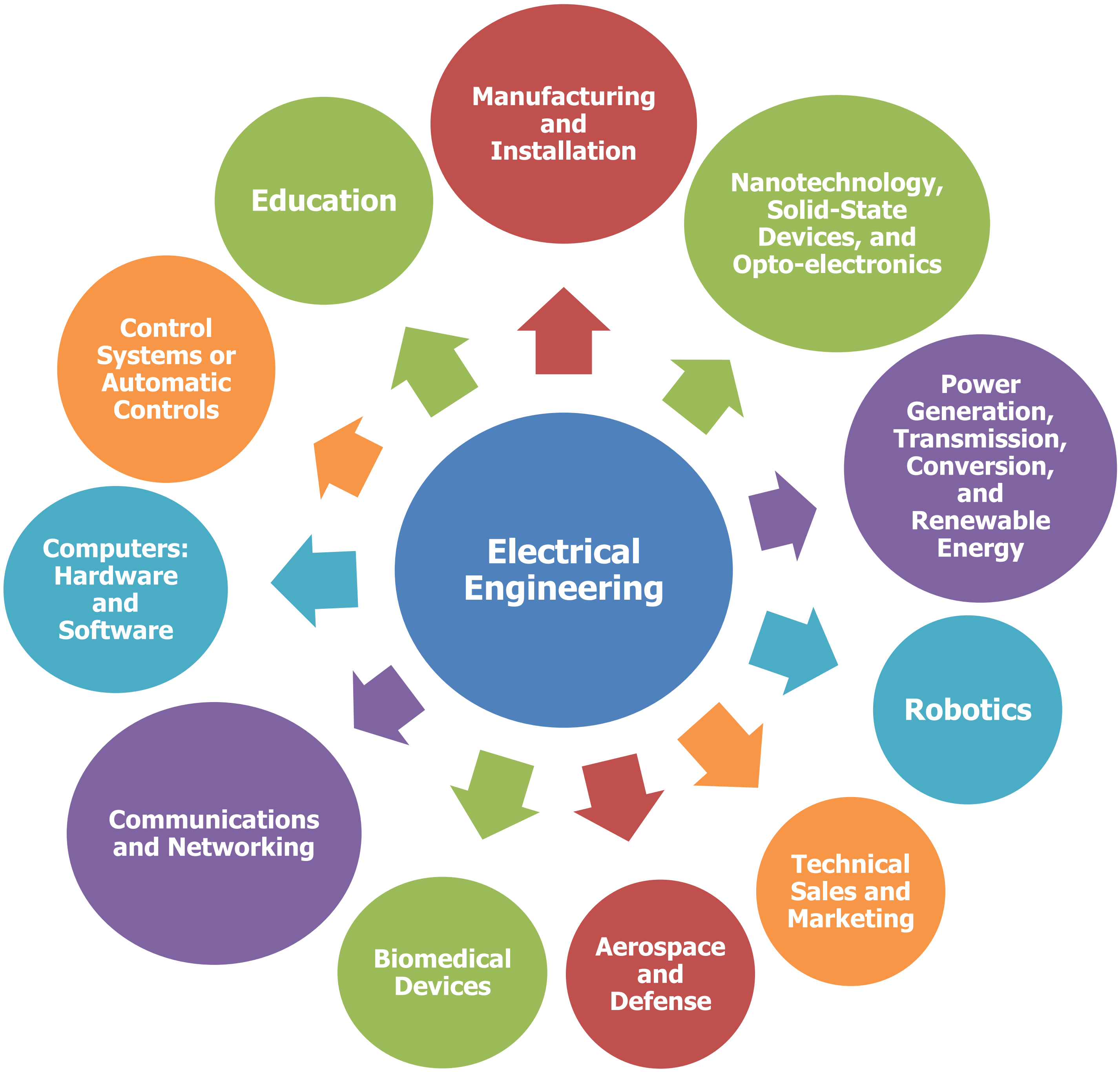


Employment Profile Description

The employment profile lists potential employment pathways available for graduates of electrical engineering programs.

