# Tutorial-3: Communication Circuit Design

AM, SSC, FM, PLL

Question 1:   A I.4-MHz carrier is modulated by a music signal that has frequency components from 20 Hz to 10 kHz. Determine the range of frequencies generated for the upper and lower side bands.

Question 2:   An unmodulated carrier is 560 V p-p. Calculate $\%m$ when its maximum p-p value reaches 700 V.

Question 3:   Determine the maximum sideband power if the carrier output is I kW. Also calculate the total maximum transmitted power.

Question 4:   A 100-V carrier is modulated by a 1-kHz sine wave. Determine the side-frequency amplitudes when m = 0.75.

Question 5:   A 500-W carrier is to be modulated to a 90 percent level. Determine the total transmitted power.

Question 6:   An AM broadcast station operates at its maximum allowed total output of 50 kW and at 95 percent modulation. How much of its transmitted power is intelligence (sidebands)?

Question 7:   An AM transmitter has a 1-kW carrier and is modulated by three different sine waves having equal amplitudes. If m_{eff} = 0.8, calculate the individual values of m and the total transmitted power.

Question 8:   A TRF receiver is to be designed with a single tuned circuit using a 10-µH inductor.
a) Calculate the capacitance range of the variable capacitor required to tune from 550 to 1550 kHz.
b) The ideal 10-kHz BW is to occur at 1100 kHz. Determine the required Q.
c) Calculate the BW of this receiver at 550 kHz and 1550 kHz.

Question 9:   Calculate the required Q for the situation depicted in figure below for
a) A 1-MHz carrier and 80-dB sideband suppression.
b) A 1-MHz carrier and 80-dB sideband suppression.
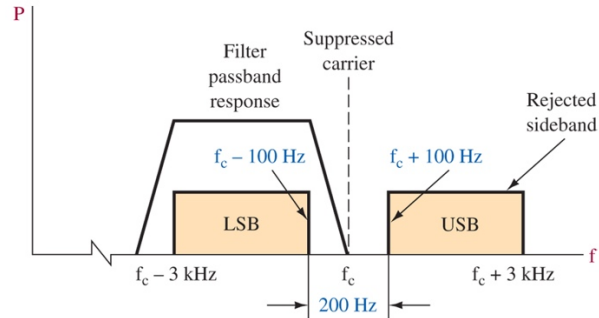
Question 10: A 25-mV sinusoid at a frequency of 400 Hz is applied to a capacitor microphone FM generator. If the deviation constant for the capacitor microphone FM generator is 750 Hz/10 mV, determine
    a) The frequency deviation generated by an input level of 25 mV
    b) The rate at which the carrier frequency is being deviated.

Question 11: An FM signal has a center frequency of 100 MHz but is swinging between 100.001 MHz and 99.999 MHz at a rate of 100 times per second.
Determine:
a) The intelligence frequency f_i.
b) The intelligence amplitude.
c) What happened to the intelligence amplitude if the frequency deviation changed to between 100.002 and 99.998 MHz

Question 12: Determine the bandwidth required to transmit an FM signal with fi = 10 kHz and a maximum deviation δ = 20 kHz.

Question 13:
    a) Determine the permissible range in maximum modulation index for commercial FM that has 30-Hz to 15-kHz modulating frequencies.
    b) Repeat for a narrowband system that allows a maximum deviation of 1-kHz and 100-Hz to 2-kHz modulating frequencies.
    c) Determine the deviation ratio for the system in part (b).

Question 14: Determine the worst-case output _S/N_ for a broadcast FM program that has a maximum intelligence frequency of 5 kHz. The input _S/N_ is 2.

Question 15: A PLL is set up so that its VCO free-runs at 10 MHz. The VCO does not change frequency until the input is within 50 kHz of 10 MHz. After that condition, the VCO follows the input to ±200 kHz of 10 MHz before the VCO starts to free-run again. Determine the lock and capture ranges of the PLL.