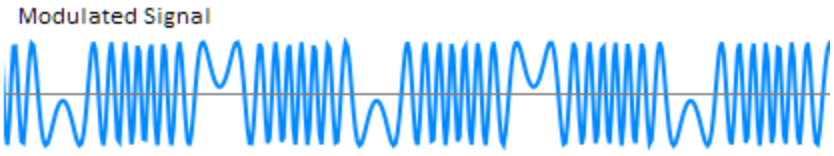
Question 1:

Angle modulation is the process by which the angle (frequency or phase) of the carrier signal is changed in accordance with the instantaneous amplitude of modulating or message signal. Please
(i) Differentiate between phase and frequency modulation.

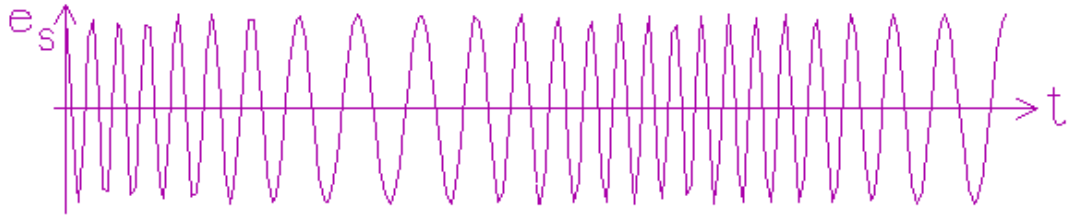
(ii) Discuss the advantages of Frequency Modulation (FM) over Amplitude Modulation (AM)

Answer 1
(i) When the amount of phase shift of a constant-frequency carrier is varied in accordance with a modulating signal, the resulting output is a **phase-modulation (PM) signal.**



Phase Modulation

A sine wave carrier can be modified for the purpose of transmitting information from one place to another by varying its frequency. This is known as **frequency modulation (FM).**



(ii)
✓ Freedom from interference: all natural and external noise consist of amplitude variations, thus receiver usually cannot distinguish between amplitude of noise or desired signal. AM is noisy than FM.
✓ Operate in very high frequency band (VHF): 88MHz-108MHz .
✓ Can transmit musical programs with higher degree of fidelity.

Question 2:

When the carrier signal $v_c(t) = 5\sin(12x10^5 \pi t)\,\mathrm{V}$ is frequency modulated by the message signal $v_m(t) = 2\sin(12x10^5 \pi t)$, the carrier frequency varies within 5% of its unmodulated value.

(ii) What is frequency sensitivity of the modulator

(iii) Determine the Carson's bandwidth and actual transmission bandwidth [2 marks]

Answer

(i) modulation index

$$f_c = \frac{12x10^5 \pi}{2\pi} = 600kHz,\ f_m = \frac{12x10^5 \pi}{2\pi} = 6kHz$$

$$\Delta f = 5\% x f_c = 0.05x600k = 30kHz$$

$$m = \frac{\Delta f}{f_m} = \frac{30k}{6k} = 5$$

(ii) frequency sensitivity

$$\Delta f = K_1 V_m$$

$$K_1 = \frac{\Delta f}{V_m} = \frac{30k}{2} = 15kHz/V$$

iii) Carson's bandwidth and actual transmission bandwidth)

$$BW_c = 2(\Delta f + f_m) = 2(30k + 6k) = 72kHz$$

$$BW_B = 2nf_m = 2(8)(6k) = 96kHz$$

Question 3:

Evaluate the carrier and modulating frequencies, the modulating index, and the maximum deviation of an FM wave for the expression:
V= 12 sin (6 x 10^8 t + 5 sin 1250 t)
Calculate the power where the wave dissipates in a 10 ohm resistor.

Answer 3
modulation index as given, m = 5

$$f_c = \frac{\omega_c}{2\pi} = \frac{6 \times 10^8}{2\pi} = 95.5MHz$$

$$f_m = \frac{\omega_m}{2\pi} = \frac{1250}{2\pi} = 199\ Hz$$

$$\Delta f = mfm = 5 \times 199 = 995\ Hz$$

$$P = \frac{V_{rms}^2}{R} = \frac{\left(\frac{12}{\sqrt{2}}\right)^2}{10} = \frac{72}{10} = 7.2\ W$$