1. Aerospace and Defense
2. Biomedical Instrumentation Devices
3. Communications and Networking
4. Computers (hardware and software)
5. Control Systems (or automatic controls)
6. Education
7. Electronics and Integrated circuits
8. Government
9. Instrumentation and Measurement
10. Manufacturing and Installation
11. Nanotechnology, Solid-State Devices, and Opto-electronics
12. Power Generation/Transmission, Conversion, and Renewable Energy Systems
13. Research, Design, Development, and Testing
14. Robotics
15. Security
16. Sensors
17. Signal and Image Processing
18. Technical Sales and Marketing
19. Transportation and Navigation

Employment Profile Diagram



Electrical Engineering Competencies Profile

The key competencies profile is a schematic diagram that is derived from the competency table. It lists, for each learning outcome (columns), the required competency levels according to Bloom's taxonomy (rows) that must be gained at each of four educational levels:

1. secondary education competencies, marked "HS"
2. pre-engineering competencies, marked "CC"
3. baccalaureate-level competencies, marked "BS"
4. graduate-level competencies, marked "G"

The level of response for each of the Bloom's taxonomy levels is described through active verbs; examples of verbs for each level can be found at:

http://www.teach-nology.com/worksheets/time_savers/bloom/

Electrical Engineering Key Competencies Diagram

Lumina Foundation Grant Electrical Engineering Committee

Evaluation	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Synthesis	G	G	BS/G	BS/G	G	BS/G	G	G	G	G	G	G	G	BS/G
Analysis	BS	G	BS	BS	BS	BS	G	BS	G	BS	G	G	BS	BS
Application	CC/BS	CC	CC	CC/BS	BS	BS	BS	BS	BS	CC	BS	BS	CC	BS
Comprehension	CC	CC	CC	CC	CC	CC	CC/BS	CC	CC	CC	CC/BS	CC	CC	BS
Knowledge	HS/CC	HS/CC	CC	CC	HS/CC	CC	CC	CC	CC	HS	HS/CC	HS/CC	HS/CC	BS
	(a1) Math, Probability, and Statistics	(a2) Science	(a3) Circuits and Systems	(a4) Computer Engineering	(b) Experiment	(c) Engineering Design	(d) Multidisciplinary	(e) Engineering Problems	(f) Professional/Ethical	(g) Communication	(h) Engineering Impact and (i) Contemporary Issues	(j) Lifelong Learning	(k) Engineering Tools	(l) Specialization (Depth and Breadth)

G	**graduate-level competencies**
BS	**baccalaureate-level competencies**
CC	**pre-engineering competencies**
HS	**secondary education competencies**

Electrical Engineering Outcome Summaries

Electrical Engineering Competencies by Education Level

Learning outcome descriptions for each of the outcome titles of the competency table explain the knowledge, skills, and attitudes that should be achieved by the graduates.

(a1) Math, Probability, and Statistics

Mathematics is the science of numbers and their operations, interrelations, combinations, generalizations, and abstractions, and of space configurations and their structure, measurement, transformations, and generalizations. A core of knowledge of these branches of mathematics and the ability to apply that knowledge to solving engineering problems are essential skills for electrical engineers.

The knowledge and problem-solving tools derived from the study of mathematics are essential to the understanding and the practice of electrical engineering; the mathematics required for electrical engineering practice must be learned at the undergraduate level and should prepare students for subsequent courses in graduate engineering curricula. The branches of mathematics relevant to the study of electrical engineering are arithmetic, algebra, geometry, trigonometry, calculus (differential, integral, and multivariate), differential equations, optimization, probability, random variables, statistics, set theory, numerical methods, vector analysis, linear algebra, and complex variables.

MATHEMATICS, PROBABILITY, AND STATISTICS			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
Solve problems in mathematics in algebra, plane geometry, trigonometry, and analytical geometry (or pre-calculus), and apply this knowledge to the solution of science and technology problems; students should be ready to complete Calculus I in their first college semester	Explain key concepts and problem-solving processes in mathematics through multivariate calculus and differential equations	Solve problems in mathematics (through differential equations, linear algebra, and discrete math) and apply this knowledge to the solution of engineering problems; competence in probability and statistics is also required	Analyze a complex problem to determine the relevant mathematical and systems modeling principles, then apply that knowledge to solve the problem

(a2) Science

Science is the systematic study of the natural world through the scientific method. Science relies on experimental, quantifiable data and focuses on accuracy and objectivity. Science is the foundation from which technology is developed. The scientific method is the basis of experimental design and technological development. The principle branches of science relevant to electrical engineering are chemistry and calculus-based physics. Subsets of those bodies of knowledge important for electrical engineers include: atomic and nuclear structure, trends in chemical and physical properties of the elements, mechanics, electromagnetism, electro-optics, and thermodynamics. The knowledge of these principles from a calculus-based perspective and the ability to apply them to solve engineering problems are essential skills for electrical engineers.

