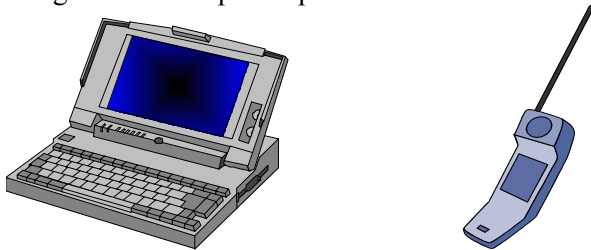


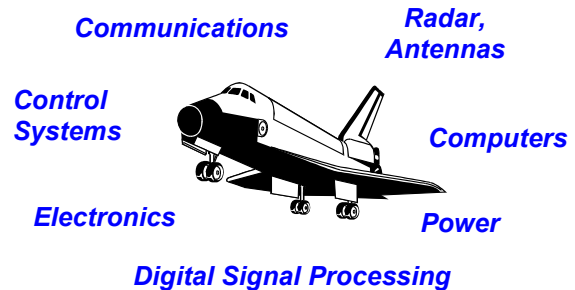
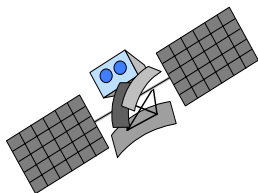
What is Electrical Engineering?

The professional activities of electrical engineers directly affect the everyday lives of most of the world's population. They are responsible for the design and development of radio and television transmitters and receivers, telephone networks and switching systems, computer systems, and electric power generation and distribution. Within the broad scope of these systems, the electrical engineer is concerned with a challenging and diverse array of design and development problems.



Electrical engineers design miniature semiconductor integrated circuits that contain millions of elementary devices. Electrical engineers also create systems for automatically controlling mechanical devices and a variety of processes. Electrical engineers are responsible for the design of satellite communication links as well as patient monitoring systems for hospitals. The development of the microprocessor has expanded the opportunities for electrical engineers to improve the design of familiar products since these devices are now incorporated in automobiles, consumer and office products, entertainment systems, and a vast variety of test and measurement instruments and machine tools.

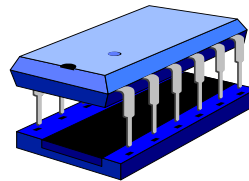
Students who earn a B.S.E. degree in Electrical Engineering will be involved in a variety of electrical and electronic problems in the course of their careers. To ensure the necessary breadth of knowledge, the ASU Electrical Engineering curriculum includes basic (core) engineering courses and courses in networks and electronic circuits, electromagnetic fields and waves, signal processing, microprocessors, communication and control systems, solid state electronics, electrical power systems, and other special courses. The following describes our major areas of emphasis.



Solid State Electronics

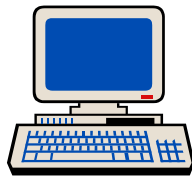
Solid State Electronics is the study of the behavior of solids. It deals mainly with the behavior of semiconductor materials and devices. Solid State Electronics is also concerned with other solids, such as insulators and conductors, but semiconductors are by far the most important. Semiconductors are very important today because they are the building blocks of integrated circuits and other electronic circuits. The most important semiconductor is silicon, because it is the basis of most integrated circuits.

The circuits that make computers work are made of semiconductors. They do the calculations, the memory function, and drive the display screen. Integrated circuits are the heart of electronic watches, where they direct the oscillating quartz

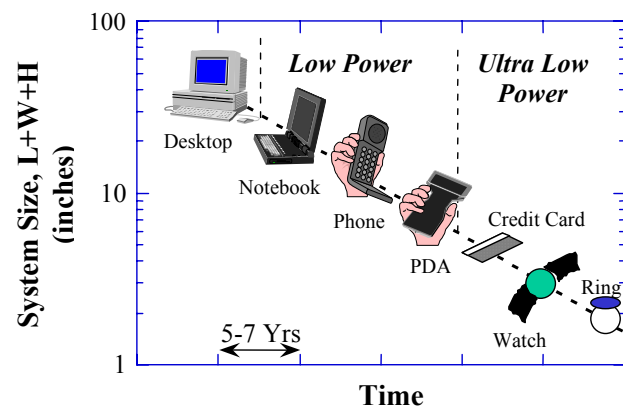


crystal that controls the time. Semiconductor chips control television sets and radios. Semiconductors other than silicon can be made to emit light and are used today in the brake safety lights seen in the spoiler of certain cars. The lasers that are used to detect the sound in compact disk players are made of semiconductors, as are the light emitters and light detectors in fiber optic communication systems. Large semiconductor devices are used in the transmission of power where they convert direct current to alternating current and vice versa. Semiconductors are utilized to charge the battery in a car and control many other functions in a car, from the crash impact detector for releasing air bags, to chips that control the automated braking system.

No electronic function exists without semiconductors in today's world. The semiconductor industry is growing at a very rapid rate. The semiconductor business was about \$200 billion worldwide in 2000 and is expected to grow to about \$350 billion by the end of the decade.



