Principles of Communications
ECS 332

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7. Angle Modulation

Office Hours:
BKD 3601-7

Monday	**14:40-16:00**
Friday	**14:00-16:00**

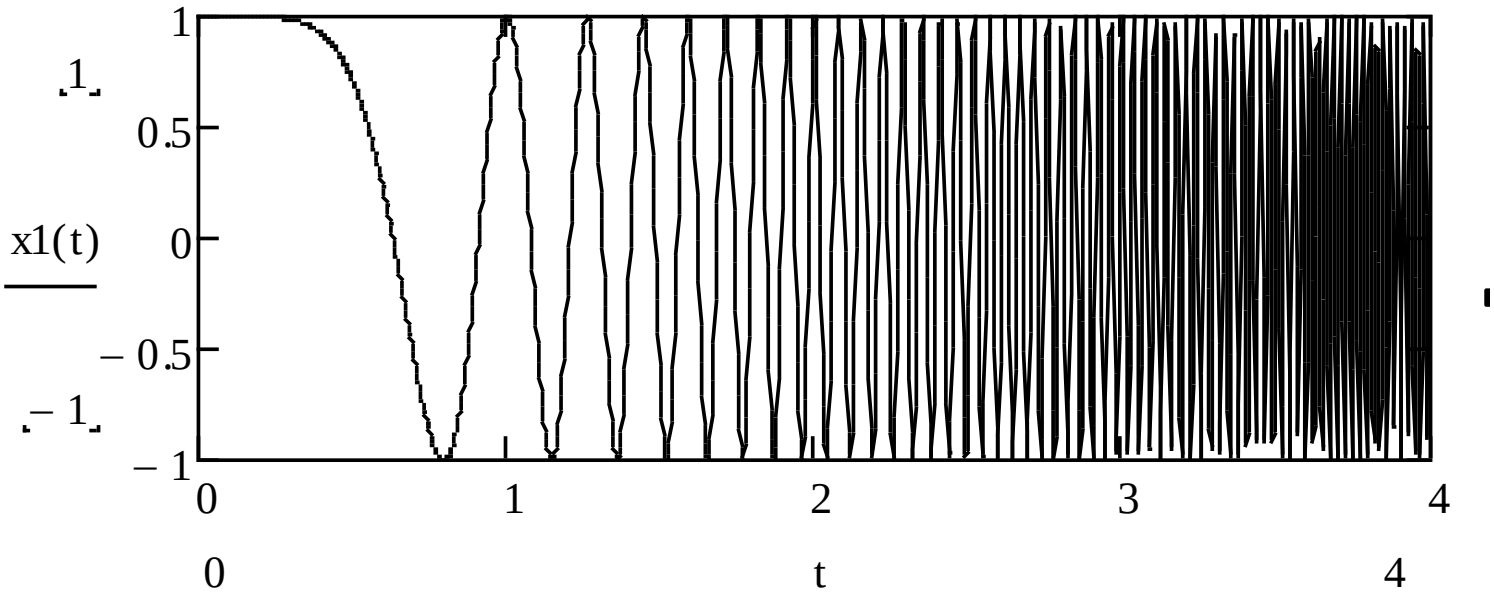
$f(t) = t^2$

Instantaneous Frquency

$\theta(t) = 2\pi t^3$

$$x_1(t) = \cos\left(2\pi t^2 t\right)$$

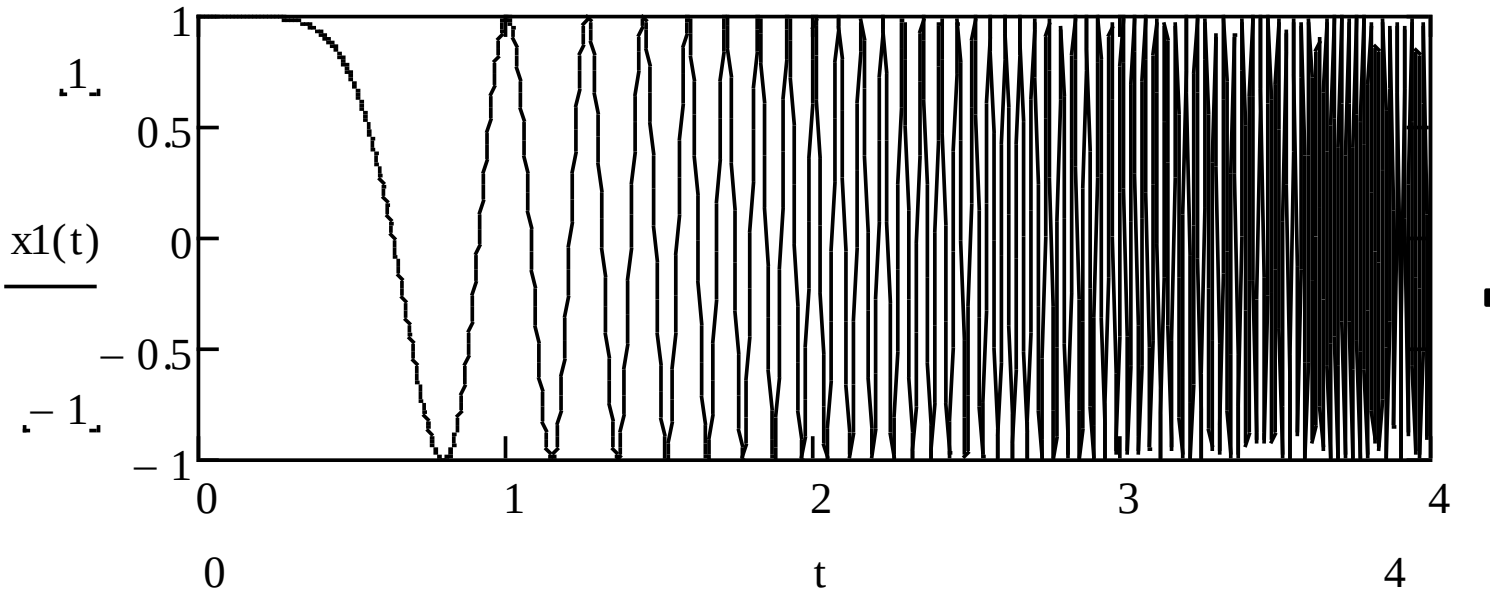
$f(t) = \frac{2\pi}{2\pi} 3t^2 = 3t^2$



At t = 2, frequency = ?

