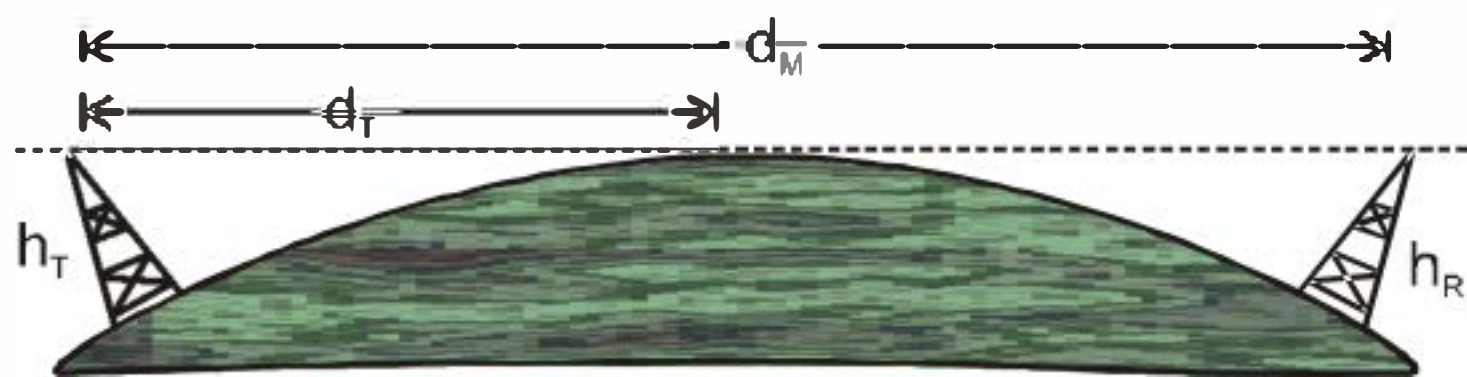# PRINCIPLE OF COMMUNICATION

Transmission from tower of height h

- the distance to the horizon $d_T = \sqrt{2Rh_T}$

- $d_M = \sqrt{2Rh_T} + \sqrt{2Rh_R}$

Amplitude Modulation

- The modulated signal $c_m(t)$ can be written as

$$c_m(t) = A_c \sin \omega_c t + \frac{\mu A_c}{2} \cos(\omega_c - \omega_m)t - \frac{\mu A_c}{2} \cos(\omega_c + \omega_m)$$

- Modulation index $m_a = \dfrac{\text{Change in amplitude of carrier wave}}{\text{Amplitude of original carrier wave}} = \dfrac{kA_m}{A_c}$

where k = A factor which determines the maximum change in the amplitude for a given amplitude E_m of the modulating. If k = 1 then

$$m_a = \frac{A_m}{A_c} - \frac{A_{max} - A_{min}}{A_{max} - A_{min}}$$

- If a carrier wave is modulated by several sine waves the total modulated

index m_t is given by $m_t = \sqrt{m_1^2 + m_2^2 + m_3^2 + \ldots\ldots}$

- Side band frequencies

$(f_c + f_m)$ = Upper side band (USB) frequency

$(f_c - f_m)$ = Lower side band (LBS) frequency

- Band width = $(f_c + f_m) - (f_c - f_m) = 2f_m$

- Power in AM waves : $P = \dfrac{V_{rms}^2}{R}$

(i) carrier power $P_c = \dfrac{\left(\dfrac{A_c}{\sqrt{2}}\right)^2}{R} = \dfrac{A_c^2}{2R}$

(ii) Total power of side bands $P_{sb} = \dfrac{\left(\dfrac{m_a A_c}{2\sqrt{2}}\right)^2}{R} = \dfrac{\left(\dfrac{m_a A_c}{2\sqrt{2}}\right)}{2R} = \dfrac{m_a^2 A_c^2}{4R}$

(iii) Total power of AM wave $P_{Total} = P_c + P_{ab} = \dfrac{A_c^2}{2R}\left(1 + \dfrac{m_a^2}{2}\right)$

(iv) $\dfrac{P_t}{P_c} = \left(1 + \dfrac{m_a^2}{2}\right)$ and $\dfrac{P_{sb}}{P_t} = \dfrac{m_a^2/2}{\left(1 + \dfrac{m_a^2}{2}\right)}$

(v) Maximum power in the AM (without distortion) will occur when $m_a = 1$ i.e., $P_t = 1.5\ P = 3P_{ab}$

(vi) If I_c = Unmodulated current and I_t = total or modulated current

$\Rightarrow \dfrac{P_t}{P_c} = \dfrac{I_t^2}{I_c^2} \Rightarrow \dfrac{I_t}{I_c} = \sqrt{\left(1 + \dfrac{m_a^2}{2}\right)}$

Frequency Modulation

- Frequency deviation $\delta = = (f_{max} - f_c) = f_c - f_{min} = k_f \cdot \dfrac{E_m}{2\pi}$

- Carrier swing (CS) = CS = 2 × Δf
- Frequency modulation index (m_f)

=. $m_f = \dfrac{\delta}{f_m} = \dfrac{f_{max} - f_c}{f_m} = \dfrac{f_c - f_{min}}{f_m} = \dfrac{k_f}{f_m}\ \dfrac{E_m}{}$

- Frequency spectrum = FM side band modulated signal consist of infinite number of side bands whose frequencies are $(f_c \pm f_m)$, $(f_c \pm 2f_m)$, $(f_c \pm 3f_m)$.........

- Deviation ratio = $\dfrac{(\Delta f)_{max}}{(f_m)_{max}}$

- Percent modulation , m = $\dfrac{(\Delta f)_{actual}}{(\Delta f)_{max}}$