Students obtaining undergraduate degrees in electrical engineering should be able to define, describe, and calculate mechanical characteristics of systems; define, describe, and calculate thermal characteristics of systems; define, describe, and calculate electromagnetic characteristics of charge systems in appropriate regular simple geometries. They should be able to identify appropriate sources of information for conducting laboratory experiments involving principles of chemistry and physics. They should be able to determine the basic nuclear and electronic structure of atoms and identify trends in chemical and physical properties of the elements using the Periodic Table. The science required for electrical engineering must be learned at the undergraduate level with a calculus-based approach, and should prepare students for subsequent courses in the engineering curricula.

SCIENCE			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
Explain key electrical and material concepts in physics, chemistry, and biology to solve related problems	Explain key electrical and material concepts in problem-solving processes in chemistry and calculus-based physics	Solve electrical engineering problems in calculus-based physics and chemistry, and apply this knowledge to the solution of electrical engineering problems	Analyze complex problems to determine the relevant physics, chemistry, and/or other areas of natural science principles, then apply that knowledge to solve the problem

(a3) Circuits and Systems

Electrical engineering programs must demonstrate that their students have the ability to analyze and synthesize electrical and electronic circuits, devices, and systems. Circuits, devices, and systems encompass electrical networks and electronic networks from small-scale (e.g., electronic components) to large-scale (e.g. power systems). "Analyze" means to determine the electrical behavior of an electrical or electronic network by experimental methods (measurements of actual circuits), simulation methods (model-building, numerical simulation methods, use of simulation software), or theoretical methods (involving Kirchhoff's laws; linear superposition; phasor, Laplace, Fourier, and Z-transforms).

They should be able to use both classical analytical methods (nodal and mesh analysis) and modern circuit analysis software tools to determine Thevenin and Norton equivalents, two-port models, and the frequency response of given circuits in the time and frequency domains. Students at the undergraduate level must be able to derive Fourier, Laplace, and Z-transforms of mathematical operations in addition to those of energy signals and power signals. "Synthesis" means the design of a circuit or system using modern engineering tools. Students must also be able to derive and analyze feedback control models for circuits and systems.

CIRCUITS AND SYTEMS			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
Intentionally left blank	Apply analysis of circuits in both time and frequency domain	Demonstrate the ability to analyze and design electrical and electronic circuits, devices, and systems using appropriate methods	Synthesize and evaluate electrical and electronic circuits, devices, and systems using appropriate methods

(a4) Computer Engineering

The area of computer engineering includes interrelated aspects of electrical engineering and computer science. It is often regarded as the area of overlap between the hardware (electrical and electronics) and the software (operating system and applications) of a computer system. Thus, computer engineering may be thought of as the knowledge of hardware-software interaction and co-design. A student of electrical engineering should demonstrate the requisite knowledge to analyze, design, and evaluate computer systems including the hardware, software, and any interaction thereof between the sub-systems and the external world. Computer engineering forms the fundamental basis of many systems including integrated circuits, computers, transducers, analog/digital converters, and control systems.

The body of knowledge in this area includes: digital systems, microprocessors, microcontrollers, gate arrays, assembly language, hardware/software interfacing, and a working knowledge of programming high- and low-level languages. Students need to demonstrate proficiency in the following areas: Boolean algebra; logic gates; number systems and codes; combinational logic; sequential logic; design of logic circuits; analog-digital interface; memory devices; microprocessor architecture, programming, and interfacing; assembly language programming; microcomputers; microcontrollers; instruction sets; chip interfacing; addressing modes; interrupts; input/output; and communications.

COMPUTER ENGINEERING			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
Intentionally left blank	Demonstrate the ability to use a higher-level programming language in engineering applications; analyze and design basic digital systems	Design and apply digital systems using microprocessor languages, logic, and computer architecture	Synthesize and evaluate digital systems

(b) Experiment

Experiments are controlled trials to study effects, establish hypotheses, or verify that equipment meets stated specifications. Electrical engineering students must have the ability to design, conduct, and verify laboratory experiments to explore and investigate physical and mathematical relationships of electrical and electronic circuits and systems. They must demonstrate the ability to analyze and interpret experimental results. The design of experiments encompasses the selection of: 1) control variables, 2) variables to measure, 3) measurement instruments, and 4) procedures. To conduct experiments is to carry out the procedures. To analyze and interpret experiments involves data reduction using appropriate graphical methods and/or numerical methods (e.g., regression, statistical techniques) to draw conclusions.

