Principle of Communication (BEC-28)

Amplitude Modulation

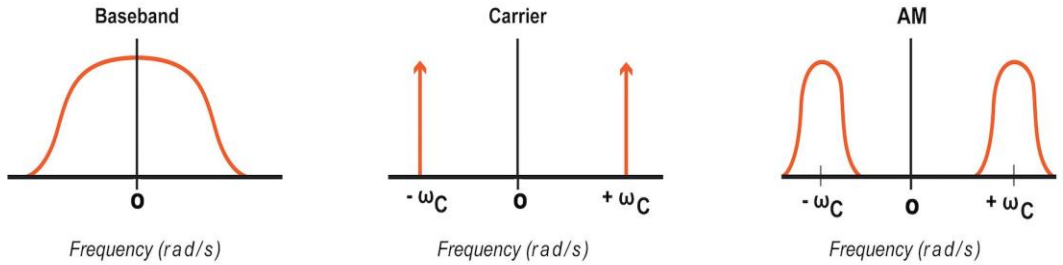
Dr. Dharmendra Kumar
- Assistant Professor
- Department of Electronics and Communication Engineering
- MMM University of Technology, Gorakhpur–273010.
- Email: dkece@mmmut.ac.in

UNIT-1

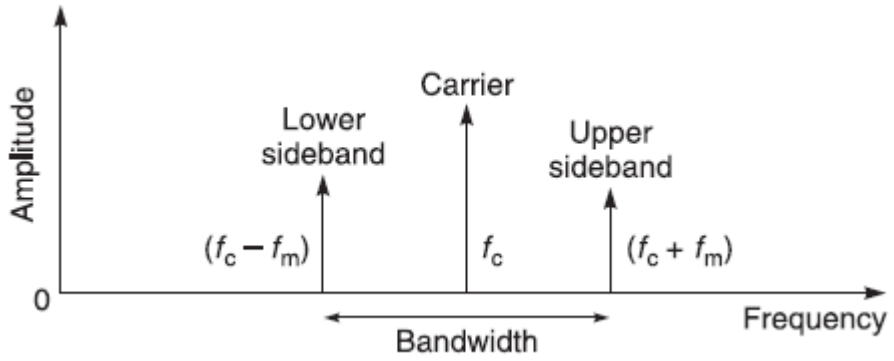
- Overview of Communication system
- Communication channels
- Need for modulation
- Baseband and Pass band signals
- Comparison of various AM systems
- Amplitude Modulation
  - Double side-band with Carrier (DSB-C)
  - Double side-band without Carrier
  - Single Side-band Modulation
  - SSB Modulators and Demodulators
  - Vestigial Side-band (VSB)
  - Quadrature Amplitude Modulator.

Frequency Spectrum of AM Signal

- When Message signal spectrum has continuous band of frequency



- When Message signal spectrum has single frequency



Problem

Problem1. A modulating signal $m(t) = 10\cos(2\pi \times 10^3 t)$ is amplitude modulated with a carrier signal $c(t) = 50\cos(2\pi \times 10^5 t)$. Find the modulation index, the carrier power, and the power required for transmitting AM wave.

Solution:

$$m(t) = 10\cos(2\pi \times 10^3 t)$$

$$f_m = 10^3 Hz = 1KHz$$

$$c(t) = 50\cos(2\pi \times 10^5 t)$$

$$A_c = 50volts$$

$$f_c = 10^5 Hz = 100KHz$$

$$\mu = \frac{A_m}{A_c}$$

$$\mu = \frac{10}{50} = 0.2$$

$$P_c = \frac{{A_c}^2}{2R}$$

Assume $R = 1\Omega$ and substitute A_c value in the above formula.

$$P_c = \frac{(50)^2}{2(1)} = 1250W$$

$$\Rightarrow P_t = P_c\left(1 + \frac{\mu^2}{2}\right)$$

$$P_t = 1250\left(1 + \frac{(0.2)^2}{2}\right) = 1275W$$

Problem…

Problem2. The equation of amplitude wave is given by $s(t) = 20\left[1 + 0.8\cos\left(2\pi \times 10^3 t\right)\right]\cos\left(4\pi \times 10^5 t\right)$. Find the carrier power, the total sideband power, and the band width of AM wave.

Solution:

$$s(t) = 20\left[1 + 0.8\cos\left(2\pi \times 10^3 t\right)\right]\cos\left(4\pi \times 10^5 t\right)$$

$$s(t) = 20\left[1 + 0.8\cos\left(2\pi \times 10^3 t\right)\right]\cos\left(2\pi \times 2 \times 10^5 t\right)$$

$$s(t) = A_c\left[1 + \mu\cos(2\pi f_m t)\right]\cos(2\pi f_c t)$$

$$A_c = 20volts \quad \mu = 0.8$$

$$f_m = 10^3 Hz = 1KHz$$

$$f_c = 2 \times 10^5 Hz = 200KHz$$

$$P_c = \frac{{A_e}^2}{2R} = 200W$$

$$P_{SB} = \frac{P_c \mu^2}{2} = 64W$$

$$BW = 2f_m = 2KHz$$

Problem for practice (Assignment-1)

1. For an AM total sideband power is given by 100 watts with 50% of modulation. Find total AM transmitted power.
2. For an AM each of the sideband power is given by 2Kwatts and carrier power is given by 8 Kwatt. Find percentage of modulation.
3. A carrier of $10\cos(8\pi \times 10^6 t)$ is amplitude modulated by a message signal of $4\cos(4\pi \times 10^3 t)$ with 50% of modulation. Antenna resistance is given by 5 ohm. Find all parameters of AM. Plot AM spectrum and identify the spectral components.
4. A carrier of $10\cos(8\pi \times 10^5 t)$ is amplitude modulated by a message signal of $6\cos(\pi \times 10^4 t)$ with 50% of modulation. Find all parameters of AM. Plot AM spectrum and identify the spectral components.
5. An AM signal is given by

   $$s(t) = 4\cos(3200\pi t) + 10\cos(4000\pi t) + 4\cos(4800\pi t)$$

   Find all the parameter and plot spectrum.

Thank You