Instantaneous Frquency

$$x_1(t) = \cos\left(2\pi t^2 t\right)$$

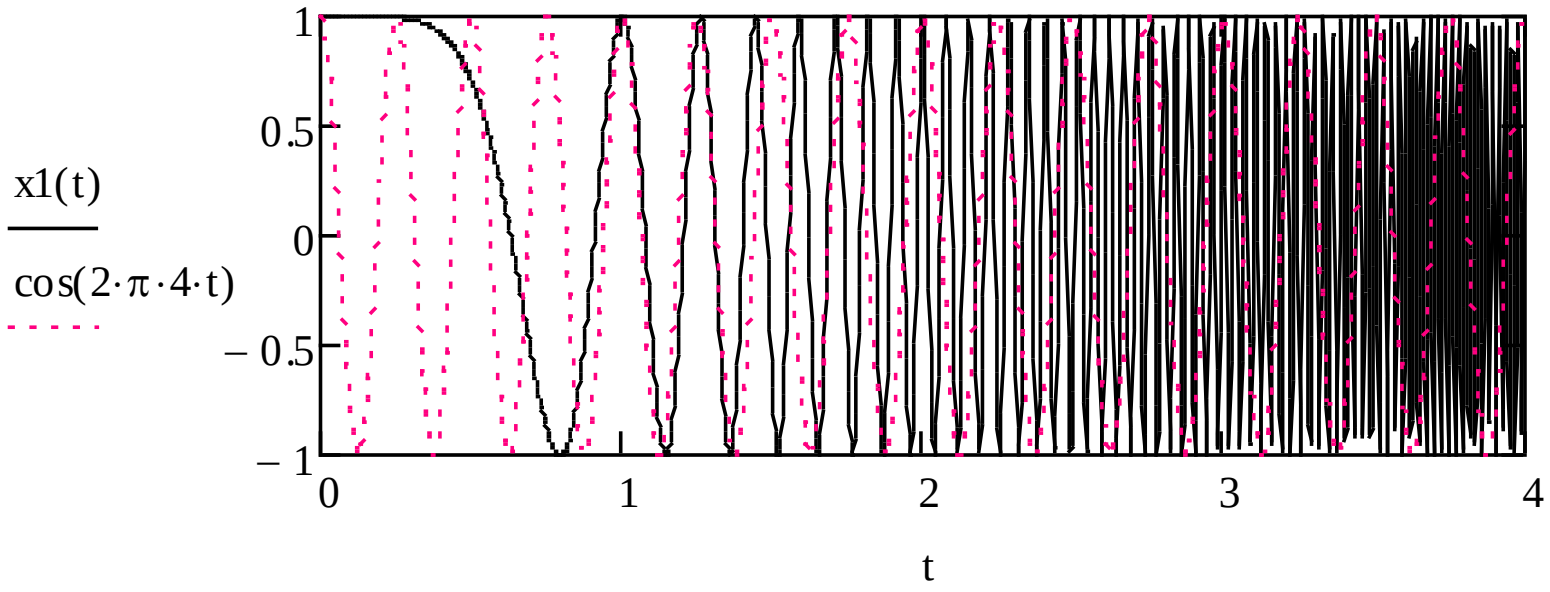


$\cos(2\pi ft)$ ⇒ At t = 2, $f = t^2 = 4$ Hz?

