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AMPLITUDE MODULATION

Electronics & Communication Engg. Dept.

School of Engineering & Technology

CUTM

OBJECTIVE: The objective of a communication system is to efficiently transmit an information-bearing signal (message) from one location to another through a communication channel (transmission medium).

WISH LIST:

- High reliability
- Minimum signal power
- Minimum transmission bandwidth
- Low system complexity (low cost)

EFFICIENT TRANSMISSION: Can be achieved by processing the signal through a technique called modulation.

MODULATION TYPES:

- Analog modulation
- Digital modulation

Amplitude modulation

In this type of modulation the amplitude of a sinusoidal carrier is varied according to the desired message signal. Let $m(t)$ be the message signal we would like to transmit, k_a be the amplitude sensitivity (modulation index), and $c(t) = A_c \cos(2\pi f_c t)$ be the sinusoidal carrier signal, where A_c is the amplitude of the carrier and f_c is the carrier frequency.

The transmitted AM signal waveform is described by

$$s_{AM}(t) = A_c [1 + k_a m(t)] \cos(2\pi f_c t)$$

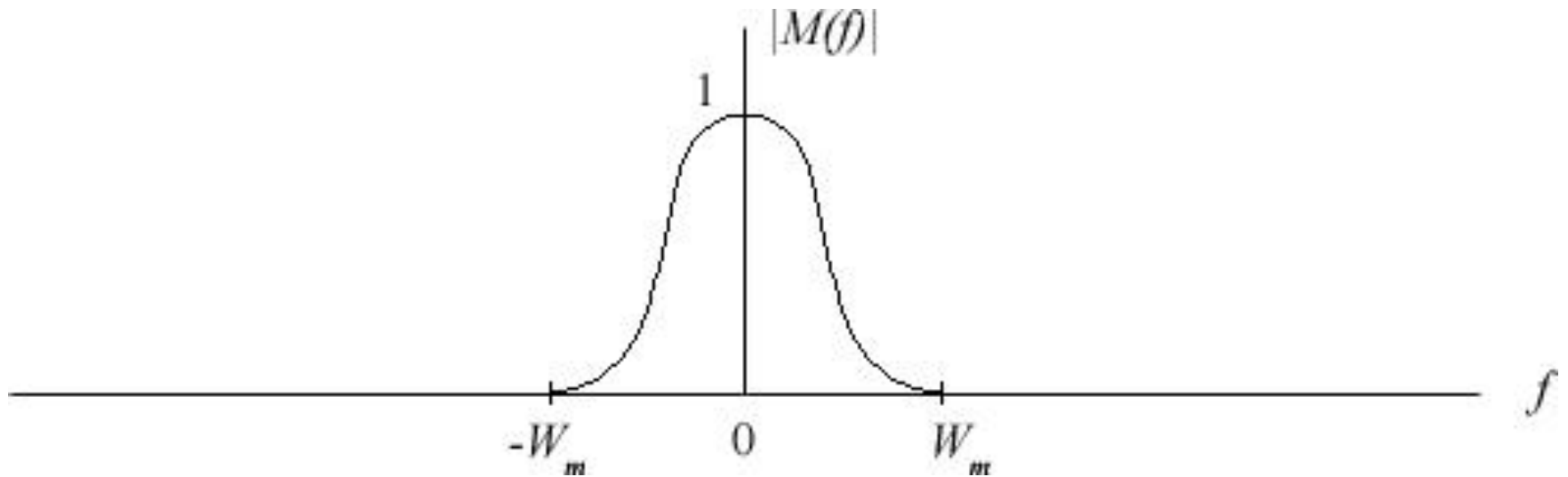
Requirements:

1. $|k_a m(t)| < 1, \forall t$
2. $f_c \gg W_m$ where W_m is the message bandwidth

