EE 421: Communications I
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Assignment 5: FM and PM Modulation and Demodulation
Do **NOT** submit this assignment. It will be included in the Test material.

Q1. Assume that the baseband message signal $m(t) = \alpha\cos(\omega_m t) = 2\cos(2\pi \times 25 \times t)$, and the unmodulated carrier is $c(t) = \cos(2\pi \times 210 \times t)$. Use MATLAB to sketch the FM modulated signal in time domain in the interval [0, 0.1] seconds. Use the MATLAB function `fmmod()`, and sketch $\phi_{FM}(t)$ for two cases (modulation indices):

(a) $\beta = 2$, (b) $\beta = 5$.

Q2. Repeat the above problem for a square wave signal using the following MATLAB function:

```
t = 0 : 1/1e5 : 0.1;  % 100 kHz sample freq for 0.1 sec
d = 0 : 1/50 : 0.1;   % 50 Hz repetition freq
m_t = 4*(pulstran(t,d,'rectpuls',0.05)-2);
```

and a sawtooth signal using the following MATLAB function:

```
t = 0 : 1/1e5 : 0.1;  % 100 kHz sample freq for 0.1 sec
d = 0 : 1/50 : 0.1;   % 50 Hz repetition freq
m_t = 4*pulstran(t,d,'tripuls',0.01,-1);
```

Q3. On the MATLAB command prompt, enter the following command:

```
>> type fmmod
```

This will display the contents of the `fmmod()` function. Now scroll down to read the lines:

```
int_x = cumsum(x)/Fs;
y = cos(2*pi*Fc*t + 2*pi*freqdev*int_x + ini_phase);
```

Can you tell what is MATLAB doing in the `fmmod()` function?

Q4. Again for a baseband message signal $m(t) = \alpha\cos(\omega_m t) = 2\cos(2\pi \times 25 \times t)$, and an unmodulated carrier $c(t) = \cos(2\pi \times 210 \times t)$, use MATLAB to sketch the FM modulated signal in time domain in the interval [0, 0.1] seconds. Use the MATLAB function `pmmod()`, and sketch $\phi_{PM}(t)$ for two cases (modulation indices):

(a) $k_p = \pi/2$, (b) $k_p = \pi/4$.

Q5. Repeat the above problem for a square wave signal (using the MATLAB function `m_t = 4*(pulstran(t,d,'rectpuls',0.05)-2)`).

Note: In the above use a sampling frequency of 10^5 Hz.