Correct?

Instantaneous Frquency

$$x_1(t) = \cos\left(2\pi t^2 t\right)$$

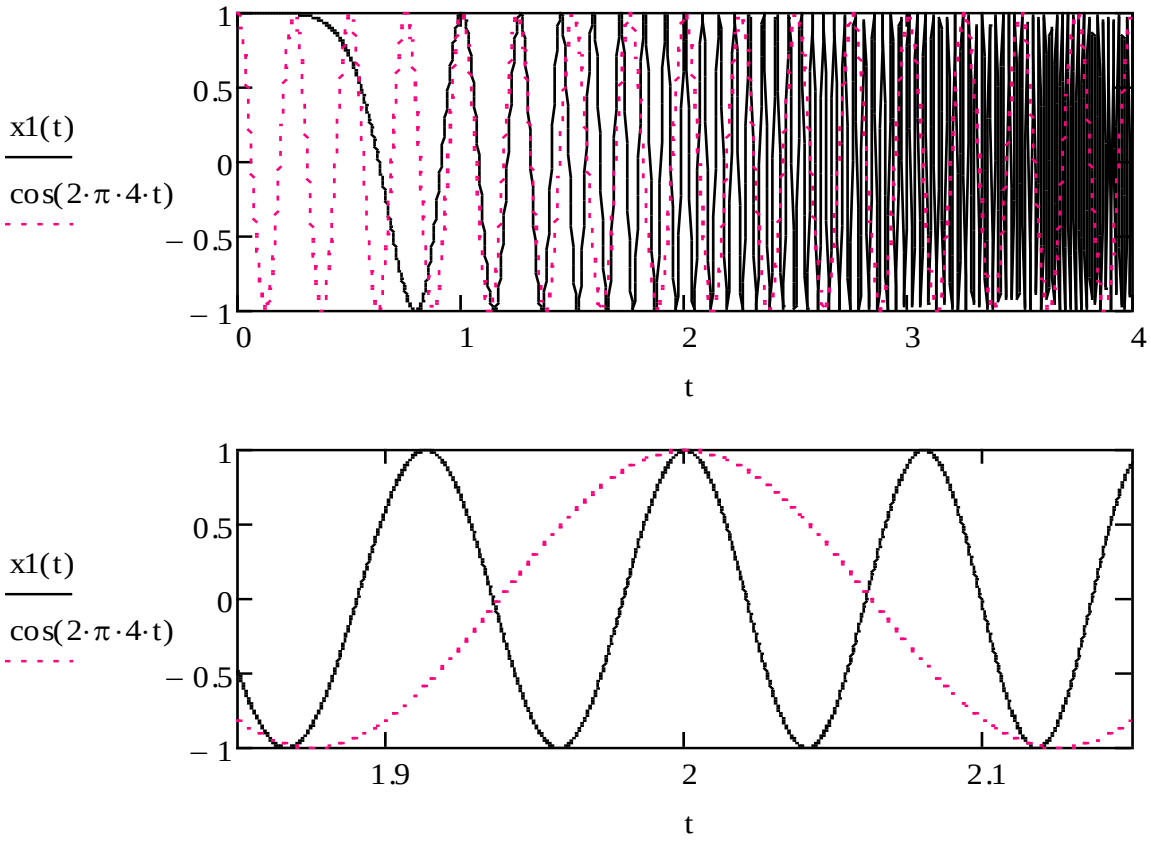


$\cos(2\pi ft)$ ⇒ At t = 2, $f = t^2 = 4$ Hz?

