Practice problems:

1. A 10 W signal is passed through 4 amplifiers with gains of 2 dB, 1.5 dB, 3 dB, and 2.5 dB respectively in sequence. What is the value (in Watts) of the signal received at the end of the last amplifier?
2. Consider a channel of bandwith 10 MHz. The Signal-to-noise ratio used for transmission is 10 dB. What is the maximum data rate supported by the channel? How many signal levels do you need to support this data rate?
3. You need to transmit a signal over a distance of 100 km. The media used has an attenuation of 0.3 dB/km. If you send a 100W signal, what would be the received signal strength (in watts)? If you need a receive signal strength of at least 10W for proper reception at the receiver or at any repeater, what is the minimum number of repeaters you will need and what should be the gains of the repeaters to restore the signal to the original input level?
4. Consider a sender and receiver transmitting at 1 Mbps. If the receiver clock is 2% slower than the sender clock, what is the maximum number of bits that can be transmitted before resynchronization is needed if the receiver samples at (i) middle of bit, (ii) after ¼-th bit interval, (iii) after ¾-th bit interval? Assume that the clocks are perfectly synchronized at the beginning.
5. Consider that a sender and a receiver wishes to transfer data at 100 Mbps. What will be the minimum bandwidth (in Mhz) needed if we use (i) NRZ-L, (ii) Differential Manchester encoding?
6. Consider a bit stream 0100100101011100. Show the encoding of the bit stream using each of the encoding methods (NRZ-L), (ii) NRZ-I, (iii) Bipola-AMI, (iv) Manchester, (v) Differential Manchester.
7. Suppose that you wish to transmit the frame with the data 1011100000001011. We wish to do error detection with CRC, with the generator pattern 1001. What would be the FCS? Show all calculations.
8. Repeat Pr. 7 by using checksum instead of CRC for error detection.
9. Consider a link of length 100 Km, with propagation speed of 2×10^9 m/sec. A ttransmission over the link uses a 10 Mbps transmitter, a data frame size of 64 bytes, and an ACK frame size of 8 bytes. What is the line efficiency achieved if we use the stop-and-wait protocol for flow control? If the data rate 1000 Mbps, what should be the frame size to achieve a line efficiency of at least 20%?
10. Consider that you have to send a 200 KB file using either (i) asynchronous transmission using 1 start, 1 stop, and 1 parity bit, and (ii) synchronous transmission with a 1 byte preamble, 16 byte header, no postamble or trailer, and a maximum frame size of 1400 bytes. Calculate the overhead percentage in each case. Note that frame size typically includes the header but not the preamble.