EES 351: In-Class Exercise # 19

Instructions

1. Work alone or in a group of no more than three students. **The group cannot be the same as any of your former groups after the midterm.**
2. Only one submission is needed for each group.
3. You have two choices for submission:
   (a) Online submission via Google Classroom
   - PDF only.
   - Only for those who can directly work on the posted files using devices with pen input.
   - Paper size should be the same as the posted file.
   - No scanned work, photos, or screen capture.
   - Your file name should start with the 10-digit student ID of one member. (You may add the IDs of other members, exercise #, or other information as well.)

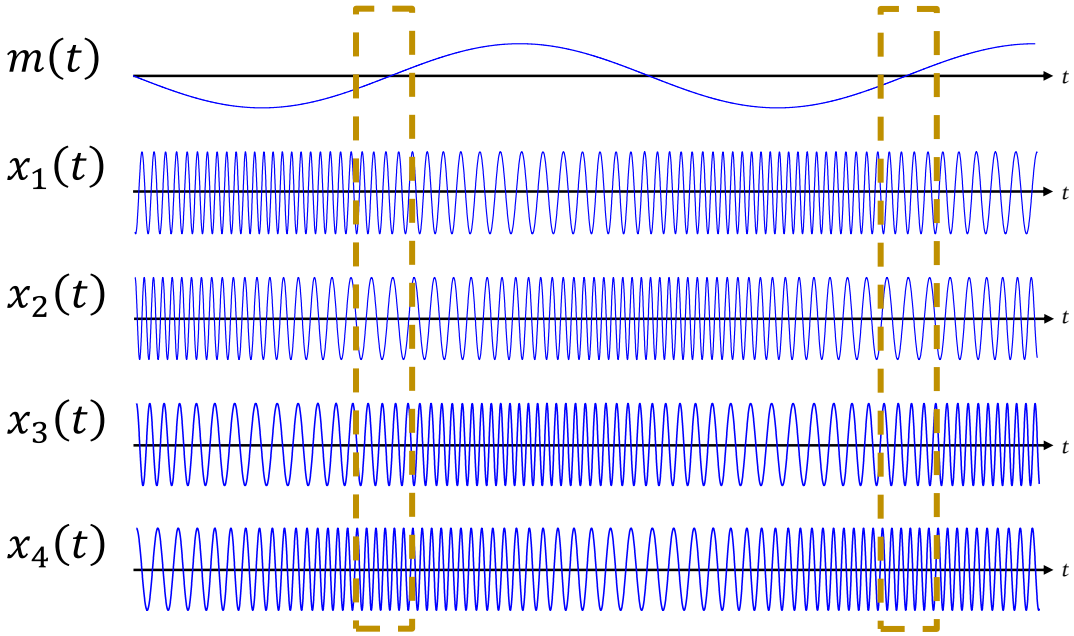
   (b) Hardcopy submission
4. **Do not panic.**

Date: 13 / 11 / 2020			
Name	ID (last 3 digits)		

1. Consider a signal $x(t) = 8\cos\left(2\pi t^3 - 18\pi t^2 + 84\pi t - \pi\right)$.
   Let $f(t)$ be its instantaneous frequency. Find $f(3)$.

$$\theta(t) = 2\pi t^3 - 18\pi t^2 + 84\pi t - \pi$$
$$\frac{d}{dt}\theta(t) = 2\pi(3t^2) - 18\pi(2t) + 84\pi = 6\pi t^2 - 36\pi t + 84\pi$$
$$f(t) = \frac{1}{2\pi}\frac{d}{dt}\theta(t) = 3t^2 - 18t + 42$$
$$f(3) = 3(3)^2 - 18(3) + 42 = 15.$$

2. [ENRPa] Consider five plots below. The top one is the baseband message signal $m(t)$ that is used in the modulation to create a PM signal. Identify which plot is $x_{\text{PM}}(t)$.



$x_{\text{PM}}(t)$: $x_4(t)$

The "frequency" of the PM signal should follow the value of $\frac{d}{dt}m(t)$.

For example, the time when $\frac{d}{dt}m(t)$ has highest value should correspond to the time when PM signal has the highest frequency.