Tutorial 2
Amplitude Modulation (AM)

Problem 1 (AM-DSB-SC)

Signal $s(t)$ (with Fourier transform $S(f)$) is applied to a double-sideband suppressed-carrier (DSB-SC) modulator operating at a carrier frequency of 200 Hz with a scaling factor of 1. Sketch the spectrum of the resulting AM-DSB-SC waveform and identify the upper and lower sidebands for each of the following cases.

(i) $s(t) = \cos 100\pi t$

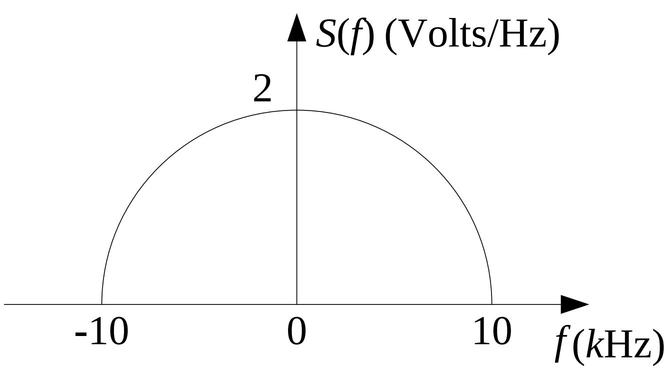
(ii) $$S(f) = \begin{cases} [1+\cos(\pi f/100)]/2 & |f| < 100 \\ 0 & \text{elsewhere} \end{cases}$$

Problem 2 (AM-DSB-C)

Consider an information signal with the spectrum shown below. Suppose we have a channel capable of passing frequencies in the range $300kHz \leq f \leq 320kHz$ and we want to transmit the signal across the channel using AM-DSB-C with a scaling factor of 1 and a modulation index of 0.667. Suppose that the maximum amplitude of the information signal is +2 volts and the minimum amplitude is -2 volts.

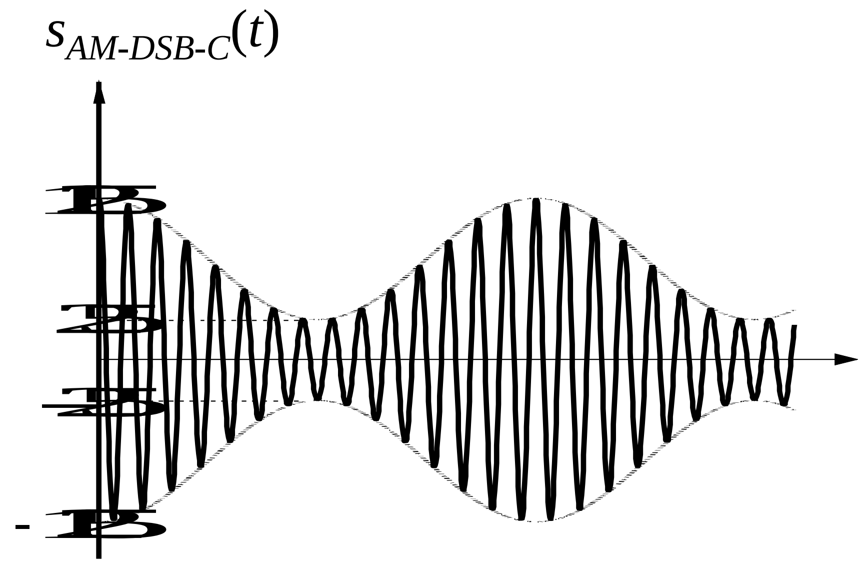
1) Determine the carrier frequency.

2) Draw the spectrum of the transmitted signal.



Problem 3.1 (AM-DSB-C)

For the sinusoidally modulated AM-DSB-C waveform shown below:



1) Find the modulation index.
2) Find the time-domain expression of the waveform.
3) Sketch the spectrum of the waveform.
4) Show that the sum of the two sideband parts in part (3), divided by the carrier part, yields the modulation index. Explain why.

Problem 3.2 (AM-DSB-C)

5) Sketch the output of the envelope detector .

6) If an additional carrier is added to the waveform $s_{AM\text{-}DSB\text{-}C}(t)$ to attain a modulation index of 20%, determine the peak amplitude of this additional carrier.

7) Sketch the output of the envelope detector that takes the waveform in (6) as the input.