ECS 332: In-Class Exercise # 16 - Sol

Instructions

1. Separate into groups of no more than three students each. **The group cannot be the same as any of your former groups after the midterm.**
2. ENRE (Explanation is not required for this exercise.)
3. **Do not panic.**

Date: 0 1 / 1 1 / 2019			
Name	ID (last 3 digits)		
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1. In QAM system, the transmitted signal is of the form

$$x_{\text{QAM}}(t) = m_1(t)\sqrt{2}\cos(2\pi f_c t) + m_2(t)\sqrt{2}\sin(2\pi f_c t).$$

Here, we want to express $x_{\text{QAM}}(t)$ in the form

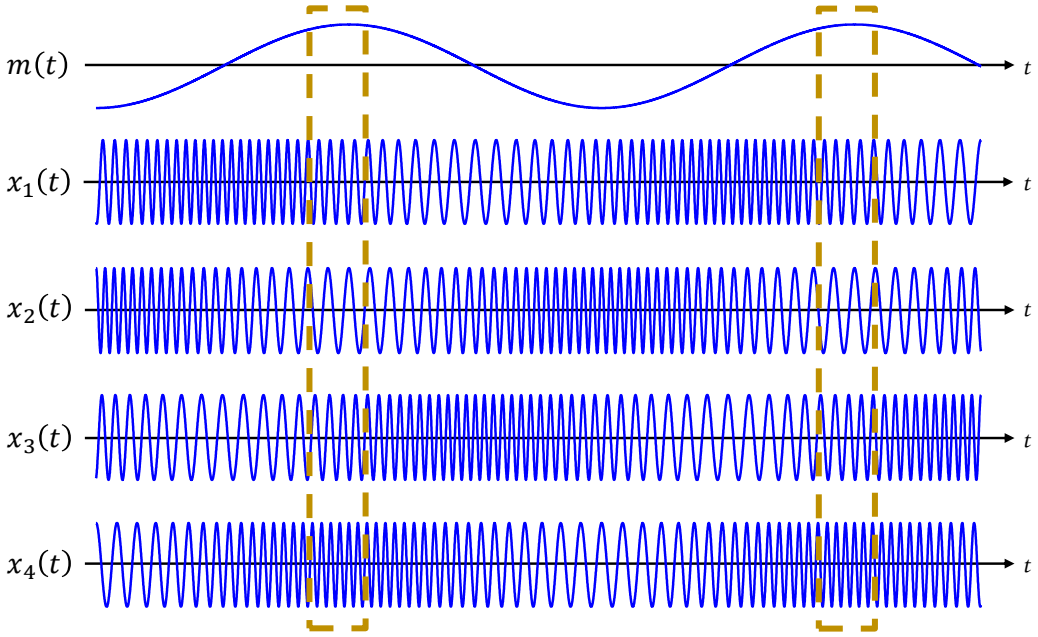
$$x_{\text{QAM}}(t) = \sqrt{2}E(t)\cos(2\pi f_c t + \phi(t)),$$

where $E(t) \geq 0$ and $\phi(t) \in (-180^\circ, 180^\circ]$.

This problem assumes the messages are piecewise constant. Their values during three time intervals are listed below. Find the values of $E(t)$ and $\phi(t)$ during the corresponding time intervals.

Intervals	$m_1(t)$	$m_2(t)$	$E(t)$	$\phi(t)$	$m_1 - jm_2$
$0 \leq t < 1$	-1	-1	$\sqrt{2}$	135°	$1 + j = \sqrt{2}\angle 135^\circ$
$1 \leq t < 2$	0	5	5	-90°	$-5j = 5\angle -90^\circ$
$2 \leq t < 3$	-3	4	5	-126.87°	$-3 - 4j \approx 5\angle -126.87^\circ$

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



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

The "frequency" of the FM signal should follow the value of $m(t)$.
For example, during the time when $m(t)$ has highest value should correspond to the time when FM signal has the highest frequency.