Solutions to Midterm Exam

Question 1

(a) The Unicode codepoints were U+0A90 and U+0A91. In binary these are 0000 1010 1001 0000 and 0000 1010 1001 0000.

(b) According to the table (Table 3-6) in the Unicode standard (see Lecture 1), the UTF-8 encoding for these values requires 3 bytes.

(c) What are the values of those bytes in hexadecimal?

The bit allocations are:

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z=0000
y=1010 10
x=01 0000 or x=01 0001
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so the three bytes are: 1110 0000, 10 101010, and 10 010000 (or 10 010001) which are 0xe0, 0xaa, and 0x90 (or 0x91) in hex.

Question 2

The character { has an ASCII code 0x7b (binary 0111 1011) and was to be transmitted at 38.4 kb/s with 8 bits, even parity.

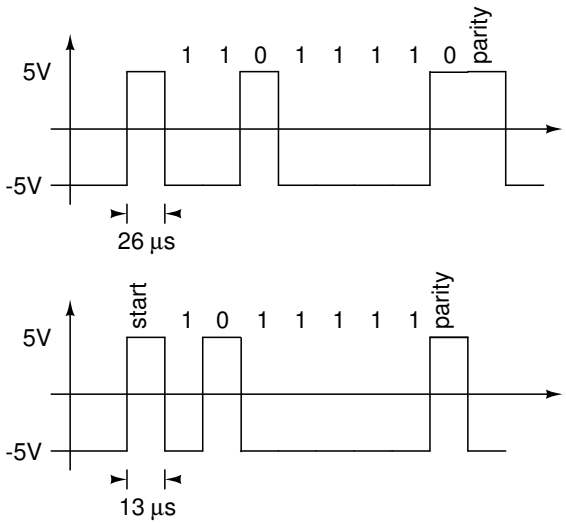
The character } has an ASCII code 0x7d (binary 0111 1101) and was to be transmitted at 76.8 kb/s with 7 bits, even parity.

On an asynchronous serial interface ("RS-232") the bits are sent in order from LS to MS bit and a 1 is represented as a low voltage level.

For even parity the number of ones must be even. For both characters the number of 1's is 6 which is already an even number so a zero parity bit is used to keep the number of one's an even number.

The bit duration (period) is the inverse of the bit rate (frequency). For a bit rate of 38.4 kb/s the period is $\frac{1}{38400} = 26\ \mu$s. For a bit rate of 76.8 kb/s the period is $\frac{1}{76800} = 13\ \mu$s.

The waveform would look as follows:



Question 3

(a) The velocity of propagation in a cable is given by:

$$v = \frac{1}{\sqrt{LC}}$$

which for this cable with L=67 pF and C=0.43 μH gives $v = 1.86 \times 10^8 \times 1$ m/s (the factor 1 is for the cable length, 1 m).

This is equal to the velocity factor multiplied by the velocity of light, $c = 3 \times 10^8$ m/s:

$$c \times VF = \frac{c}{\sqrt{\varepsilon_r}} = v = 1.86 \times 10^8$$

We can solve for $\varepsilon_r = \left(\frac{3\times10^8}{1.86\times10^8}\right)^2 = 2.6$.

(b) From the diameters of the inner and outer conductor diameters and ε_r we can compute the characteristic impedance:

$$Z_0 \approx \frac{60}{\sqrt{2.6}} \ln\left(\frac{5}{3.5}\right) = 13.3\Omega$$

Question 4

(a) The normalized error threshold level is $t = \frac{v-\mu}{\sigma} = \frac{50-0}{25} = 2$.

(b) The error rate, P_e is the probability that the signal exceeds the normalized threshold. This is 1 minus the probability that the signal is less than the threshold which can be found from the Normal distribution curve on page 7 of the notes for Lecture 4 or using a calculator as 0.98. So the probability of error, is about 2%.