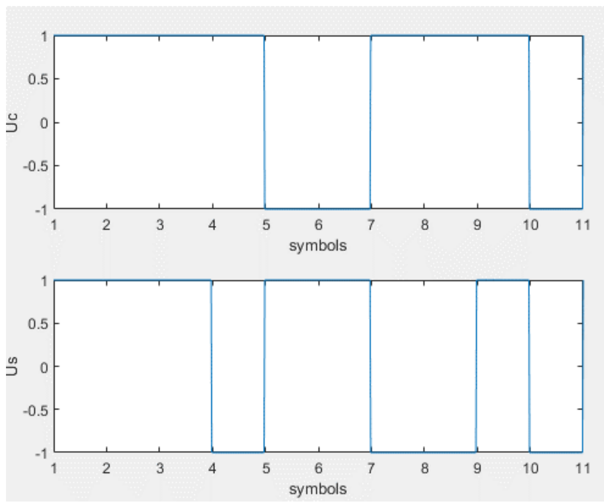
Communication Theory

Assignment-1

Simulation Questions:

a. In this question we have been asked to plot $U_c(t)$ and $U_s(t)$ over 10 symbols. We have the plot as shown below:



We obtain $U_c(t)$ and $U_s(t)$ by multiplying p(t-n),which are shifted rectangular pulses, with $b_c[n]$ and $b_s[n]$ which are +1 and -1 generated randomly.

We have the parameters,

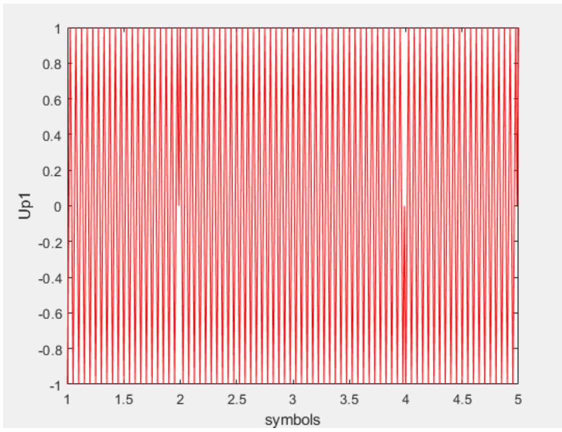
N = 10

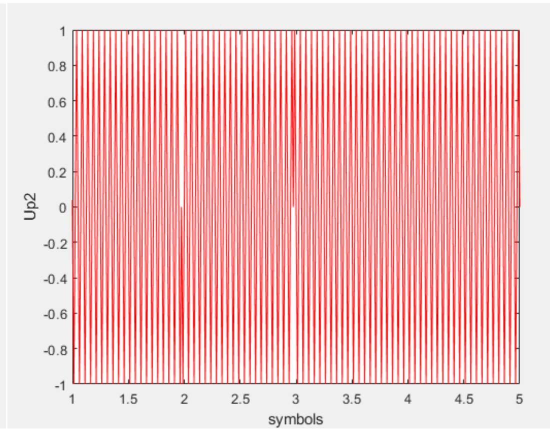
F_s = 80

In the plot it starts from 1 because we have our n starting from 1.

b. The plot for the up conversion of $U_c(t)$ and $U_s(t)$ are given in (c) part.

c. In this part we plotted $U_{p1}(t)$ by multiplying $U_c(t)$ with cos(40*pi*t) . We get the plot as shown below. Here the parameters are, N = 4 F_s = 240 which is a multiple of carrier frequency(20) and is plotted for 4 symbols.



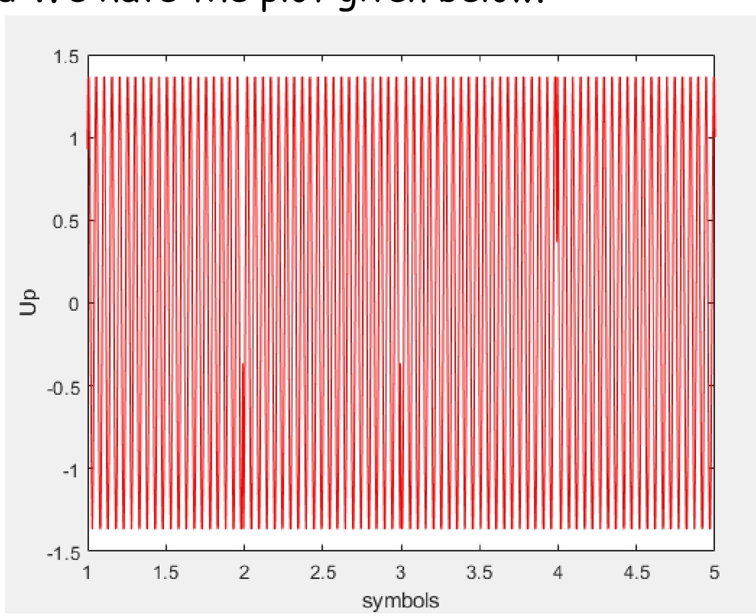


for reference

We have plotted $U_{p2}(t)$ which is given by multiplying $U_s(t)$ with sin(40*pi*t).

