AV343 - Labsheet

In this labsheet you will use Matlab to demodulate a real world dataset containing a BASK signal transmission with data frames. Details of this transmission is as follows.

Frame format:
For the dataset given to you, each frame consists of 40 data bits, preceded by a 13 bit Barker sequence, preceded by 20 bits of alternating 1s and 0s. The 40 data bits are obtained by the 8 bit ASCII coding of 5 characters (say for example "HELLO", quotations not part of the data being transmitted). Note that each character is converted to the ASCII code and the bits are transmitted with the MSB first and then proceeding to the LSB. So for the evaluation dataset the first 20+13+40 bits of each frame looks like (with the example characters being HELLO)
1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,1,1,1,1,0,0,1,1,0,1,0,1,0,1,0,0,1,0,0,1,0,0,0,0,1,0,0,0,1,0,1,0,1,0, 0,1,1,0,0,0,1,0,0,1,1,0,0,0,1,0,0,1,1,1,1

Signalling format:
BASK or on-off keying with a bit rate of approximately 1 kbits/sec. The center frequency used for BASK modulation is approximately 433.9 MHz.

Dataset:
The BASK transmission is received using an RTL-SDR. The RTL-SDR is used to produce a sequence of I-Q samples. The I and Q samples are obtained from an RTL-SDR operating at a center frequency of 433.9 MHz with a sampling rate of 2.048 MHz. This means that the I and Q samples are obtained from a passband of one sided bandwidth of 2.048 MHz centered at 433.9 MHz. The I and Q samples are given to you (see below) in the form of a ".mat" file containing a matrix with the first column containing the I samples and the second column the Q samples. Each row corresponds to a particular sample.

For additional credit you can also receive the data from a provided RTL-SDR and do this task.

Objectives:
The main objective is to decode at least one frame and show the decoded characters as output. You should also draw the block diagram of the system that you are going to implement. The complete specification of each block should also be given - what inputs and outputs are, its format, and what the input-output relationship is.

Appendix - Using RTL-SDR with Matlab
The objective of this section is to familiarize yourself with the use of RTL-SDR (or other SDR hardware as available) in Matlab.
- Setting up RTL-SDR in Matlab:
    - Click on Addons in the toolstrip,
    - Select Hardware support packages,
    - Select Communication System Toolbox support for RTL-SDR
    - sdrinfo - check whether the installation is correct
- Using RTL-SDR to collect I-Q samples

- ◦ This follows the documentation at
  - https://in.mathworks.com/help/supportpkg/rtlsdrradio/ug/comm.sdrrtlreceiver-system-object.html
  - https://www.instructables.com/rtl-sdr-on-Ubuntu/
- Another option is to use rtlsdr commandline tools for data capture