ELECENG 4035 - COMMUNICATIONS IV
Tutorial 2

1 Exercise 3.2 from Proakis and Salehi

In a double sideband (DSB) system the carrier is $c(t) = A\cos(2\pi f_c t)$ and the message signal is given by $m(t) = \mathrm{sinc}(t) + \mathrm{sinc}^2(t)$. Find the frequency domain representation and the bandwidth of the modulated signal.

[Note that this question, as written in the textbook, is slightly ambiguous; that is, it could be DSB suppressed carrier (DSBSC), or double sideband transmitted carrier (which we call AM). I suggest answering this question for AM, in which case the answer is a function of the modulation index, a. The answer for DSBSC then follows from a simplification of the AM case.]

2 Exercise 3.7 from Proakis and Salehi

An AM signal has the form

$$u(t) = [20 + 2\cos(3000\pi t) + 10\cos(6000\pi t)]\cos(2\pi f_c t),$$

where $f_c = 10^5$ Hz.

1. Sketch the (voltage) spectrum of $u(t)$.
2. Determine the power in each of the frequency components.
3. Determine the modulation index.
4. Determine the power in the sidebands, the total power, and the ratio of the sidebands' power to the total power.

3 Exercise 3.30 from Proakis and Salehi

An FM signal is given as

$$u(t) = 100\cos\left[2\pi f_c t + 100\int_{-\infty}^{t} m(\tau)d\tau\right],$$

where $m(t)$ is shown below.

1. Sketch the instantaneous frequency as a function of time.
2. Determine the peak-frequency deviation.

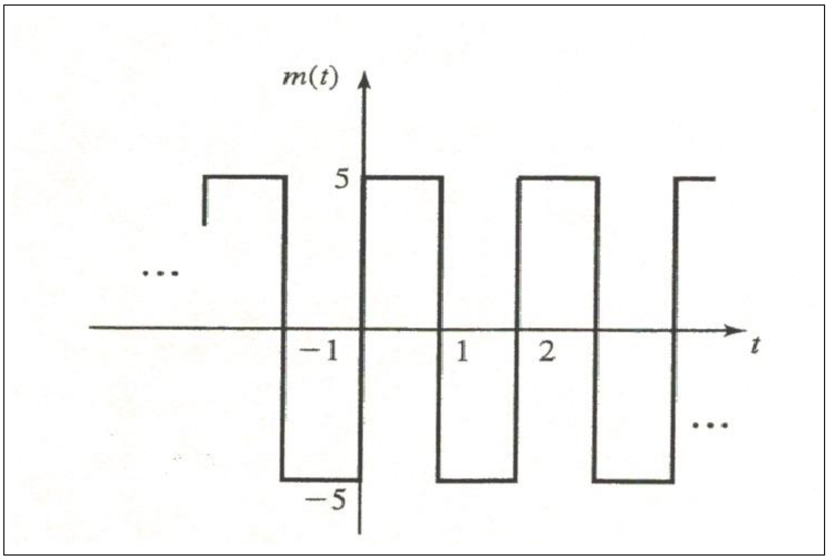

Figure 1:

4 Exercise 4.69 from Proakis and Salehi

A zero-mean white Gaussian noise signal, $n_w(t)$, with power-spectral density $\frac{N_0}{2}$, is passed through an ideal filter whose passband is from 3–11 kHz. the output process is denoted by $n(t)$.

1. If $f_0 = 7$ kHz, find $S_{n_c}(f)$, $S_{n_s}(f)$, and $R_{n_c n_s}(\tau)$, where $n_c(t)$ and $n_s(t)$ are the in-phase and quadrature components of $n(t)$.
2. Repeat part 1 with $f_0 = 6$ kHz.