CHAPTER 1

Number Systems and Codes

1.1 Digital System Organization

We are surrounded today by a myriad of digital devices. Digital watches, electronic calculators, digital meters, microprocessors, and digital computers are all examples of such systems. A *digital system* manipulates data that are composed of a finite number of discrete elements. The results that the digital system produces are also made up of a set of discrete elements. In contrast, an *analog system* manipulates data that are represented in a continuous form, producing results that also appear in continuous form. In electronic digital systems, the discrete elements of data correspond to *signals* which are either voltage levels or current magnitudes. Each specified voltage level can represent an element of data. The signal thus can be at only one of these specified levels. In an analog system, signals assume values in a continuous range of voltage.

For example, the signals in a digital system might be restricted to two levels (0 and +5 volts), corresponding to the two discrete elements of information, while analog signals may take any value in the range of +5 to −5 volts. Compared with analog systems, digital systems are more accurate and reliable. Hence, they are replacing analog systems wherever possible, although for certain applications analog systems are clearly superior. In order to introduce the terminology, we will now examine two popular digital devices.

An electronic calculator is a digital device in which input data are composed of discrete values entered through the keyboard, and the instructions to manipulate the data are also entered through the keyboard by means of the function keys. The output is a set of discrete values represented as digits on the display. In a programmable calculator, the sequence of instructions (i.e., the *program*) is stored in the calculator memory and used repeatedly on various sets of input data to produce results.