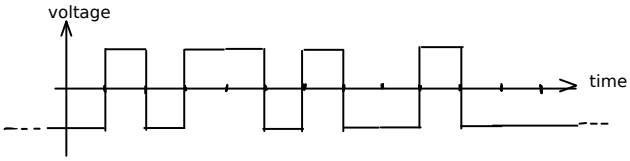
Solutions to Mid-Term Exam

Question 1

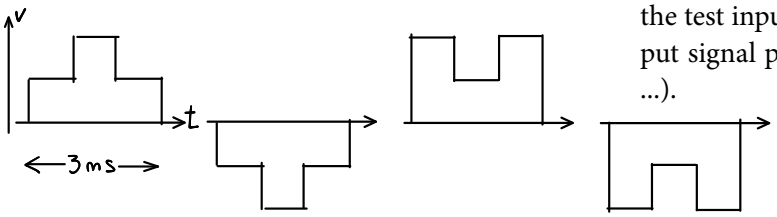


(a) There are 8 bits (a byte is 8 bits). There is a high start bit followed by some high bits that are read as '0' and some low bits that are '1's. The order is LS to MS. The result is binary 0110 1001 or hex 0x69:

(b) The two bit durations following the last data bit are both low. This could mean either a '1' parity bit was transmitted (meaning odd parity) or it could be the stop bit. So the correct answer is "can't tell."

Question 2

A transmitter outputs one of the following four waveforms every 3 milliseconds:



There are four different symbols so each symbol defines $\log_2(4) = 2$ bits. Since the symbol duration is 3 ms, the bit rate is $2/3 \approx 0.666$ kb/s. There is one symbol per 3 ms so the symbol rate is ≈ 0.333 kbps. There are a maximum of three level transitions per symbol and the symbol duration is 3 ms so the baud rate is $3/3 = 1$ kHz.

Question 3

For line-of-sight propagation the Friis equation applies. From the values given in the question, $P_T = 50 \times 10^3$, $G_T = G_R = 2$, $d = 10 \times 10^3$ and $\lambda = c/f = 3 \times 10^8/100 \times 10^6 = 3$ m. The received power is:

$$P_R = P_T G_T G_R \left(\frac{\lambda}{4\pi d}\right)^2 \approx 114\,\mu W$$

Question 4

The mean of the distribution is given as 12 V and the standard deviation as 1 V. The warning light comes on when the voltage drops below the threshold $v = 10$ V. The normalized threshold $t = \frac{10-12}{1} = -2$. The probability that the voltage is below the threshold (i.e. the probability that the warning light is on) is $P(x < 10) = P(-2) \approx 2\%$ using either the logistic approximation, the graph in the lecture notes or a calculator.

Question 5

If the test signal is a single 1 kHz sine-wave then THD is being measured as IMD requires two sine waves as the test input. At the output we would expect the input signal plus its harmonics (2 kHz, 3 kHz, 4 kHz, ...).