In the above plots we get small gaps in between , which represents the change in the value of the symbol, and this is known as BPSK(Binary Phase Shift Key).

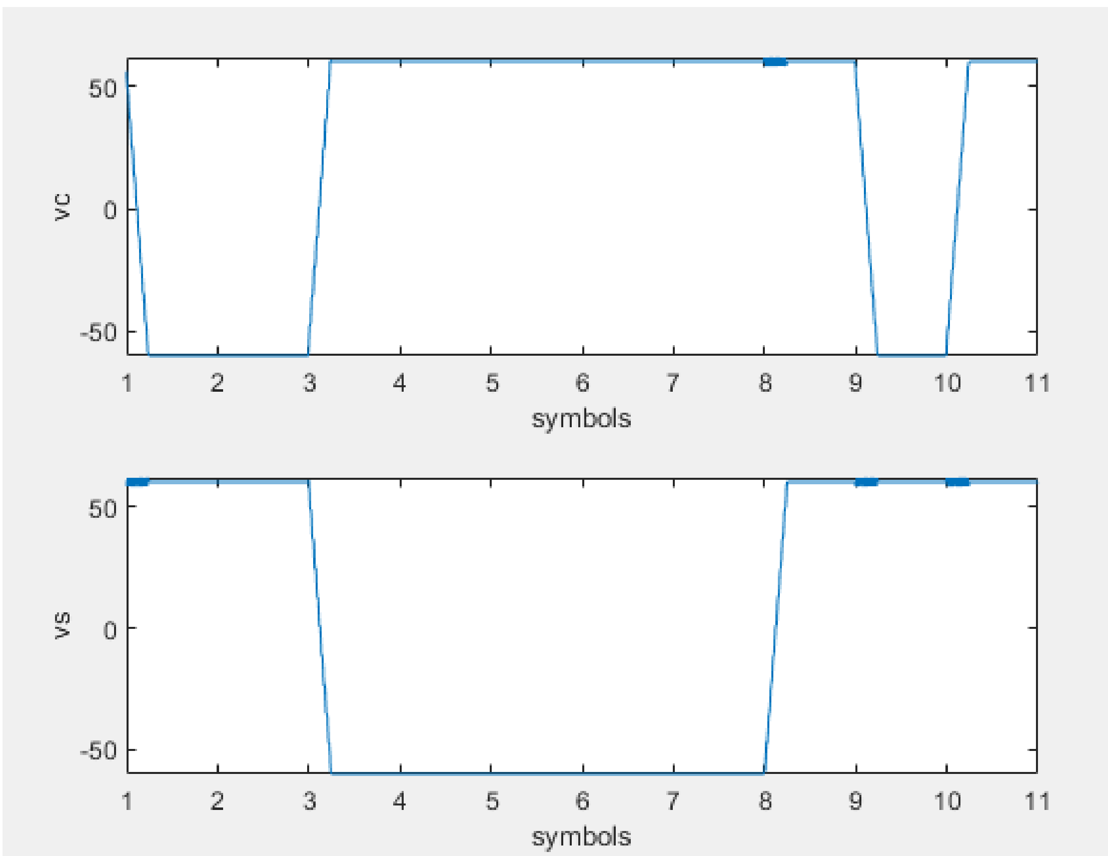
d. Now we must subtract $U_{p1}(t)$ and $U_{p2}(t)$ to get $U_p(t)$ and plot it for 4 symbols. This is known as up conversion or converting baseband to passband We have the plot given below.



In this plot also we have small gaps in between which denotes that this is QPSK(Quaternary Phase Shift Key).
We have the parameters,
$N = 4$, $F_s = 240$.

e. Now we do the down conversion part where we multiply $U_p(t)$ with 2*cos(40*pi*t + phi) and -2*sin(40*pi*t + phi) where phi is the phase difference between the receiver and the transmitter, and then we pass both the obtained signals through a low pass filter to obtain $V_c(t)$ and $V_s(t)$ respectively. In this case we have phi = 0.