Correct?

Instantaneous Frquency

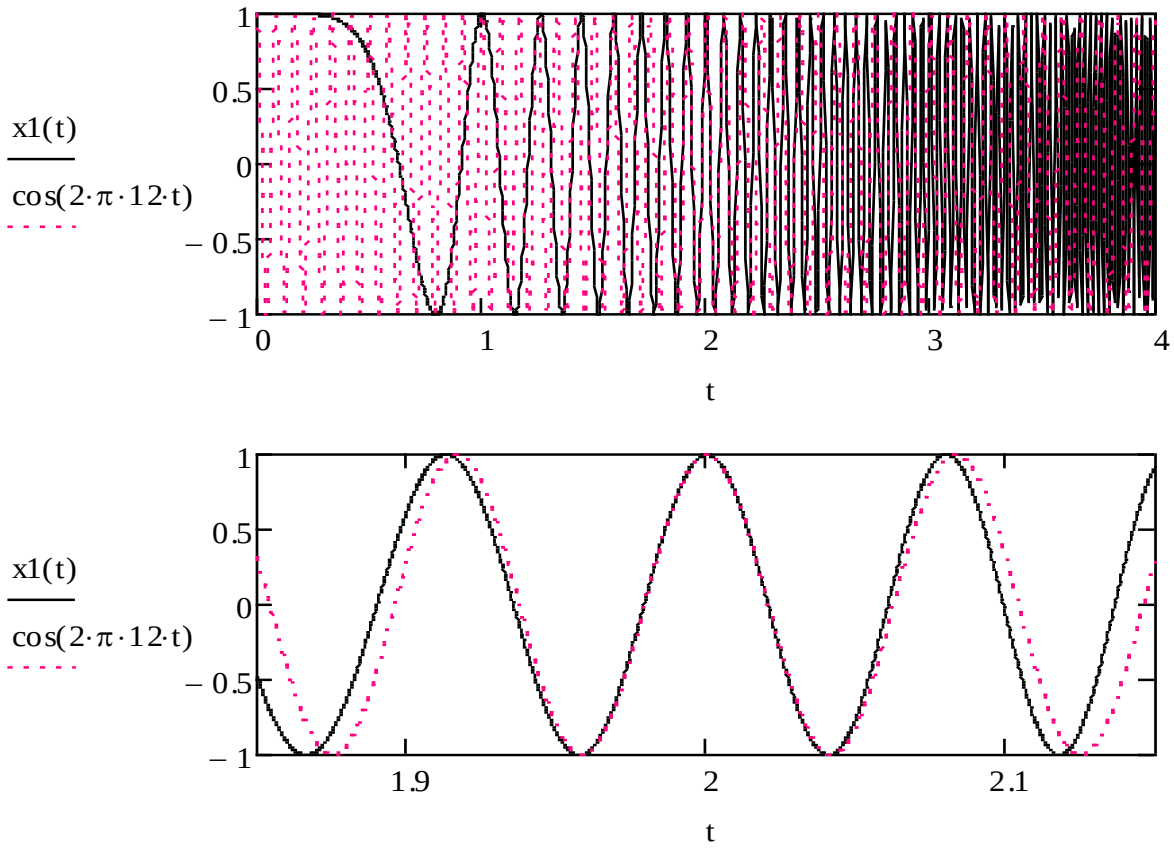
$$x_1(t) = \cos\left(2\pi t^2 t\right)$$



