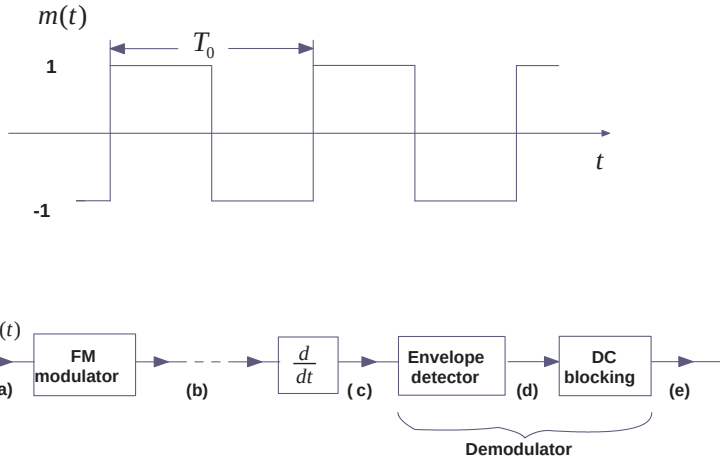
Electrical Engineering and Computer Science ELE 551, Fall 2010
Syracuse University

Homework #8

Submission is not necessary

1. [10 points](L&D Exercise 5.3-1) Design (the block diagram of) an Armstrong indirect FM modulator to generate an FM carrier with a carrier frequency of 96 MHz and $\Delta f = 20$ kHz. A narrowband FM generator with $f_c = 200$ kHz and adjustable Δf in the range of 9 to 10 Hz is available. The stockroom also has an oscillator with adjustable frequency in the range of 9 to 10 MHz. There are bandpass filters with any center frequency, and only frequency doublers are available.

2. [10 points] (L&D Exercise 5.4-2) A periodic square wave $m(t)$ (shown in the figure below) frequency-modulates a carrier of frequency $f_c = 10$ kHz with $\Delta f = 1$ kHz. The carrier amplitude is A. The resulting FM signal is demodulated, as also shown in the figure below. Sketch the waveforms at points b, c, d, and e. (Note that the DC blocking in the following figure suppresses the none time-varying part of the signal.



3. [10 points] (L&D Exercise 5.4-3) Let $s(t)$ be an angle-modulated signal that a receiver obtains,

$$s(t) = 2\cos\left[10^7\pi t + 2\sin(2000\pi t + 0.3\pi) - 3\pi\cos(100t)\right].$$

(a) Find the bandwidth of this FM signal.
(b) If $s(t)$ is sent to an (ideal) envelope detector, find the detector output signal.
(c) If $s(t)$ is first differentiated before the envelope detector, find the detector output signal.
(d) Explain which detector output can be processed to yield the message signal $m(t)$ and find the message signal $m(t)$ if $k_f = 200\pi$.