<div align="center">**Exercise 1**</div>

1.1 Probability

For the modules of an electronic device, resistors of a certain resistance (Ω-value) are necessary. 10000 such resistors have been bought from three different manufacturers.
5000 pieces from manufacturer A_1 (1% of the resistors do not meet the specification),
3000 pieces from manufacturer A_2 (2% of the resistors do not meet the specification),
2000 pieces from manufacturer A_3 (5% of the resistors do not meet the specification).
How is the probability of event B that an arbitrarily picked resistor is out of specification?

1.2 Probability

Let a radio transmission chain:
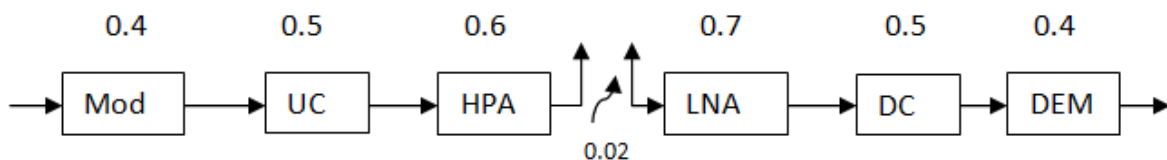
The following probabilities for the components breakdown within a time interval T are given:

Modulator (Mod) breakdown, event A_1: P (A_1) = 0.4
Up-Converter (UC) breakdown, event A_2: P (A_2) = 0.5
Power amplifier (HPA) breakdown, event A_3: P (A_3) = 0.6
Transmission media break down, event A_4: P (A_4) = 0.02
Low noise amplifier (LNA) breakdown, event A_5: P (A_5) = 0.7
Down converter (DC) break down, event A_6: P (A_6) = 0.5
Demodulator (DEM) breakdown, event A_7: P (A_7) = 0.4

What is the probability that no interrupt occurs within a time interval T?

1.2 Probability density function (pdf) and cumulative distribution function (cdf)

Let the probability density function (pdf) of a random variable x (ζ):

$$f_x(x) = \begin{cases} \dfrac{k}{8} e^{-\frac{x}{k+2}} & x \geq 0 \\ 0 & otherwise \end{cases}$$

a) Calculate the constant k.

b) Calculate the mean and the variance (m_x, σ_x^2) of the random variable x (ζ).

c) Calculate the probability $P(\{-1 \leq x(\zeta) < 2\})$.

1.3 Matlab: Sine function and rectangle function

a) Create a sine signal named "sine1" within the timeframe 0 seconds until 5 seconds. The frequency of the sine signal shall be 4 Hz, the amplitude is 3. The sampling frequency is 30 Hz (i.e. 30 samples per second). Plot the signal.

b) Let a rectangle signal x (t):

$$x(t) = \begin{cases} 3 & for -1 \leq t \leq 2 \\ 0 & otherwise \end{cases}$$

Plot x(t) in the range of -3 $\leq t \leq$ 4 .