4 Hz is too low!!!

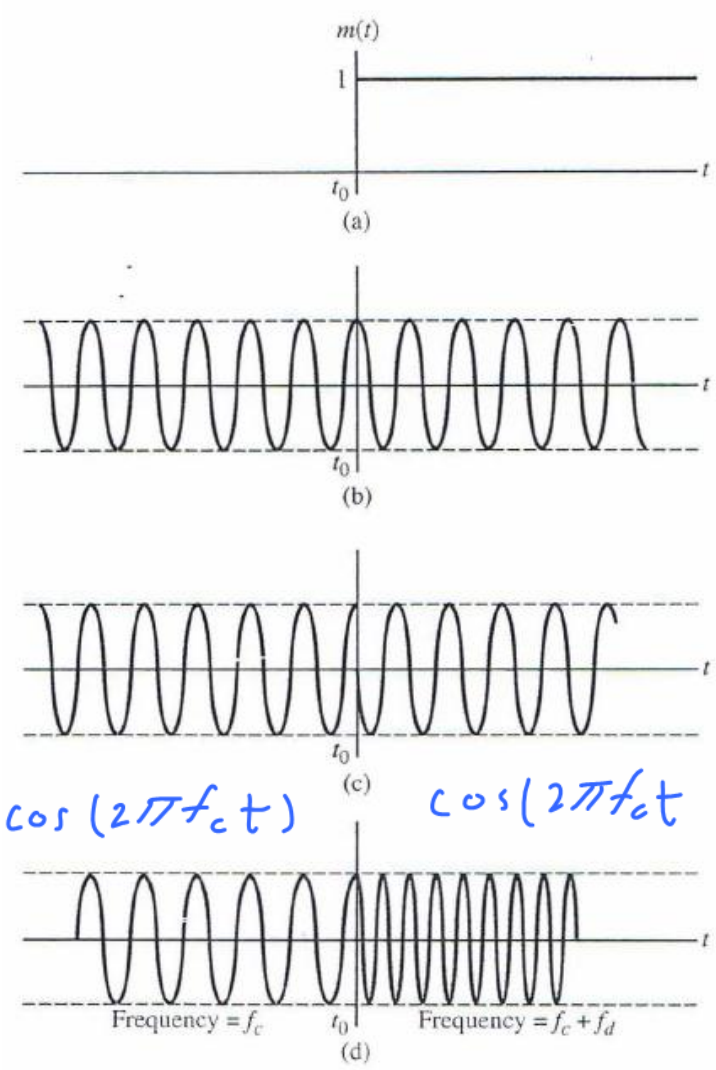
Instantaneous Frquency

$$x_1(t) = \cos\left(2\pi t^2 t\right)$$



12 Hz?

FM vs. PM



Message signal

Unmodulated carrier

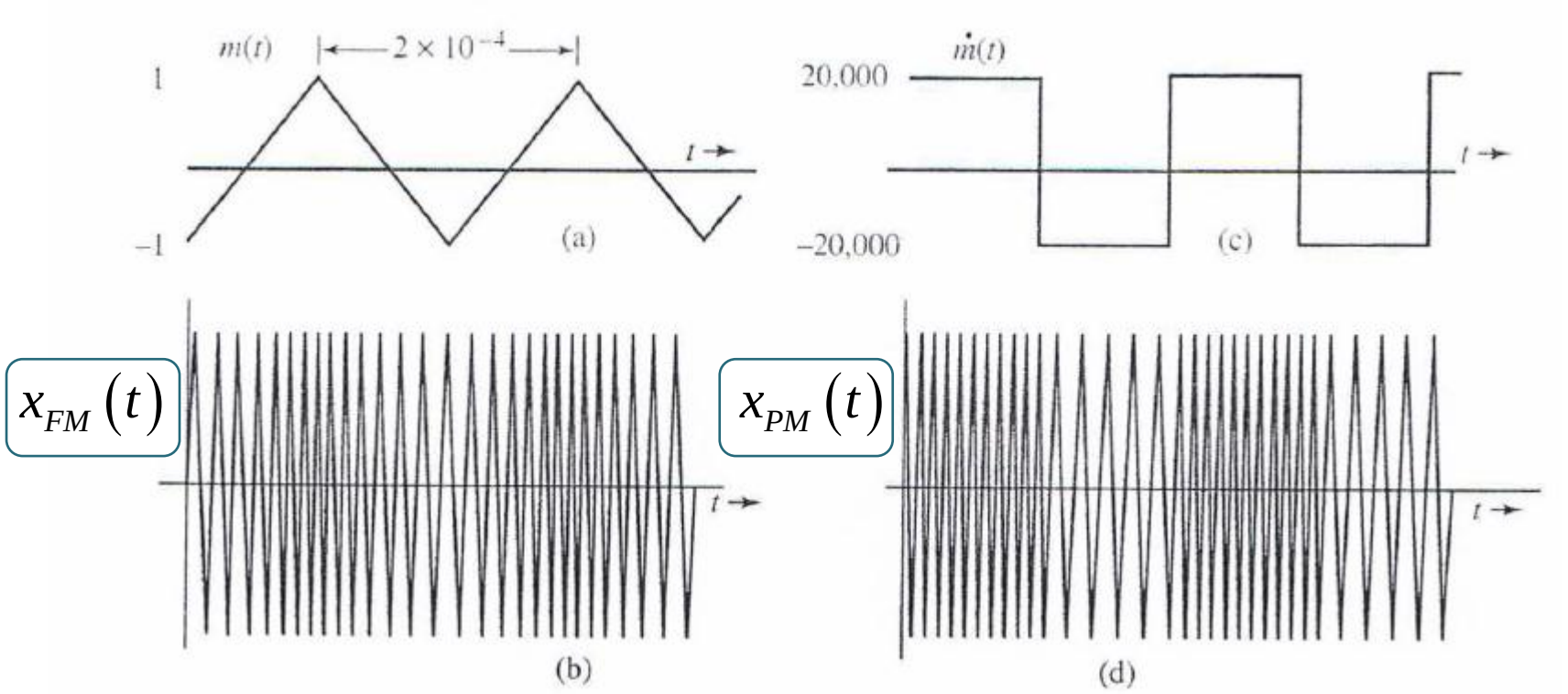
Phase-modulated signal

