

ECE 457 Practice Problems for Exam 1

1. Answer the following questions briefly:
 - a) For a message with baseband bandwidth W , the maximum transmitted bandwidth using a linear modulation scheme is _____.
 - b) Draw the block diagram of a system that achieves AM demodulation.
 - c) For PM modulation, the frequency deviation is proportional to _____.
 - d) State briefly the operating principle of a frequency discriminator.
 - e) The video signals in a TV system are transmitted using _____ modulation.

2. Show that a coherent demodulation scheme can be used to demodulate AM signals. Draw the block diagram and find the output at each point.

3. An angle-modulated signal with carrier frequency $f_c = 1\text{MHz}$ is described by the equation $x_c(t) = 10 \cos(2\pi f_c t + 0.1 \sin(2000\pi t))$
 - a) Find the power of the modulated signal.
 - b) Find the peak frequency deviation.
 - c) Find the peak phase deviation.
 - d) Determine whether this signal is narrowband or wideband.
 - e) Sketch the amplitude spectrum and estimate the bandwidth.

4. Design an Armstrong indirect FM modulator to generate an FM carrier with a carrier frequency of 96 MHz and $\Delta f = 20\text{kHz}$. A narrowband FM generator with $f_c = 200\text{kHz}$ and adjustable Δf in the range of 9 to 10 Hz is available. We also have an oscillator with adjustable frequency in the range of 9 to 10 MHz. There is a bandpass filter with any center frequency, and only frequency doublers are available.

5. An USB signal is generated by using the phase-shift modulator method shown in Figure 3.8.
 - a) If the input to this system is $\hat{m}(t)$ instead of $m(t)$, what will be the output?
 - b) Is this signal still an SSB signal with bandwidth equal to that of $m(t)$?
 - c) Can this signal be demodulated to get back $m(t)$? If so, how?