13 Applications of Digital Electronics

13.1 Conversion of relay systems to electronic logic

A situation which arises in industry is the necessity for designing electronic logic systems to replace relay systems. Certain basic connections are repeatedly found in circuits used for the control of electrical machines, and in this section we shall show how the more important of these are converted into logic circuits.

Normally-open contacts in series

Where normally-open series connected contacts are used to complete a circuit, as shown in figure 13.1(a), they are replaced by an AND gate as shown in figure 13.1(b). This arrangement of contacts could occur in an installation in which switches A, B, and C must be closed before the circuit can be completed.

Normally-open contacts in parallel

Where we wish to start a motor by either of two switches, we connect the two in parallel as shown in figure 13.2(a). The electronic logic circuit which satisfies this arrangement is the 2-input OR gate of figure 13.2.

Normally-closed contacts in series

In some industrial applications it is necessary to include safety devices in the system, such as emergency stop push-buttons. These switches have normally-closed
contacts which are opened when the switch is operated. This has the effect of cutting off the circuit current. The relay circuit is shown in figure 13.3(a), its logical equivalent being an AND gate with negated (NOT) inputs, as shown in figure 13.3(b).

A complete circuit

Suppose that we are required to convert the relay circuit in figure 13.4(a) into an electronic logic network. Inspecting the circuit, we see that signals A, B, and C can be replaced by the logic network (b)