# Modulation:

The message signal m(t) is modulated by a carrier signal c(t)…so what does that mean?

It means as if there exists a c(t) signal, usually having a high frequency sinusoidal which can be considered as the ***body*** of a communicational message. And its ***soul and attribute*** which gives character to it, is our original message signal m(t) (our voice or fairly anything we intend to send to another place). Therefor every signal has a c(t) but depending on the modulation method, it gets different characteristics, like in humans, some are tall, some short, some anxious and some calm. As if you are creating a signal being! P.126 of Perakis

# AM Modulation:

So in AM modulation, the frequency of the carrier signal c(t) won’t change, but its amplitude modifies according to our message signal m(t).

If the carrier signal is sinusoidal, then because of the generation of two Delta Dirac functions in its Fourier transform, we call it double sideband or ***DSB\_AM*** modulation. Also for the same reason if the bandwidth of the message signal is W, the bandwidth of xc(t) is 2W. P.129 of Perakis

But DSB\_SC AM lacks simplicity in design demodulation (we should use a PLL (phase locked loop) or a phase coherent (synchronous) demodulator) that is solved by another modulation technique called *conventional* double sideband or ***CDSB\_AM***, that uses a constant factor 0 < μ < 1 named modulation index to reach this aim. (In all AM modulations we consider |m(t)| ≤ 1 (or by simply a normalization of m(t)), otherwise the message becomes over modulated which again complicates the design of the demodulator.) due to the simplicity of demodulator in conventional AM compared to DSB\_ SC, it is used for **AM radio** broadcast.

As marked above, DSB \_SC uses the double bandwidth of the message signal and in order to be more efficient, ***SSB\_AM*** modulation is used which uses the upper or the lower sideband of the message signal. And as it is like DSB\_SC, a phase coherent demodulator is needed. However, the high spectral efficiency of this technic causes it to be used in **telephone communication**.

So there is a bargain between bandwidth and simplicity in demodulator design. In another method named vestigial sideband or ***VSB\_AM*** modulation, a part of the unwanted signal is allowed to pass resulting in the simplicity of demodulator, thus it is ideal for standard TV broadcasting.

So and ***SSB\_AM*** are ***VSB\_AM*** roughly the developed forms of ***DSB\_AM***.

# Multiplexing:

This method is Used When we intend to send multiple signals having different frequencies over a channel. First, signals pass a LPF to make sure their bandwidth is W, then modulated and summed in order to be sent. After being received, they should pass a BPF so that each message gets its unique frequency, then they get demodulated and again each should pass a LPF so that parts having a frequency more than W, would disappear.

Furthermore, when we have signals of the same frequency, we use a quadrature multiplexer which in case of a two same frequency signal, will multiply *m1* by *cos(2 fc t)* and *m2* by *sin(2 fc t).*