$\cos(2\pi f_c t)$ $\cos(2\pi f_c t + 30^\circ)$

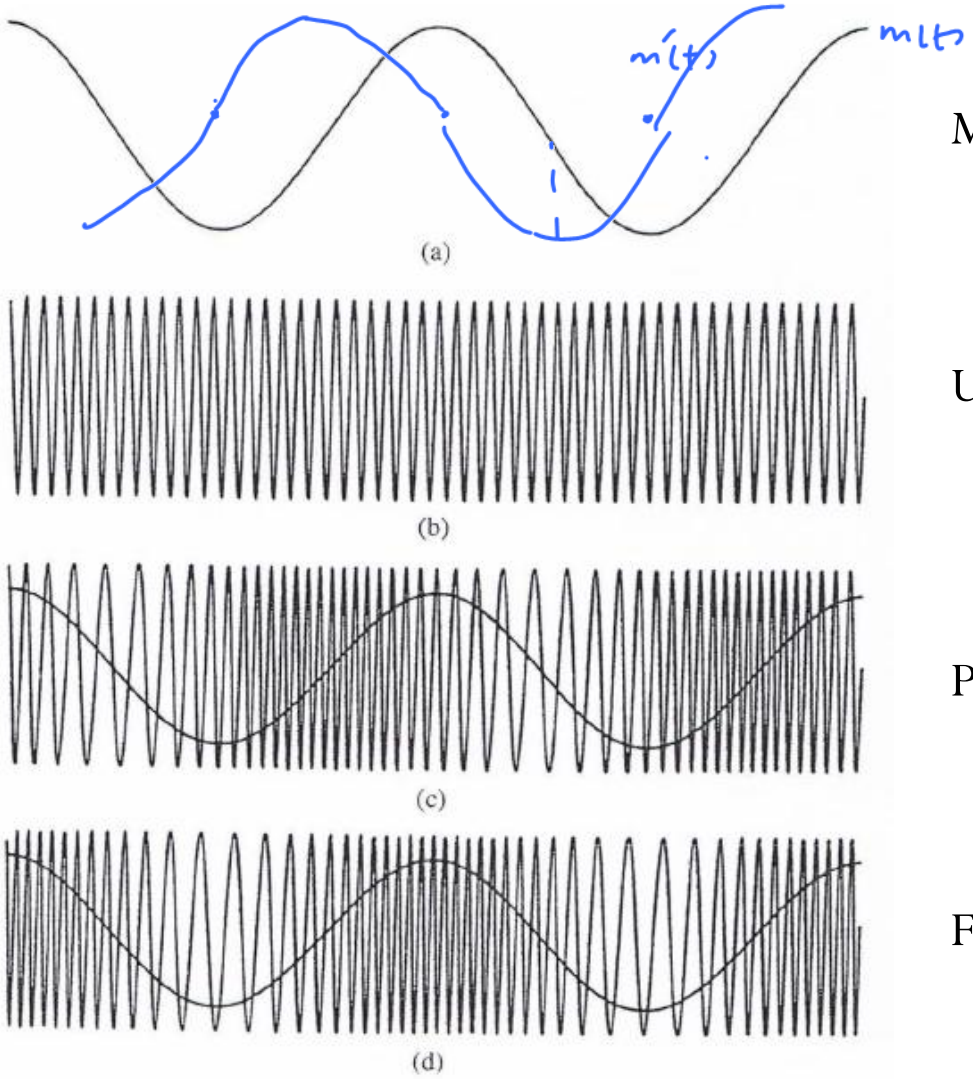
Frequency-modulated signal

FM vs. PM

Remark: To see $x_{PM}(t)$ of time varying m(t), it is usually easier to look at the instantaneous freq. via the derivative first.



