Solutions to Mid-Term Exam

Question 1

(a) The answer depends on your name. However, the code points of ASCII characters fall in the range 0x00 to 0x7f and so the UTF-8 encoding consists of the ASCII value.

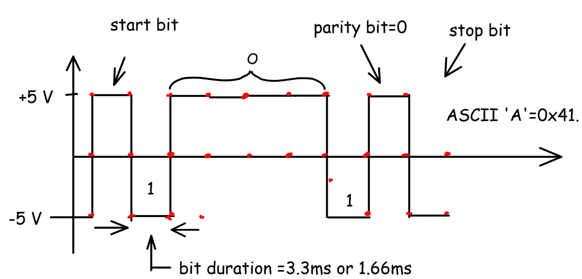
For example, if the letter is 'A', the code point and ASCII values are 0x41. In binary this is 0100 0001.

(b) The waveform should begin with a high (+5V) start bit, followed by seven data bits in order from LS to MS bit with a '0' bit having a high (+5V) level and a '1' bit a low (-5V) level. The data bits are followed by a parity bit and a low (-5V) stop bit.

For even parity the number of 1's (including the data bits and the parity) needs to be an even number. The bit duration will be either $\frac{1}{300} = 3.33$ ms or $\frac{1}{600} = 1.67$ ms.

For example, for the letter 'A' the data bits in LS-to-MS bit order are 1000 001 and since the number of 1's is already an even number (2), the parity bit should be set to zero.

The waveform would be:



Question 2

(a) The question asks for the probability that Gaussian-distributed noise voltage (x) with a given RMS voltage (standard deviation) σ and zero mean $\mu = 0$ exceeds a voltage of $v = 3$ V.

There were two versions of this question ($\sigma = 1.2$ and $\sigma = 1.8$). We first compute the normalized threshold t:

$$t = \frac{v - \mu}{\sigma} = \frac{3 - 0}{1.2} = 2.5 \text{ or } \frac{3 - 0}{1.8} = 1.67$$

Then use either the approximation formula, a calculator or the graph from Lecture 3 to compute the probability that the voltage is less than 3, $P(x < 3) = P(t)$. The results are $P(2.5) = 0.99379$ or $P(1.67) = 0.95221$.

But the probability of error is the probability that $x > 3$ which is one minus the above, or $1 - P(2.5) = 0.00621 = 6.21 \times 10^{-3}$ or $1 - P(1.67) = 0.04779 = 4.78 \times 10^{-2}$.

(b) The expected number of errors would be the error probability times the number of bits. There were two possible values for the number of bits (10^6 and 10^5) so the answers could have been approximately 621, 6210, 4779, or 47790.

Question 3

The attenuation of the cable is the length of the cable (in unit lengths) times the attenuation per unit length (in this case the unit length is 100m). There were two sets of numbers (50m at 6dB/100m and 100m at 3dB/100m) both of which give a loss of of 3 dB. This is a power ratio of $10^{-3/10} = 0.5$. Thus the output power is 6dBm - 3dB = 3dBm. In linear units this is $10^{3/10} = 0.5$ mW or 5×10^{-4} W.

To find the voltage we use $V_{rms} = \sqrt{P \times R} = \sqrt{5 \times 10^{-4} \times 50} = 316$ mV.