The plot is shown below.



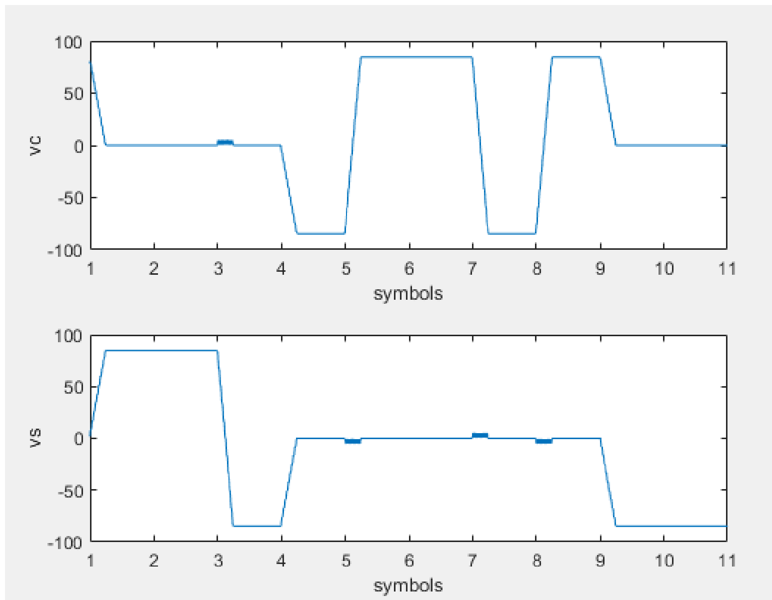
We have the parameters,

$N = 10$, $F_s = 240$.

They look like scaled versions of $U_c(t)$ and $U_s(t)$ with less aberrations.

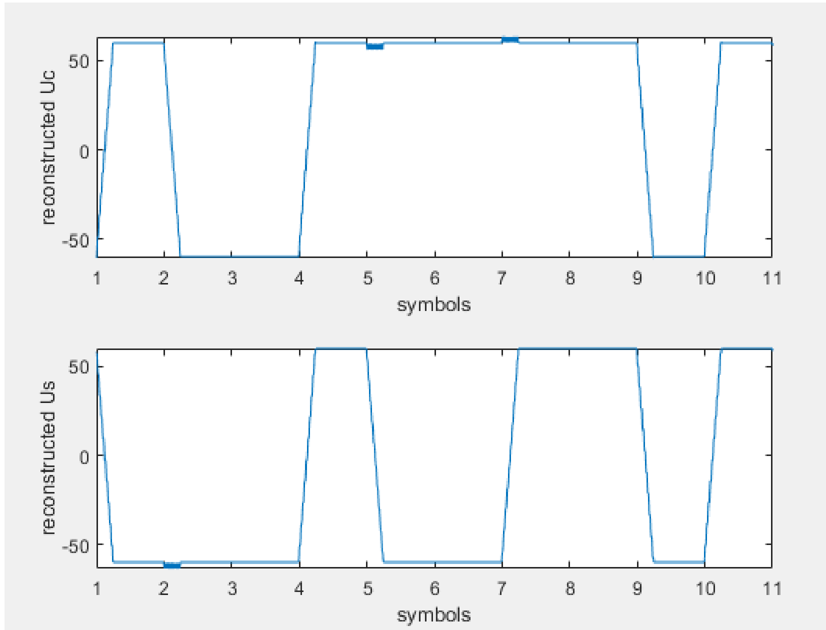
We can easily read off $b_c[n]$ and $b_s[n]$ by eyeballing.

f. We do the same thing as done in (e) but with phi = pi/4.
   The plot is shown below.



   This graph is also like scaled version of $U_c(t)$ and $U_s(t)$.
   It is quite difficult to read off $b_c[n]$ and $b_s[n]$ by eyeballing because of the shift.

g. In this we take the initial $U_c(t)$ and $U_s(t)$ and up convert them with cos(40*pi*t + pi/4) and sin(40*pi*t + pi/4) and then the resulting passband signal is down converted with 2*cos(40*pi*t - pi/4) and -2*sin(40*pi*t - pi/4) and pass the resulting signals through a low pass filter then we get amplified versions of $U_c(t)$ and $U_s(t)$. The plots are given below.



These graphs are scaled versions of $U_c(t)$ and $U_s(t)$.

Yes, we can easily read off $b_c[n]$ and $b_s[n]$ by eyeballing.