

### EE354 Homework #5

1. A 10 MHz carrier is frequency modulated by a sinusoid of unit amplitude, frequency of 10 kHz, and with  $k_f = 10$  Hz/V. Determine the approximate bandwidth of the FM waveform.
2. A carrier is frequency modulated by a sinusoidal signal that has an amplitude of  $A_m$  and frequency of  $f_m$ .
  - (a) Determine the values of  $\beta$  for which the carrier amplitude is 0.
  - (b) Consider now that the message frequency is 1.0 kHz, and the message amplitude varies from 1.0V to 5.0V. Determine the  $k_f$  and corresponding message amplitude associated with the point where the carrier amplitude disappears a second time.
3. A 100 MHz carrier is frequency modulated by a sinusoidal signal that has a frequency of 75 kHz. The FM transmission has a frequency deviation of 500 kHz. Determine the bandwidth and range of frequencies occupied by the FM transmission.
4. The message signal shown below is a sawtooth waveform. Sketch the FM and PM waveforms produced by  $m(t)$ . Hint: plug in some numbers and use Matlab to plot.