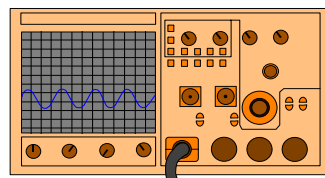
The electronics business worldwide today is larger than the automobile, steel and aerospace businesses combined. Semiconductors are indeed very important in today's industrial world. The continued shrinkage of the size of semiconductor devices allows handheld devices such as cellular telephones and portable digital assistants to become ever smaller, lighter and lower power. The future will bring smart credit cards, watches and even rings that perform "smart" functions.



Electromagnetics

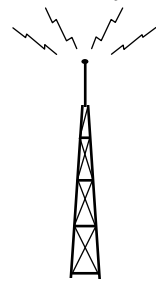
Electromagnetics is the study of electromagnetic fields and waves. These are the physical basis for your cell phones and pagers, and cable television and high speed Internet connections.

Electrical engineers (EEs) use electromagnetic fields and waves when they build the largest objects that anyone builds. They build systems that allow us to transfer energy and information from one end of the planet to the other, and in some instances from Earth to Mars. Some of these



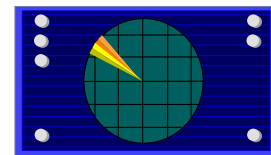
systems use wires; some use optical fibers; others are "wireless." All of these systems use electromagnetic fields and waves. EEs build radar systems that allow us to detect objects far away by bouncing electromagnetic waves off of the objects.

Inside a TV picture tube or a Xerox machine, we make small objects go where we want them to go and stay where we want them to stay by charging these small objects and then controlling them with electric and magnetic fields. EEs let you cook your food rapidly in a microwave oven by zapping the food with electromagnetic waves. EEs also answer questions such as "do cell phones cause cancer?" or "should I live under the power lines?" by asking how electromagnetic fields and waves affect biological systems. Electromagnetics is used to explain how mirrors, sunglasses and magnets work. "Why can I hear AM radio stations that are far away but cannot hear the FM stations?" Because different frequencies of electromagnetic waves behave differently in the atmosphere. "Why can't I use the normal telephone line for a high speed Internet connection?" Because normal telephone lines do not allow electromagnetic waves of sufficiently high frequency to travel along them.



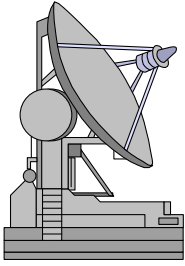
Electrical engineers do these things and answer these questions because they know how to predict, control and use the behavior of electromagnetic waves and fields. These fields arise from charged particles at rest and in motion, and exert forces on other charged particles.

The electromagnetic force is one of the four known fundamental forces of nature, and is the only one that humans can easily manipulate.



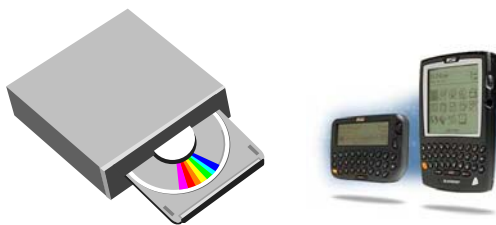
Electromagnetic radiation is the transmission of energy in the form of waves that have both electric and magnetic fields. Light waves and radio waves are the most familiar forms of electromagnetic radiation. X-rays and gamma rays, and infrared and ultraviolet light are other forms of electromagnetic waves. All of these forms of electromagnetic radiation are the same physical phenomena. They differ only in wavelength. All electromagnetic waves propagate through a vacuum with a velocity equal to approximately 300,000,000 meters per second. This fact underlies many of the issues involved in building the systems that cover the planet as it means that one must worry about the time it takes for information to move from one spot to another. As we force computers to go faster and faster, we are beginning to face the same worry inside the computer and sometimes inside a single computer chip.

Students who study electromagnetics will be able to analyze, model and design electromagnetics-based devices, such as antenna systems, fiber optic systems and microwave systems. Computational electromagnetics allows the student to estimate the radar cross-section of aircraft---for example, determine the "stealthness" of a fighter. They also can study the electromagnetic phenomena that arise in very high-speed digital systems and in natural situations such as atoms, molecules and lightning.



Communications and Signal Processing

Communication Systems engineers design, build, and operate systems through which information is transmitted. The capabilities of modern communication systems have radically changed the way in which information is shared in our society. These communication systems include cellular phones and next-generation wireless, radio and television, satellite, wireless and optical networks, and the Internet. Transmitted information ranges from multimedia content (speech, music, images, and video) to digital data. Communication systems engineering is founded on mathematical signal and system theory, and brings together expertise from several diverse fields, including design of digital and analog hardware, computer systems design and programming, and signal processing and coding.



Signal Processing: the field of digital signal processing (DSP) is concerned with the processing of signals by computers and/or DSP chips. The main objectives of DSP are to extract, encode, and process signals, and to suppress noise and other distorting effects. Signals arise from many sources including radar, sonar, wireless communication transmitters, geological sensors, medical imaging devices, speech, music, and video. Typical DSP applications include real-time MP3 digital audio, multimedia communications, digital surround systems in theaters, DVD and digital TV

compression systems, smart bomb guidance systems, detection and identification of targets using radar or sonar, heart monitoring and digital pacemakers, acoustic imaging and tomography, and algorithms for enhanced privacy and improved reception in digital cordless and cellular phones.

