EE 421: Communications I
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Assignment 1: DSB-SC Modulation and Demodulation
Do **NOT** submit this assignment. It will be included in the Test material.

Q1. Using MATLAB, create a time axis between [0, 0.1] seconds with a sampling interval of $\Delta t = 1\times10^{-5}$ seconds, as follows: `t = 0 : 1/1e5 : 0.1;` Now sketch the following signals in time domain:

Modulating signal (low-frequency sinusoidal): `m_t = cos(2*pi*25*t);`

Carrier signal (high-frequency sinusoidal): `c_t = cos(2*pi*210*t);`

DSB-SC Modulated signal: `phi_t = m_t .* c_t;`

Q2. Identify the 180 degrees phase shifts in the modulated signals. Why do we get such phase shifts?

Q3. Now change the message signal to `m_t = sawtooth(2*pi*25*t),` or a repeated half-triangular pulse train: `d = 0 : 1/50 : 0.1; m_t = pulstran(t,d,'tripuls',0.01,-1) - 0.5;`. Plot the *modulating*, *carrier* and *modulated* signals again. Did you notice the abrupt changes in phase?

Q4. Using MATLAB, sketch the following signals in time domain in the interval [0, 0.1] seconds:

DSB-SC Modulated signal: `phi_t = m_t .* c_t;`

After multiplication at the receiver: `x_t = phi_t .* c_t;`

Recovered signal: The above signal $x(t)$ passed through a LPF. This can be done in MATLAB as follows[1]:

```
y_t = filtfilt([1 2 1],[1 -1.99688998444418 0.996894813039884], ...
                x_t)*1.20714892591976e-12;
```

For the above digital filter to work correctly, you need to make sure you use a sampling frequency of 100 kHz. In other words, successive samples of your signals should be 1×10^{-5} seconds apart.

Q5. What does the recovered signal look like?

[1] The filter used here is a second-order digital LPF with cutoff frequency = 30 Hz.