Students must also be able to prepare laboratory reports that clearly communicate experimental information in a logical and scientific manner. They must be able to evaluate the accuracy of physical measurements and the potential sources of error in measurements. In addition, students must be able to apply experimental results to find solutions to engineering problems. Students must have a working knowledge of laboratory test equipment including: power supplies, voltmeters, ammeters, function generators, oscilloscopes, and spectrum analyzers. Students must be able to design and conduct experiments to measure fundamental parameters of electrical and electronic circuits and systems to include voltage, current, power, impedance, frequency, amplitude, phase, and power gain.

EXPERIMENT			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
Conduct experiments in natural science courses according to the scientific method; report results and evaluate the accuracy of the results consistent with the scientific method	Conduct and explain the purpose, procedures, equipment, and practical applications of experiments in natural sciences and electrical engineering	Electrical engineering students must have the ability to design, conduct, and verify laboratory experiments to explore and investigate physical and mathematical relationships of electrical and electronic circuits and systems; they must demonstrate the ability to analyze and interpret experimental results	Specify an experiment to meet a need, conduct the experiment, and analyze and evaluate the experiment for effectiveness in meeting a real-world need

(c) Engineering Design

The engineering design process includes, but is not limited to, the following process steps: definition of a problem; understanding criteria and constraints; developing specifications; identifying and evaluating solutions; use of project management tools; knowledge of societal and ethical impacts of the viable solutions; differentiation of optimal from sub-optimal solutions; modeling and simulation; optimal implementation of the chosen solution; and test and solution.

Electrical and electronics engineering graduates must have the ability to design circuits, devices, and systems to meet application requirements. The engineering design process yields a viable solution to an engineering problem. Design includes all phases of the creation of circuits, devices, and systems to satisfy needs. The undergraduate student should step through the entire design process as a senior; however, the student should have experienced this process before reaching the capstone design course as a senior. Application requirements include basic functionality, environmental specifications (e.g., operating temperature range, operating supply-voltage range, ability to withstand shock and vibration), packaging constraints (e.g., size, weight), manufacturability, reliability, and cost.

ENGINEERING DESIGN			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
Intentionally left blank	Understand the purpose and steps of the engineering design process and their use in solving basic engineering problems	Apply the design process to create a solution to an electrical engineering problem while meeting the requirements of real-world constraints and IEEE standards	Synthesize and evaluate design of complex systems and assess compliance with applicable standards of practice, user needs, and relevant constraints

(d) Multidisciplinary Teams

At the time a student completes the undergraduate degree requirements, the student must have the ability to function successfully on multidisciplinary teams.

Multidisciplinary engineering teams are groups of persons engaged in engineering who represent a spectrum of engineering and technical specialties. Students must be able to identify distinctions between the various disciplines and functions within engineering. To contribute successfully is to take an active, participatory, and productive role in the accomplishment of the tasks of a team. They must possess effective leadership, management, and communication skills. They should demonstrate knowledge of the importance of planning and organizing tasks to accomplish project goals; know the importance of effectively utilizing resources; know the techniques used to run effective meetings; know the techniques used to promote team harmony; and, know the techniques used to foster high levels of performance, creativity, and professionalism. Students must also be able to define, specify, and successfully complete a major engineering design project as part of a multidisciplinary design team.

MULTIDISCIPLINARY TEAMS			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
Have experience in collaborative learning and teamwork on class projects	Discuss and demonstrate collaborative learning and teamwork on class projects	Function effectively as a member of an interdisciplinary team	Function effectively as a member of a multidisciplinary team

(e) Engineering Problems

Electrical engineering programs must demonstrate that their students have the ability to apply advanced mathematics, scientific principles, and modern engineering tools to solve practical engineering problems that confront an electrical or computer engineer. In addition to using theoretical knowledge, electrical and computer engineers must possess the ability to conduct, analyze, and interpret experiments and creatively apply experimental results to find solutions to engineering problems.

