EEE/ECE F311 Communication Systems Tutorial-3
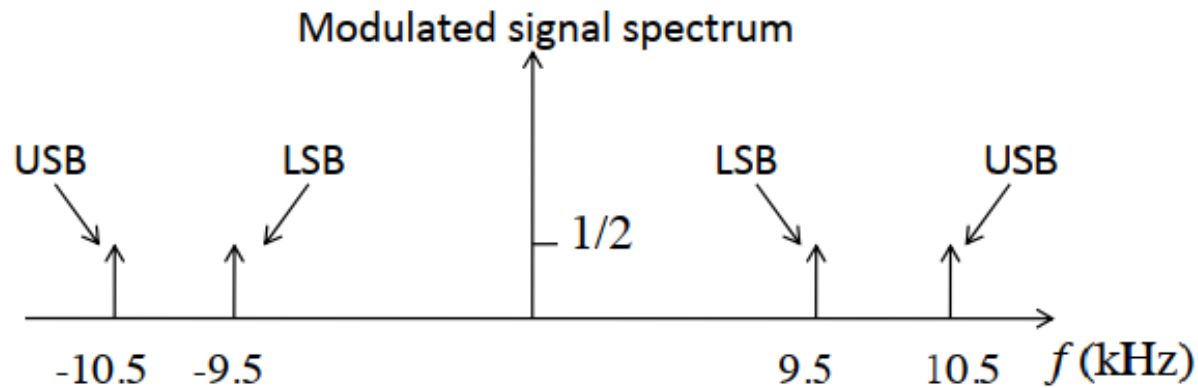
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1. For the baseband signal $m(t) = \cos(1000\pi t)$, sketch the spectrum of

    a. $m(t)$

    b. $m(t) \cos(20000\pi t)$

    c. Identify the USB and LSB spectra.

    d. Identify the frequencies in the baseband and the corresponding frequencies in the DSB-SC, USB, LSB spectra.

Solution 1

Modulated signal spectrum

2. An AM signal is generated by modulating the carrier f_c = 800 kHz by the message signal,

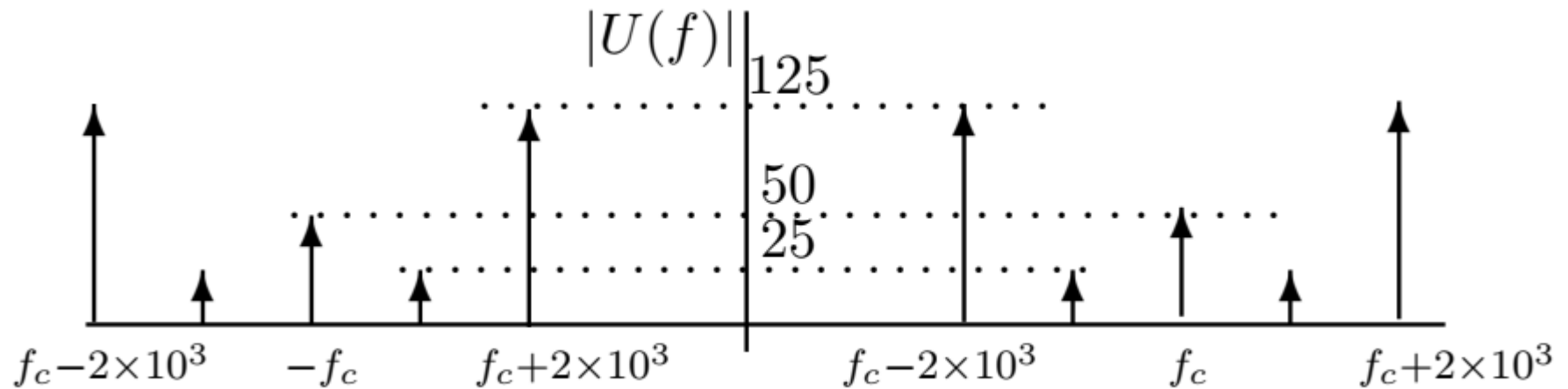$$m(t) = \sin(2000\pi t) + 5\cos(4000\pi t)$$

The AM signal,

$$u(t) = 100\left[1 + m(t)\right]\cos(2\pi f_c t)$$

is fed to a 1Ω load.

a. Determine and sketch $|U(f)|$.

b. Determine the average power in the carrier and in the sidebands.

c. What is the modulation index?

Solution 2

b. average power in the carrier = 5000 watt
average power in the sidebands= 65000 watt
c. modulation index= 5 to 6

3. An AM modulator with a tone signal input has output,

$$s\,(t) = A \cos (400\pi t) + B \cos (360\pi t) + B \cos (440\pi t)$$

The total carrier power is 100 W and the power efficiency is 40%. Compute A, B and modulation index.

Solution 3

Carrier power, $A = \sqrt{200} = 14.14$ $\mu = 1.155$

$B = 8.165$

4. Consider a message signal $m(t) = \cos(2\pi t)$ volts, and the carrier wave $c(t) = 50\cos(100\pi t)$ volts.

    a. Give the time domain expression for the resulting conventional AM signal for 75% modulation.

    b. Find the power developed across load of 100Ω due to this AM wave.

Solution 4

$$\varphi_{AM}(t) = 50\cos(100\pi t) + 18.75\cos(102\pi t) + 18.75\cos(98\pi t)$$

Total power: $P = 16.015$ watt

5. If m(t) = cos(200πt), find the transmission bandwidth and total transmitted power for AM transmission considering A_C = 10 and μ = 0.6. Repeat the same for DSB-SC transmission.

Solution 5

transmission bandwidth=200Hz

total transmitted power for AM transmission= P_T

$$P_T = 59 \, Watt$$

total transmitted power for carrier= P_C= 50 Watt

total transmitted power for DSB-SC transmission=9 Watt