**Programming Assignment 3**

**Submission Deadline: March 06, 2020 11:59 PM**

**Instructions:**

- **i) Submit on Canvas before deadline.**
- **ii) Make sure you turn in your codes (.m files) as well as all other problem specific requirements such as figures, results, explanations, and screenshots.**
- **iii) Make suitable comments in the code to explain your code.**
- **iv) Your figures must be appropriately labelled.**
- **v) You'll lose points if you don't follow these requirements.**

1. Using MATLAB
   a) Generate a continuous time periodic signal $x(t)$ of fundamental period 0.06 defined over a period as

$$x(t) = \begin{cases} 0, 0 \leq t < 0.03 \\ 1, 0.03 \leq t < 0.06 \end{cases}$$

   This is our message signal. Plot it over the range $0 \leq t < 0.12$

   b) Generate a continuous time sinusoid $c(t)$ defined as

$$c(t) = \cos(400\pi t)$$

   This is our carrier signal. Plot it over the range $0 \leq t < 0.12$.

   c) Plot the DSB-SC signal over the range $0 \leq t < 0.12$.

   d) Plot the DSB-TC signal over the range $0 \leq t < 0.12$. Use $m = 0.9$,K=2.

   e) Plot the PM signal over the range $0 \leq t < 0.12$. Use $k_p = 10\ radians/Volt$.

   f) Plot the FM signal over the range $0 \leq t < 0.12$. Use $k_f = 100\ Hz/Volt$.

   Try plotting them on one figure using subplot so you can see the modulation process clearly. Submit your code file as well as the plots.

   **HINT: When you plot FM signal, do not attempt to integrate in the code. It is possible, but complicated. Instead calculate instantaneous frequency and use it in the FM signal.** (5+5+5+5+5+5=30 points)

2. Using MATLAB
   a) Generate a continuous time periodic signal $x(t)$ of fundamental period 0.12 defined over a period as

$$x(t) = \begin{cases} 0, 0 \le t < 0.03 \\ 5, 0.03 \le t < 0.06 \\ 10, 0.03 \le t < 0.12 \end{cases}$$

   This is our message signal. Plot it over the range $0 \le t < 0.24$
   b) Generate a continuous time sinusoid $c(t)$ defined as

$$c(t) = \cos(400\pi t)$$

   This is our carrier signal. Plot it over the range $0 \le t < 0.24$.
   c) Plot the DSB-SC signal over the range $0 \le t < 0.24$.
   d) Plot the DSB-TC signal over the range $0 \le t < 0.24$. Use $m = 0.9$,K=2.
   e) Plot the PM signal over the range $0 \le t < 0.24$. Use $k_p = 10\ radians/Volt$.
   f) Plot the FM signal over the range $0 \le t < 0.24$. Use $k_f = 100\ Hz/Volt$.

   Try plotting them on one figure using subplot so you can see the modulation process clearly. Submit your code file as well as the plots.

   **HINT: When you plot FM signal, do not attempt to integrate in the code. It is possible, but complicated. Instead calculate instantaneous frequency and use it in the FM signal.** (5+5+5+5+5+5=30 points)

3. For a carrier signal $c(t) = \cos(600\pi t)$ being modulated by a message signal $x(t) = \cos(20\pi t) + \sin(40\pi t)$.
   Plot the following signal over the range $0 < t < 0.2$
   a) Message signal
   b) Carrier Signal
   c) DSB-SC
   d) DSB-TC. Use $m = 0.9$,K=2.
   e) FM. Use $k_f = 100Hz/Volt$
   f) PM. Use $k_p = 10\ radians/Volt$

Try plotting them on one figure using subplot so you can see the modulation process clearly. Submit your code file as well as the plots.

**HINT: When you plot FM signal, do not attempt to integrate in the code. It is possible, but complicated. Instead calculate instantaneous frequency and use it in the FM signal.** (5+5+5+5+5+5=30 points)

4. In a separate text document, compare figures from Problems 1 and 2 as follows:

a) 1 (c) with 2(c) and 3(c)
b) 1 (d) with 2(d) and 3(d)
c) 1 (e) with 2(e) and 3(e)
d) 1 (f) with 2(f) and 3(f)

Explain their similarity and differences by taking into account the message used to perform modulation. (2.5+2.5+2.5+2.5=10 points)