At the time a student completes the degree requirements and graduates with a Bachelor of Science in Electrical Engineering, the student must have the ability to identify, formulate, and solve problems in the practice of electrical engineering using appropriate theoretical and experimental methods.

ENGINEERING PROBLEMS			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
Explain key concepts related to problem recognition, problem articulation, and problem-solving processes related to math and science applications	Identify key factual information related to math, science, and basic electrical engineering problem recognition, problem solving, and applicable techniques and tools	Develop problem statements and solve electrical engineering problems by applying appropriate techniques and tools	Synthesize and evaluate the solution to an advanced engineering problem

(f) Professional/Ethical Responsibility

The role of ethics is the application of moral reasoning in engineering decision-making. Electrical engineering programs must demonstrate that their students have the ability to understand the global context in which engineering is practiced, including the role of ethics in the practice of engineering. The role of ethics is the application of moral reasoning in engineering decision-making (e.g., acting in accordance with the protection of public health, safety, and well-being).

Students should understand the professional and ethical responsibilities of an engineering career, as codified by, for example, the National Society of Professional Engineers (NSPE) and the Institute of Electrical and Electronic Engineers (IEEE); and understand the impact of unprofessional/unethical behavior through knowledge of engineering disaster case studies and understand the importance of service to the community. Students must also develop an understanding of the significance of quality, timeliness, and continuous improvement.

PROFESSIONAL/ETHICAL RESPONSIBILITY			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
Intentionally left blank	Identify appropriate academic and professional ethical standards and behaviors	Analyze a situation and apply standards of professional and ethical responsibility to determine appropriate action	Synthesize and evaluate studies and experiences to foster professional and ethical conduct

(g) Communication

Written communication skills involve the drafting of documents (technical and non-technical) commonly encountered in engineering (e.g., lab reports, business letters, project proposals, peer-reviewed articles, specifications, test procedures, users' manuals). Visual communication skills involve conveying information by use of graphics, images, and video. Communication skills involve the ability to communicate effectively (e.g., in meetings, presentations, conferences).

Students graduating with an undergraduate degree in Electrical Engineering must possess clear and effective written, visual, and oral communication skills.

COMMUNICATION			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
List and use basic elements of oral, written, virtual, and graphical communication	Apply the rules of grammar and composition in verbal, written, and virtual communications; properly cite sources, and use appropriate graphical standards	Organize and deliver effective oral, written, virtual, and graphical communication	Synthesize and evaluate the effectiveness of the integrated verbal, written, virtual, and graphical communication of a project to technical and non-technical audiences

(h) Engineering Impact[1]

Electrical engineering programs must demonstrate that their students have an understanding of the social, environmental, and economic impact of the discipline in a local, regional, and global context. The impact of engineering on society includes the ways in which technological developments affect individuals and organizations. Students will develop the ability to incorporate the impact of engineering solutions into the design process. Students will develop an understanding of the ethical implications of impact analysis in engineering problem solving. Students will also develop an informed historical perspective on engineering solutions to allow for a greater understanding of the impact of the discipline.

(i) Contemporary Issues

Students graduating with an undergraduate degree in Electrical Engineering will possess an educational background to understand the global context in which engineering is practiced, including knowledge of contemporary issues related to science and engineering. Contemporary issues related to science and engineering are evolving technical, social, and legal developments, and market trends that affect the direction of technological development (e.g., federal research and development funding decisions, laws regulating the practice of engineering, environmental policy decisions, and de facto technical standards established by market forces). Students should demonstrate the ability to identify and analyze contemporary national and international issues and situations and to discuss their effects and implications on individuals and organizations, economics, and the engineering profession.

CONTEMPORARY ISSUES AND IMPACT			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
Describe economic, environmental, public policy, and societal aspects of modern history	Explain the historical perspective and the impact of engineering solutions on the economy, environment, public policy, and society	Understand historical and contemporary issues and apply them in solving engineering problems	Synthesize and evaluate the impacts and relationship among engineering and historical, contemporary, and emerging issues

[1] Engineering Impact (h) and Contemporary Issues (i) have separate definitions, but a combined competency chart.