Taking the Fourier transform of the modulated waveform, we get

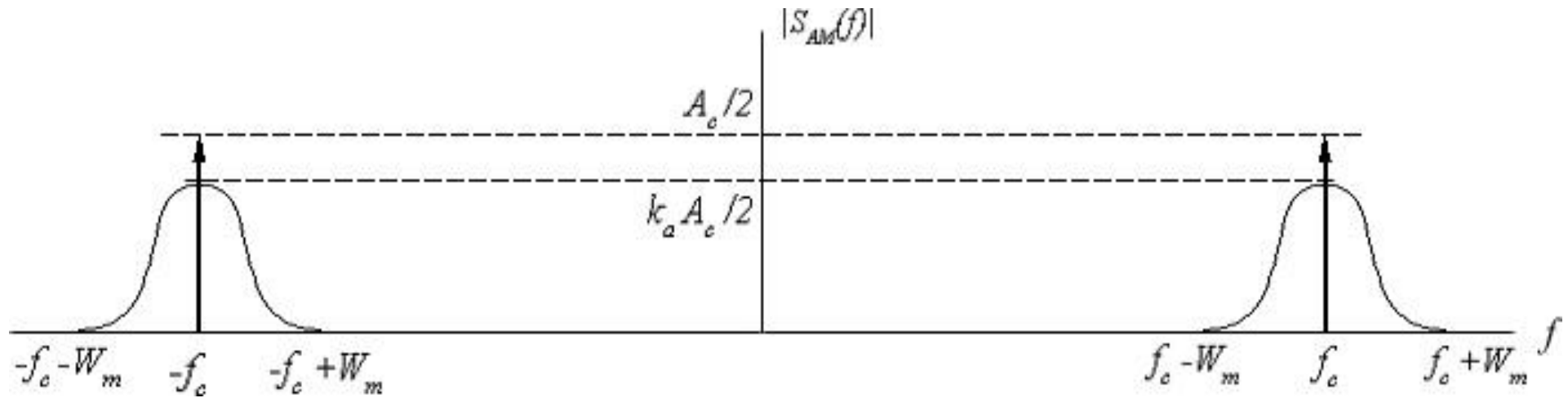
$$\begin{aligned} S_{AM}(f) &= F\{s_{AM}(t)\} \\ &= F\{A_c \cos(2\pi f_c t) + A_c k_a m(t) \cos(2\pi f_c t)\} \\ &= \frac{A_c}{2} [\delta(f - f_c) + \delta(f + f_c)] + \frac{k_a A_c}{2} [M(f - f_c) + M(f + f_c)] \end{aligned}$$

Let $|M(f)|$ be described by



Magnitude spectrum of $m(t)$

Then the magnitude spectrum of $s_{AM}(t)$ is



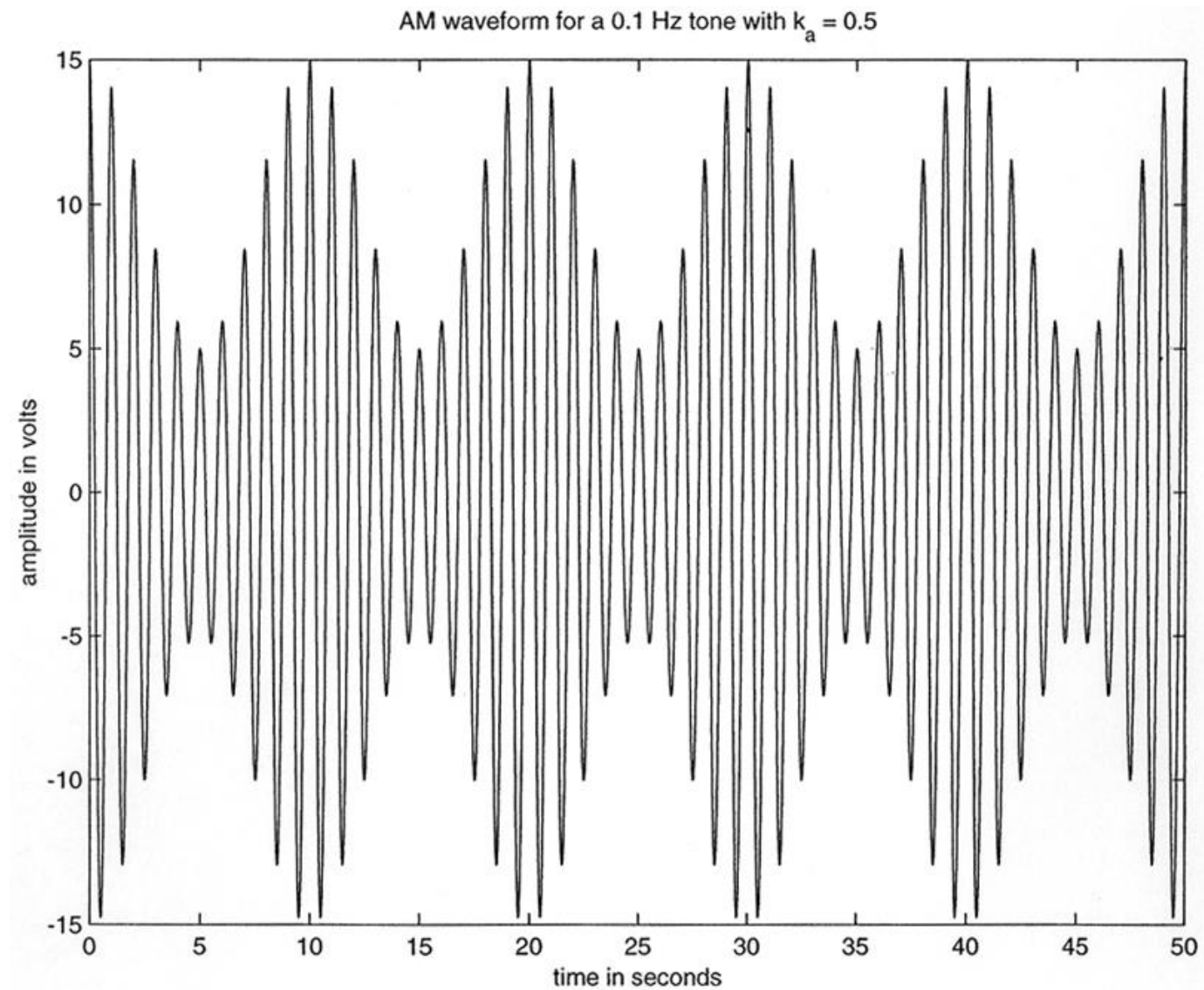
Magnitude spectrum of $s_{AM}(t)$

Observations:

