

## ELECTRICAL COMMUNICATION SYSTEMS

### ECE 09433

### Homework 3

Please write your name, your class session, and your lecturer's name on your solutions. Numbers are from the textbook.

**Problem 1** Textbook number 5-27

A sinusoidal signal  $m(t) = \cos 2\pi f_m t$  is the input to an angle-modulated transmitter,  $A_c=1$ , and the carrier frequency is  $f_c = 1$  Hz and  $f_m = f_c/4$ .

- (a) Plot  $m(t)$  and the corresponding PM signal  $S_p(t)$  using Matlab, where  $D_p = \pi$ .
- (b) Plot  $m(t)$  and the corresponding FM signal  $S_f(t)$  using Matlab, where  $D_f = \pi$ .

**Problem 2** Textbook number 5-29

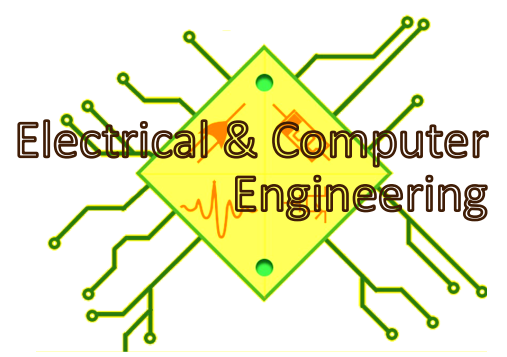
An FM signal has sinusoidal modulation with a frequency of  $f_m=15$ kHz and modulation index of  $\beta = 2.0$ .

- (a) Find the transmission bandwidth by using Carson's rule.
- (b) What percentage of the total FM signal power lies within the Carson rule bandwidth?

**Problem 3** Textbook number 5-32

A modulated RF waveform is given by  $500\cos[\omega_c t + 20\cos \omega_1 t]$ , where  $\omega_1 = 2\pi f_1$ ,  $f_1 = 1$ kHz, and  $\omega_c = 2\pi f_c$ ,  $f_c = 100$ MHz.

- (a) If the phase sensitivity  $D_p$  is 100 rad/V, find the mathematical expression for the corresponding phase modulation voltage  $m(t)$ . What is its peak value and its frequency?
- (b) If the frequency deviation constant  $D_f$  is  $1 \times 10^6$ rad/V-s, find the mathematical expression for the corresponding FM voltage  $m(t)$ . What is its peak value and its frequency?



- (c) If the RF waveform appears across a  $50\text{-}\Omega$  load, determine the average power and the PEP.