(j) Lifelong Learning

Electrical engineering programs must demonstrate that their students have the ability to understand the necessity of lifelong learning within the profession. Students must develop an understanding that continuous education has a profound impact on longevity, productivity, and career trajectories. Students must understand the roles of job experience, informal learning (conferences, seminars, magazines, journals), and formal education. Students should understand the need for lifelong learning as a professional and ethical responsibility to ensure competence and protect public welfare.

LIFELONG LEARNING			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
Demonstrate the use of informational resources	Explain the impact of continuous education on longevity, productivity, and career trajectories	Understand the necessity of lifelong learning within the profession	Incorporate the need for lifelong learning as a professional and ethical responsibility to ensure competence and protect public welfare

(k) Engineering Tools

Students graduating with an undergraduate degree in Electrical Engineering will have the ability to use modern engineering tools, techniques, and software in the practice of electrical engineering. Modern engineering tools and techniques include equipment, computer programs, and programming languages. Equipment and software provide the means to model, modify, and verify known circuit and system behavior.

ENGINEERING TOOLS			
Core Competencies Needed to enter Higher Education in Electrical Engineering	**Pre-Engineering Competencies gained during the first two years of study**	**Baccalaureate-Level Engineering Competencies**	**Graduate-Level Engineering Competencies**
Perform scientific calculations using appropriate instruments and tools; demonstrate computer literacy	Apply modern engineering tools, techniques, and software at a basic level	Apply modern engineering tools, techniques, and software in the practice of electrical engineering	Synthesize and evaluate modern engineering tools, techniques, and software

(l) Specialization (Depth and Breadth)

Students graduating with an undergraduate degree in Electrical Engineering will have sufficient breadth and depth in specialized areas of electrical engineering. They should demonstrate an ability to apply scientific principles and mathematical concepts to analyze a variety of practical application problems in the specialized areas of electrical engineering, including but not limited to: signal processing, real-time embedded systems, power electronics, solid-state devices, opto-electronics and fiber-optics, image processing, reconfigurable logic, power systems analysis, communications, and controls.

Community College Program of Study for Transfer to an Electrical Engineering Program

FRESHMAN YEAR

rst Semester (Fall)			Second Semester (Spring)		
	Course	**SCH**		**Course**	**SCH**
ATH 2413	Calculus I	4	MATH 2414	Calculus II	4
HEM 1311	General Chemistry	3	PHYS 2325	University Physics I	3
HEM 1111	Chemistry I Laboratory	1	PHYS 2125	University Physics I Laboratory	1
IGR 1201	Introduction to Engineering	2	MAH 2305	Discrete Math	3
ON 2301 or 2302	Micro- or Macroeconomics	3	or ENGR 2308	Engineering Economics	
XX ####	Texas Core Curriculum Requirement	3	XXXX ####	Texas Core Curriculum Requirement	3
			XXXX ####	Texas Core Curriculum Requirement	3
	Semester Credit Hours	**16**		**Semester Credit Hours**	**17**

