List of equations for class
wireless

Wavelength (λ)

freq. ,(f)

constant (propration speed)

$\lambda = \frac{c}{f}$ or $f = \frac{c}{\lambda}$ or $c = f * \lambda$

Bit Rate
Wave length for analog Signals

Bitrate for digital signals
Wavelength anologgy for ditigal is:
Bi~~trate~~ length is distence of one bit

Bit length = ~~propagation~~ propration speed *
Bit duration

$P = V^2$ power of a ~~Siggal~~ Signal = square of voltage

Capacity = C

Band width = B

equations

NdB noise in dB decibels

$$NdB = 10 \log_{10}\left(\frac{P_2}{P_1}\right)$$

P_2 is ending power level in ~~watts~~

P_1 is starting power level in watts

Signal to noise ratio

Sometimes messured in dB_m (millwatts)

$dB_m = 10 \log P_m$, where P_m is the power in milliwatts, assumed ~~for~~ nosie is 1

Channel Capacity /w noise equation

More realistic becose it includes noise

Use Shannon Capacity

$$C = \text{Bandwidth} * \log\left(1 + \frac{S}{N}\right)$$

Channel capacity eq

1 for Bit Rate

Max Bit Rate is (Nosieless) Nyqcist

$2 * \text{Bandwidth} \cdot \log_2(L)$ (bps)

Equations overview for Wireless

SNR problems

$S = 1000\ W$

$N = 20\ mW \quad = N = \quad 0.02\ W$

$$10 \log_{10}\left(\frac{1000}{\cancel{200}0.02}\right) \qquad \log_{10}(50{,}000) \cdot 10 =$$

$$46.989 = SNR_{dB}$$

first, convert the power units to the same unit.

$20.0\ mW = \underbrace{0}_{3}\underbrace{2}_{2}\underbrace{0}_{1}\ W$ because $mW = 10^{-3} W$

Second fill out the formual

$$10 \log_{10}\left(\frac{1000}{0.02}\right) = 10 \log_{10}(50{,}000) = 46.98$$

Reduce, ≈ 46.989

equations for Antenna Gain

Gain $= G$

$\lambda =$ wavelength Carrier

$f =$ carrier freq

$c =$ speed of light $(3 \times 10^8 \, m/s)$

in relation to a perfect isotrophic antenna

$$G = \frac{4\pi A}{\lambda^2} = \frac{4\pi f^2 A}{c^2} = \cancel{4\pi f} \; \frac{4\pi f^2 A}{c^2}$$

$$= \frac{4\pi f^2 A}{(3 \times 10^8 \, m/s)^2}$$

Free space loss formual

Free space loss is for an idea (Isotrophic) antenna

$$* \quad \frac{P_t}{P_r} = \frac{(4\pi d)^2}{\lambda^2} = \frac{(4\pi f d)^2}{c^2}$$

Midterm
final need to know

P_t = Signal power @ transmitter

f = freq carrier wave

P_r = Signal Power @ reciver

λ = wavelength carrier

d = propagation distance between trans and reiver

c = speed of light (3×10^8 m/s)

λ and d should the same units

FSL_{dB} formual

$$FSL_{dB} = 10\log_{10}\left(\frac{P_t}{P_r}\right)$$

$$FSL_{dB} = 20\log_{10}\left(\frac{4\pi f d}{c}\right)$$
Or

$$FSL_{dB} = 20\log_{10}(f) + 20\log_{10}(d) - 147.56$$