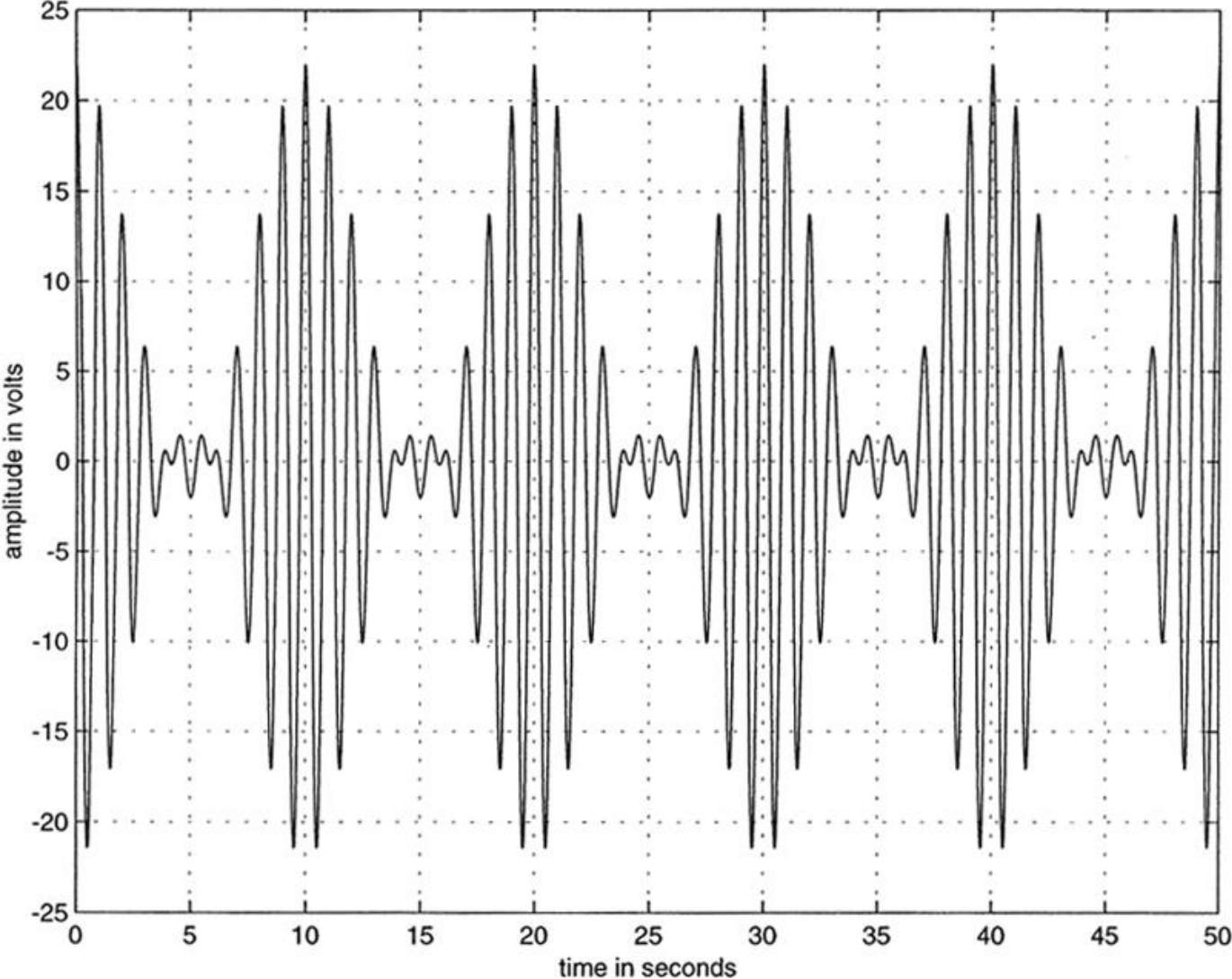
1. $B_{AM} = 2W_m$
2. Carrier is transmitted explicitly

Let $m(t) = \cos(0.2\pi t)$, then

$$s_{AM}(t) = A_c [1 + k_a \cos(0.2\pi t)] \cos(2\pi f_c t)$$



AM waveform for a 0.1 Hz tone with $k_a = 1.2$





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THANK YOU.....