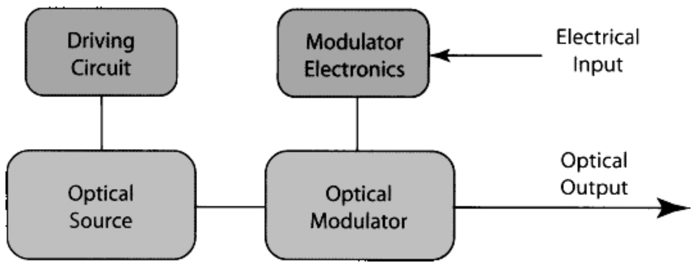

Figure 1.13: Components of an optical transmitter.

Appendix A)

$$\text{power (dBm)} = 10\log_{10}\left(\frac{\text{power}}{1\text{ mW}}\right). \tag{1.4.1}$$

Thus, 1 mW is 0 dBm, but 1 μW corresponds to -30 dBm. The launched power is rather low (< -10 dBm) for light-emitting diodes but semiconductor lasers can launch powers ~ 10 dBm. As light-emitting diodes are also limited in their modulation capabilities, most lightwave systems use semiconductor lasers as optical sources. The bit rate of optical transmitters is often limited by electronics rather than by the semiconductor laser itself. With proper design, optical transmitters can be made to operate at a bit rate of up to 40 Gb/s. Chapter 3 is devoted to a complete description of optical transmitters.

1.4.3 Optical Receivers

An *optical receiver* converts the optical signal received at the output end of the optical fiber back into the original electrical signal. Figure 1.14 shows the block diagram of an optical receiver. It consists of a coupler, a photodetector, and a demodulator. The coupler focuses the received optical signal onto the photodetector. Semiconductor photodiodes are used as photodetectors because of their compatibility with the whole system; they are discussed in Chapter 4. The design of the demodulator depends on the modulation format used by the lightwave system. The use of FSK and PSK formats generally requires heterodyne or homodyne demodulation techniques discussed in Chapter 10. Most lightwave systems employ a scheme referred to as "intensity modulation with direct detection" (IM/DD). Demodulation in this case is done by a decision circuit that identifies bits as 1 or 0, depending on the amplitude of the electric signal. The accuracy of the decision circuit depends on the SNR of the electrical signal generated at the photodetector.

The performance of a digital lightwave system is characterized through the *bit-error rate* (BER). Although the BER can be defined as the number of errors made per second, such a definition makes the BER bit-rate dependent. It is customary to define the BER as the average probability of incorrect bit identification. Therefore, a BER of 10^{-6} corresponds to on average one error per million bits. Most lightwave systems specify a BER of 10^{-9} as the operating requirement; some even require a BER as small