SOPHOMORE YEAR

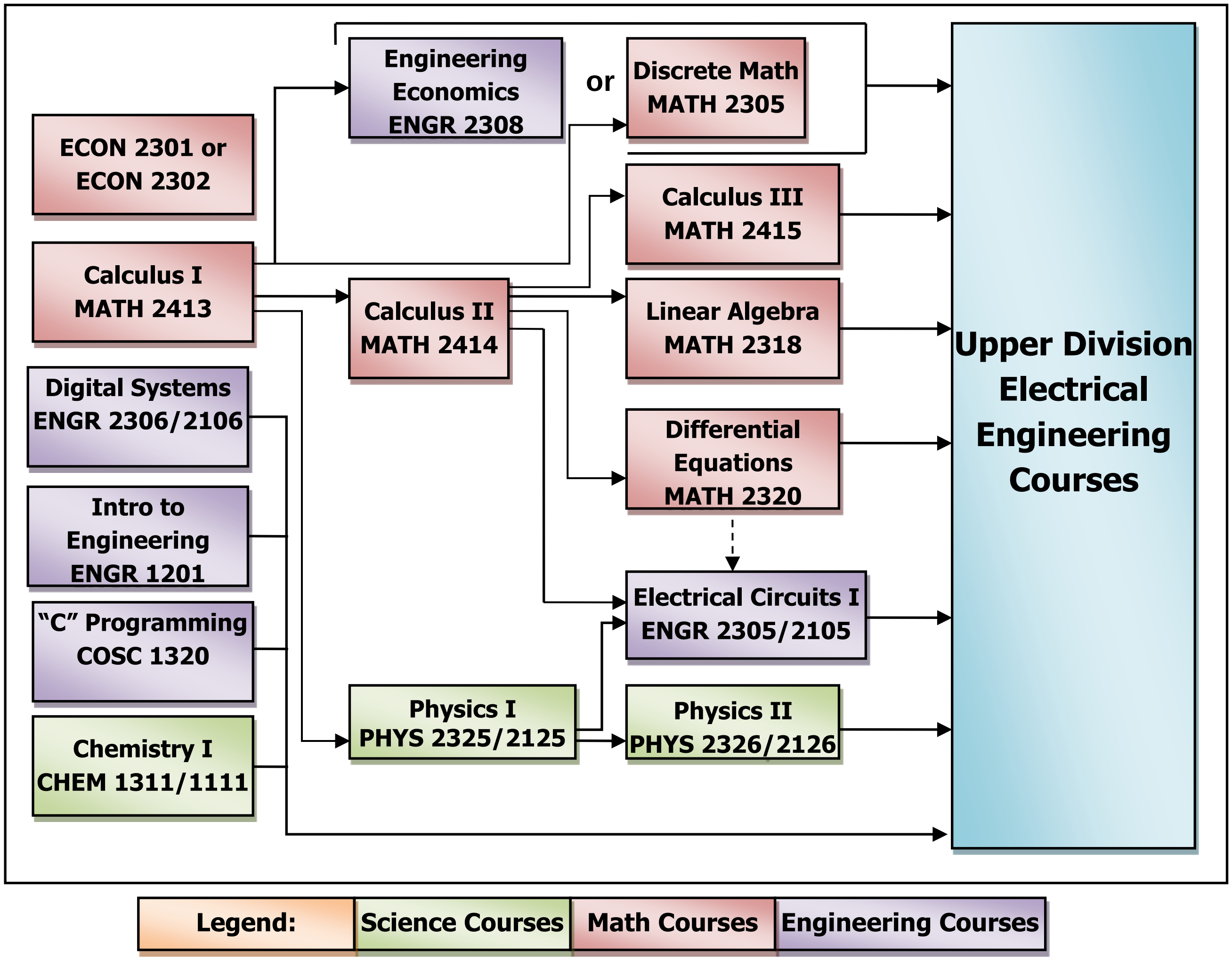
rst Semester (Fall)			Second Semester (Spring)		
	Course	**SCH**		**Course**	**SCH**
ATH 2415	Multi-Variable Calculus (Calculus III)	4	MATH 2320	Differential Equations	3
HYS 2326	University Physics II	3	EENG 2305	Electrical Circuits I	3
HYS 2126	University Physics II Laboratory	1	EENG 2105	Electrical Circuits I Laboratory	1
IGR 2306	Digital Systems	3	MATH 2318	Linear Algebra	3
IGR 2106	Digital Systems Laboratory	1	XXXX ####	Texas Core Curriculum Requirement	3
OSC 1320	"C" Programming	3	XXXX ####	Texas Core Curriculum Requirement	3
XX ####	Texas Core Curriculum Requirement	3			
	Semester Credit Hours	**18**		**Semester Credit Hours**	**16**

Notes:

1. Texas Common Course Numbers are used for all TCCN-numbered courses.
2. Some electrical engineering programs require Chemistry II in addition to Chemistry I. The student is advised to check with the school to which he or she intends to transfer for specific requirements.
3. Some electrical engineering programs will accept the course ENGR 1201 for transfer credit and as applicable to the engineering major, while others will accept the course for transfer credit only. The student is advised to check with the school to which he or she intends to transfer for specific applicability of this course to the engineering major.

Note: Program of Study revised 11/15/2013 to reflect the Academic Course Guide Manual (ACGM) Committee's approval to modify the ACGM course ENGR 2308 Engineering Economics to remove the prerequisites ECON 2301 Principles of Macroeconomics or ECON 2302 Principles of Microeconomics.

Prerequisite Flowchart



Note: Prerequisite Flowchart revised 11/15/2013 to reflect the Academic Course Guide Manual (ACGM) Committee's approval to modify the ACGM course ENGR 2308 Engineering Economics to remove the prerequisites ECON 2301 Principles of Macroeconomics or ECON 2302 Principles of Microeconomics.