FM vs. PM



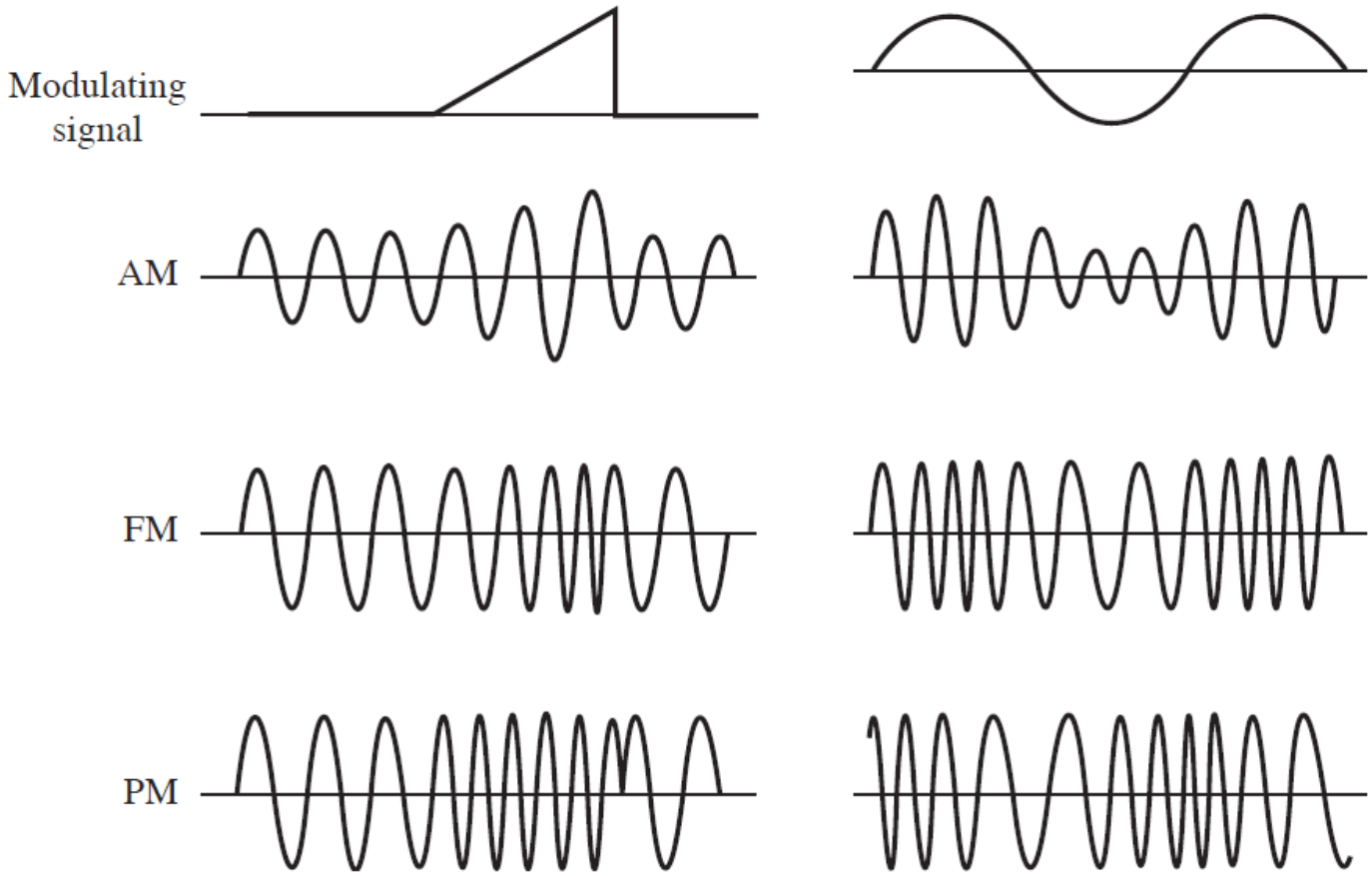
Message signal

Unmodulated carrier

Phase-modulated signal

Frequency-modulated signal

AM, FM, and PM



FM vs. PM