Digital Modulation

Summary of Concepts

Frequency Modulation

- Modulating Frequency
- Modulation Index
- Bessel Tables
- Sideband Pairs
- Bandwidth
- Bandwidth Efficiency

Modulating Frequency

- $F_a = F_b / 2$
- This value separates the side band pairs
- Provides link to “spectral spread”.

Modulation Index

- Used to determine number of side band pairs.
- MI = $F_m – F_s / F_b$
- MI = “delta” F / F_a
- MI $\leq$ .25 ……Narrow Band FM

Bessel Tables

- Sideband Pairs
- BW = 2 (#pairs) ($F_{a)}$

Bandwidth Efficiency

$$= F_b / BW$$

Phase Modulation / PSK

$$BW = 2\,F_a$$

Multi-Bit Modulation

$$M = 2^n$$

$$N = \mathrm{Log}_2 M$$

QPSK

$M = 4$

$n = 2$

$BW = F_b / n$

8PSK

- Amplitude to each modulator is different

$$M = 8$$

$$n = 3$$

$$BW = F_b / 3$$

8QAM

- Amplitude to each modulator is same
- M = 8
- n = 3
- BW = F_b / 3