**ELECTRICAL AND ELECTRONICS ENGINEERING**

Electrical and electronics engineering is the largest and most diverse field of engineering. Among the most important subjects in the field are electric power and machinery, electronic cir­cuits, control systems, computer design, superconduc­tors, solid-state electronics, medical imaging systems, robotics, lasers, radar, consumer electronics, and fibre optics. Despite its diversity, electrical engineering can be di­vided into four main branches: electric power and ma­chinery, electronics, communications and control, and computers.

**Electric Power and Machinery**

The field of electric power is concerned with the de­sign and operation of systems for generating, transmit­ting, and distributing electric power Engineers in this field have brought about several important developments since the late 1970s. One of these is the ability to trans­mit power at extremely high voltages in both the direct current (DC) and alternating current (AC) modes, reduc­ing power losses proportionately. Another is the real-time control of power generation, transmission, and dis­tribution, using computers to analyse the data fed back from the power system to a central station and thereby optimizing the efficiency of the system while it is in op­eration.

A significant advance in the engineering of electric machinery has been the introduction of electronic con­trols that enable AC motors to run at variable speeds by adjusting the frequency of the current fed into them. DC motors have also been made to run more efficiently this way.

**Electronics**

Electronic engineering deals with the research, de­sign, integration, and application of circuits and devices used in the transmission and processing of information. Information is now generated, transmitted, received, and stored electronically on a scale unprecedented in history, and there is every indication that the explosive rate of growth in this field will continue unabated.

Electronic engineers design circuits to perform spe­cific tasks, such as amplifying electronic signals, add­ing binary numbers, and demodulating radio signals to recover the information they carry. Circuits are also used to generate waveforms useful for synchronization and timing, as in television, and for correcting errors in dig­ital information, as in telecommunications.

Prior to the 1960s, circuits consisted of separate elec­tronic devices — resistors, capacitors, inductors, and vacuum tubes — assembled on a chassis and connected by wires to form a bulky package. The electronics revo­lution of the 1970s and 1980s set the trend towards inte­grating electronic devices on a single tiny chip of silicon or some other semi-conductive material. The complex task of manufacturing these chips uses the most advanced technology, including computers, electron-beam lithog­raphy, micro-manipulators, ion-beam implantation, and ultraclean environments.

**Communications and Control**

Engineers work on control systems ranging from the everyday, passenger-actuated, such as those that run a lift, to the exotic, such as systems for keeping spacecraft on course. Control systems are used extensively in air­craft and ships, in military fire-control systems, in power transmission and distribution, in automated manufac­turing, and in robotics.

**Computers**

Computer engineering is now the most rapidly grow­ing field. The electronics of computers involve engineers in design and manufacture of memory systems, of cen­tral processing units, and of peripheral devices. The field of computer science is closely related to computer engi­neering; however, the task of making computers more «intelligent» (artificial intelligence), through creation of sophisticated programs or development of higher level machine languages or other means, is generally regarded as the aim of computer science.

One current trend in computer engineering is micro­miniaturization. Engineers try to place greater and greater numbers of circuit elements onto smaller and

smaller chips. Another trend is towards increasing the speed of computer operations through the use of parallel processors and superconducting materials.

**HARDWARE**

What is hardware? Webster's dictionary gives us the following definition of the hardware —themechanical, magnetic, electronic, and electrical devices composing a computer system.

Computer hardware can be divided into four catego­ries:

1. input hardware; 2. processing hardware; 3. storage hardware; 4.output hardware. Some of them are presented here.

**Machine-Tools**

Machine-tools are used to shape metals and other materials. The material to be shaped is called the workpiece, Most machine-tools are power electrically driven. Machine-tools with electrical drive are faster and more accurate than hand tools: they were an important element in the development of mass-production processes, as they allowed individual parts to be made in large numbers so as to be interchangeable.

All machine-tools have facilities for holding both the workpiece and the tool, and for accurately controlling the movement of the cutting tool relative to the workpiece. Most machining operations generate large amounts of heat, and use cooling fluids (usually a mixture of water and oils) for cooling and lubrication.

Machine-tools usually work materials mechanically but other machining methods have been developed lately. They include chemical machining, spark erosion to machine very hard materials to any shape by means of a continuous high-voltage spark (discharge) between an electrode and a workpiece. Other machining methods include drilling using ultrasound, and cutting by means of a lase rbeam. Numerical control of machine-tools and flexible manufacturing systems have made it possible for complete systems of machine-tools to be used flexibly for the manufacture of arange of products.

**ELECTRIC POWER PLANTS.**

Electric power is generated at electric power plants. The main unit of an electric power plant comprises a prime mover and the generator which it rotates.

In order to actuate the prime mover energy is required. Many different sources of energy are in use nowadays. To these sources belong heat obtained by burning fuels, pressure due to the flow of air (wind), solar heat, etc.

According to the kind of energy used by the prime move: power plants are divided into groups. Thermal, hydraulic (water-power) and wind plants form these groups. According to the kind of prime mover, electric power plants are classed as:

a) Steam turbine plants, where steam turbines serve as prime movers. The main generating units at steam turbine plants belong to the modern, high-capacity class of  
power plants.

b) Steam engine plants, in which the prime mover is a piston-type steam engine.

Nowadays no large generating plants of industrial importance are constructed with such prime movers. They are used only for local power supply.

c) Diesel-engine plants; in them diesel internal combustion engines are installed. These plants are also of small capacity, they are employed for local power supply.

d) Hydroelectric power plants employ water turbines as prime movers. Therefore, they are called hydroturbine plants. Their main generating unit is the hydrogenerator.

Modern wind-electric power plants utilize various turbines: these plants as well as the small capacity hydroelectric power plants are widely used in agriculture.