Solutions to Mid-Term Exam

Question 1

(a) The battery voltage would appear across the line when phone is on-hook. This voltage is nominally 48 VDC although it can vary. The voltage drops when the subscriber goes off-hook.

(b) When the phone goes off-hook the CO responds by supplying dial tone when it is ready to receive the number to call. The small AC signal is thus dial tone: 350 Hz plus 440 Hz at a level of about -9 dBm.

(c) The subscriber can dial using either DTMF tones or pulse dialing. The pulses were the subscriber sending the called number using pulse dialing.

(d) The subscriber was using pulse dialing (the CO was using call progress tones).

Question 2

Based on the assumptions in this question the signal level received at the ONT is the transmit level minus the cable loss minus the splitter loss:

$$P_{\text{ONT}} = P_{\text{transmit}} - L_{\text{cable}} - L_{\text{splitter}}$$

Thus the required transmit level is:

$$P_{\text{transmit}} = P_{\text{ONT}} + L_{\text{cable}} + L_{\text{splitter}}$$

There were various versions of this question with different numerical values.

The cable loss is equal to the attenuation per unit length multiplied by the length. At a loss of 0.3 dB/km, a 20 km distance would produce a loss of 6dB and a 30 km distance a loss of 9 dB.

The splitter loss is the splitting ratio, $\frac{1}{N}$. A splitting ratio of $\frac{1}{N}$ gives a gain (loss) of $10\log_{10}(\frac{1}{N})$ which is 15 dB for a 1:32 ratio and 18 dB for a 1:64 ratio.

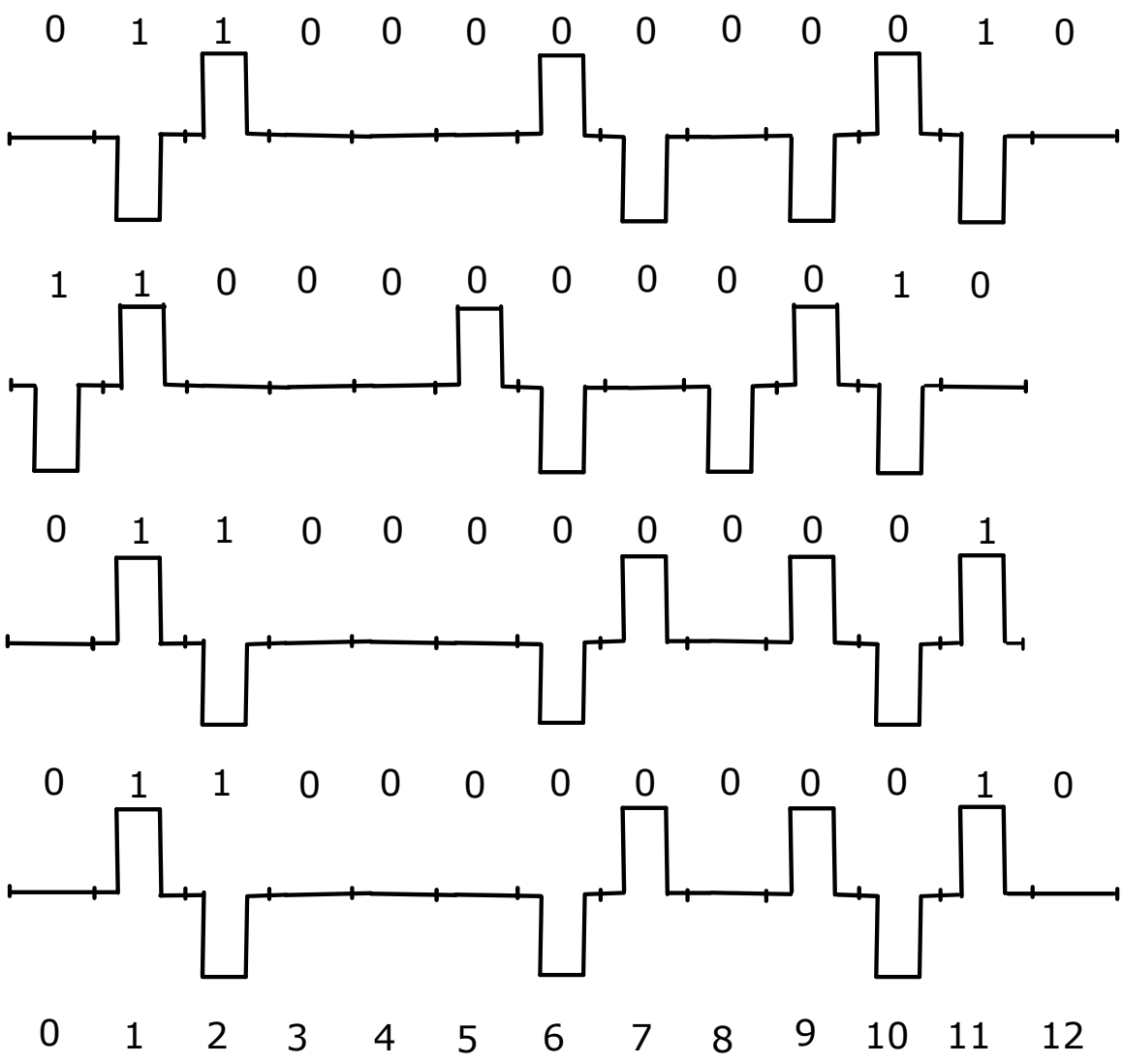
The possible answers were:

$$-20 + 9 + 15 = 4$$
$$-20 + 9 + 18 = 7$$
$$-23 + 6 + 15 = -2$$
$$-23 + 6 + 18 = 1$$

for possible required transmit powers of 4, 7, -2 and 1 dBm.

Question 3

There were four versions of the waveform as shown below. All included one B8ZS zero-substitution sequence preceeded by 011 or 11 and followed one 10 or 1. A total of either 12 or 13 bits were transmitted. In each case there were two line coding violations - one indicates the insertion of the B8ZS sequence and one violation within the sequence balances the pulse polarities. The sequence of bits for each sequence is shown below.


0 1 1 0 0 0 0 0 0 0 0 1 0
1 1 0 0 0 0 0 0 0 0 1 0
0 1 1 0 0 0 0 0 0 0 0 1
0 1 1 0 0 0 0 0 0 0 0 1 0
0 1 2 3 4 5 6 7 8 9 10 11 12