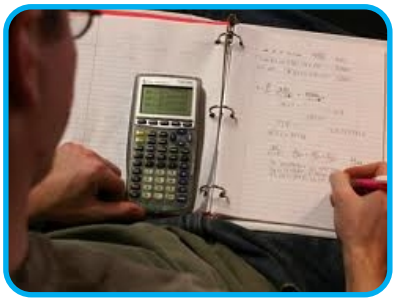
ENGINEERING

Education, Training, Job demands, Opportunities



ENGLISH

The most important subject you need to master is: ENGLISH. A total command of the English language is essential for any career especially for engineering. You need to thoroughly understand your studies, the reports and communications from others and all types of technical and non technical materials. You need be able to communicate to others technically or informally in writing or orally. Your communications need to be grammatically correct, clear, understandable, and capable of persuading others of the points you want to convey.

MATHEMATICS

Mathematics is the language of nature. If someday we meet intelligent aliens, they will know the same math. They will have different symbols and methods but the basic math will be the same. Math is the basis for understanding all the sciences such as physics, chemistry, biology, economics etc. Complete mastering of mathematics is essential for engineering. As an engineer, you will be designing and building new things such as machines, buildings, vehicles, software, chemicals etc, depending on your specialty. All those will require precise calculations to insure that they perform their intended purpose.

PHYSICS

Physics is the most basic science because it studies and describes all of nature, from subatomic particles to stars and galaxies. With physics you learn how mechanical things interact, the laws of motion, energy, electricity, optics, magnetism, acoustics and relativity. Physics is the basis for other sciences such as chemistry and biology. The engineer needs to understand and apply the laws of physics to design new thins or to test and evaluate existing ones.

HANDS ON EXPERIENCE

Theoretical study is not enough. If you are going to design structures or machines you need the practical experience of constructing things with your own hands. You need to spend time in a machine shop, not only to learn to use the machines but also to be familiar with standard materials, component parts, digital controlled machines etc. You can take part in engineering competitions where groups of students build robots or vehicles under a set of rules to compete with other groups. An engineering student should also have a hobby building some electronic or mechanical devices. Without practical experience all the theoretical studies fall short of providing a real engineering education.

A WELL ROUNDED EDUCATION

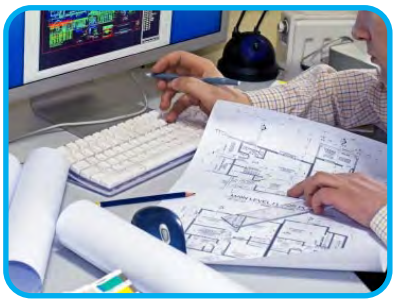
Some other academic fields may seem to have little connection with engineering, but in reality an engineer needs to be competent in many areas. Economics: any project has to be not only physically possible but also economically feasible. Art: a good esthetic sense is essential for the success of most projects. Ethics, civics, history, geography, current affairs, a second language and a general cultural level are not only important for professional success but also for self assuredness and personal success.

EDUCATION NEVER STOPS

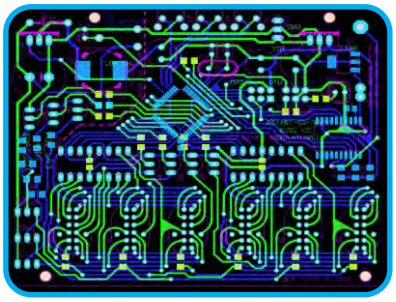
When you graduate as an engineer and accept a job that matches your studies, that is only the beginning. Soon the demands of the projects you undertake will refine the area you may become an expert on. As you get more practical experience you will also need to constantly learn to keep up with your field and the needs of your job. You may learn and study mostly on your own, but you may also take formal advances courses . This is something you have to realize, that an engineer you will never be done learning. What you learned in College is just the basis, and you will always need to improve and add to it.

AN ENGINEERING PROJECT

Consider the following example. You have been employed for several years by a manufacturing company that produces electric components for building and home construction. Your degree is in electrical engineering but you also have developed mechanical engineering skills through practice and self study. You have worked with other engineers and technicians on several projects involving production equipment. You have taken a proactive approach to your job so you are very familiar with most of the operations in your company. You talk formally and informally with every one, managers, technicians, sales persons, secretaries, production workers etc. Your hobby at home is building remote control airplanes where you design, build, assemble and fly them.



An important component of a circuit breaker produced by your company, is made with the help of some fixtures, but it is basically handmade, one at a time. You have been considering ideas about designing an automatic machine to make the part cheaper, in larger quantities and more reliably. Your managers and colleges agree and you are given the go ahead to develop a concept, and estimate of costs for the new machine. You spend several weeks putting together ideas about the machine, its different parts and functions, what it will look like, how will it be operated, what will be the control system, which components will be available purchased parts and which will have to be designed and built.



For the next several months the detailed design of every machine part takes place. All the components are drawn to precise dimensions using a Computer Aided Design (CAD) program.

An assembly drawing is set up where the drawings of the parts are put together in the computer. Some engineers use three dimensional computer renderings of the parts, most depend on the three views (front, top and side) to fit all the parts and make sure they all fit together with no interferences. There are many considerations, for instance the parts must be designed with standard metal sizes and keeping in mind the machine tools capabilities. The final machine must be easy to assemble and disassemble for maintenance. All the parts and the machine itself must be "functional" such that they fill their purpose with efficiency.

The control system for the machine must also be designed. Most automatic machines use a special computer called Programmable Controller (PC). The PC is programmed with "ladder logic" which allows the constant control and monitoring of the machine functions. This includes safety features such as shutting off in the event of malfunction. Besides the PC, interface circuits are required to transfer the electric signals of the PC to the machine components such as motors, valves and actuators. A good control panel must be designed to allow the operator control of the machine and display the current condition of the machine systems.

After the design is "finished", you still must allow some time to review and rethink all the aspects of the machine. Flaws and inconsistencies are a lot cheaper to correct in the computer than on real parts after the machine is made. Then the parts are ordered, but you still monitor their construction and procurement of purchased parts. Finally the machine is assembled, wired, and tested with possible corrections and changes to optimize its operation. In all, from the time you had your first idea until the time the automatic assembly machine is in operation, a year may have passed and at the same time you may have been responsible for other projects. One of the great satisfactions of being an engineer is the ability to create new and useful things and see them in operation.

CAREERS IN ENGINEERING

In our modern technological society there are thousands of engineering specialties. Every man made structure, machine, material, chemical, vehicle, communication system, etc. have many engineers that design, build, test and maintain them. Here is a very short list of engineered products: highways, bridges, skyscrapers, airplanes, space ships, cars, farm equipment, televisions, computers, cell phones, web sites, medicines, etc. It can be said that every item listed on the yellow pages is directly or indirectly possible because of engineering. Some items like an airliner will involve thousands of engineers working as a team and residing in different countries. Other items such as a production machine, a new chemical or an electronic chip could be the responsibility of just one engineer. There is great demand for all types of engineers. A good, competent and creative engineer has almost limitless possibilities for employment, advancement and recognition.