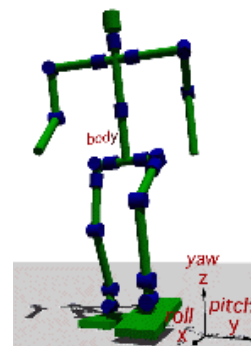


Control Systems

Control Systems engineering addresses problems related to the design of complex systems or processes that rely on the real-time processing of feedback (sensor) measurements in order to achieve required performance specifications in the presence of "uncertainty." Uncertainty may be due to a variety of sources: modeling errors (intentional and deliberate), system or component aging, disturbances, sensor noise, and reference commands.

The best example to illustrate basic control system concepts is perhaps the cruise control system found in today's cars. A speed measurement is fed back and compared with a desired speed (reference command) to form an error signal.

A control algorithm, based on a simple vehicle model, then uses the error signal to "compute" the required throttle setting or fuel flow to the engine. What is special about the cruise control system example is that it illustrates fundamental feedback principles that are universally applicable to very complex systems and processes (e.g., fighter aircraft, robotic systems, autonomous vehicles, semiconductor manufacturing processes, biological processes, etc.). Automatic landing systems for jets, for example, rely on real-time airspeed, altitude, and attitude measurements to properly coordinate (compute) the required settings for throttle, flaps, elevator, ailerons, and rudder.



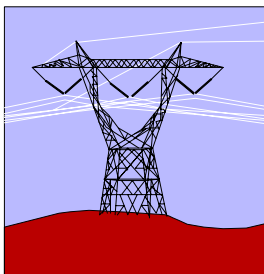
Control engineers use tools from a variety of areas: systems, signal processing, communications, power, mathematics, physics, other engineering disciplines, etc. Fundamental feedback and control system design principles appear in all areas of science,

engineering, and other disciplines. Such principles are essential for the analysis, design, and development of any system or process that exhibits "intelligence" or that requires the assistance of a computer for control. As computing, sensing, and actuation technologies achieve new milestones, the possibilities for the application of feedback design principles toward the development of truly intelligent or autonomous systems increases significantly.

Power Engineering

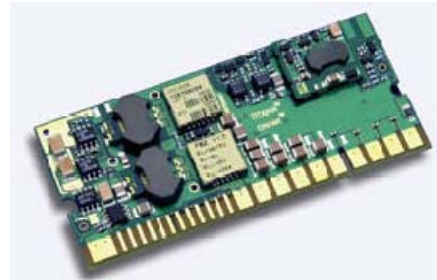
Power Engineering is a broad field that includes transmission and distribution lines, power electronics, high voltage engineering and dielectrics, power system analysis and computation, power system operation and control, and power generation.

Power transmission lines transmit the bulk electric power generated at large electric plants remote from consumers. These transmission lines are supported by towers and insulators. The insulators are required to prevent the failure and breakdown of transmission lines when abnormal conditions occur, such as lightning and switching surges. Good insulator design is required for reliable and economic operation of transmission lines. The transmission lines start from the power generation center and end at the local utility center. The lines operate at very high voltages such 500 kV (kilovolts), unlike our homes, which are usually at 120 Volts. Distribution lines transmit the power from the local utility center to the consumers, which include industries, businesses, and homes. The distribution lines are subdivided into overhead and underground (cable) lines. The distribution lines have low voltages and high currents. The high voltage and low current of transmission lines are converted to low voltages and high currents by a device called transformer. The transformer is the most widely used power device and is present almost in all electric appliances like radio, television, and computers. In all these areas, reliability is critically important.



Power electronics is a multi-disciplinary field that deals with power conversion and control using power semiconductor devices. Power electronic converters allow the conversion of power from any

available form like ac mains, batteries, and solar power to any other form suitable for different kinds of loads. The ability to control power at will, and very efficiently, has led to the widespread use of these converters. They provide the precise voltage needed for the integrated circuits in a PC, cell phone, etc., and the high frequency power needed for modern lighting; they control the speed and position of large motors in a variety of applications including the electric car. Power electronics is a key enabling technology in interfacing solar cells, fuel cells, wind power and more to the utility grid. Power electronics provide the muscle while computer electronics provide the brain.



Power systems analysis and computation involves the development of better methods and computational tools. This includes applying the latest computer technology to power system analysis for example use of parallel and vector computers for transient stability analysis, use of windowing and graphics technology to develop easier user interfaces.

Power system operation and control studies involve the development of better tools at control centers. It is necessary to assist operators by allowing computers to control the power system directly without human intervention. Power generation involves the development of advanced methods applied to power generation facilities. Such techniques include utilization of instrumentation fault detection, power plant modeling, new power sources such as fuel cells and solar energy, and ways to control all of these sources.



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