Communication Systems

- AM Wave =

$$A_C[1 + g_m\, m(t) \cos(\omega_c t)]$$ 1 Modulating i

dex, $m_a = \dfrac{A(t)_{MAX} - A(t)_{MIN}}{A(t)_{MAX} + A(t)_{MIN}}$

- Efficiency, $\eta = \frac{m_a^2}{2 + m_a^2}$
- The modulated Voltage $V = V_c\sqrt{1 + \frac{m_a^2}{2}}$
- Equivalent modulating index,

  $m_{a\,eq} = \sqrt{m_1^2 + m_2^2 + m_3^2 \ldots\ldots}$
- Hilbert transform of x (t), $x_h(t) = \frac{1}{\pi}x(t) \otimes \frac{1}{t}$
- The image frequency, $f_c' = f_c + 2f_{IF} = f_{LO} + f_{IF}$
- FM Wave

  $$S(t)_{FM} = A_c \cos\left[2\pi f_c t + 2\pi k_f \int_0^t m(t)\,dt\right]$$
- Bandwidth of FM $B_{FM} = 2f_m[1 + \beta]$
- PM Wave,

  $S(t)_{PM} = A_C \cos(2\pi f_c t + k_p A_m \cos 2\pi f_m t)$
- Power spectral density of thermal noise

  $S(f) = 2RKT\ \text{Volt}^2/\text{Hz}$
- Noise equivalent bandwidth, $\left[B_N = \frac{\pi}{2}.B_{eff}\right]$
- FOM for AM $= \frac{\beta^2}{2 + \beta^2}$
- Sampling theorem, $\frac{1}{T_s} \geq 2f_M$.
  (Nyquist theorem)
- Step size, $\Delta = \frac{2\,M_{max}}{L}$
- SNR(signal is sinusoidal)

  $= 10\log(SNR)_o = 1.8 + 6\nu$ dB
- Probability density function (pdf),

  $f_x(a) = \frac{dF_x(a)}{da}$
- Mean-squared value

  $$E[X^2] = \lim_{N\to\infty}\sum_{i=1}^{N} x_i^2 P\{X = x_i\} = \int_{-\infty}^{+\infty} x^2 f(x)dx$$
- Information $I(s_k) = \log_{base}\frac{1}{p_k}$
- Entropy $H(s) = \sum_{k=0}^{K-1} p_k I(s_k)$
- Channel capacity, $C = B\log_2\left(1 + \frac{S}{N}\right)$
- Numerical aperture, $NA = \sqrt{(n_1^2 - n_2^2)}$
- Satellite velocity $V = \sqrt{\frac{Gm_e}{r + h}}$

- Total noise

$$G_1G_2 \ldots\ldots G_nKB\left(T_S + Te_1 + \frac{Te_2}{G_1} + \frac{Te_3}{G_1G_2} + \ldots\ldots + \frac{Te_n}{G_1G_2 \ldots G_{n-1}}\right)$$

- Noise temperature, $\boxed{T_e = (F-1)T_0}$

- Radiation resistance, $\boxed{R_r = 80\pi^2\left(\frac{dl}{\lambda_0}\right)^2}$

- Gain of antenna, $\boxed{G = \frac{4\pi}{\lambda^2}A_e}$