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CSE-431

Class Test-2

1. Ans Amplitude Modulation Index: Modulation Index μ is a measure of the extent to which a carrier voltage is varied by the modulating signal.

Modulation Index is defined as: $\mu = \frac{A_m}{A_c}$

Modulation: In the modulation process, some characteristic of a high-frequency carrier signal is changed according to the instantaneous amplitude of the information signal

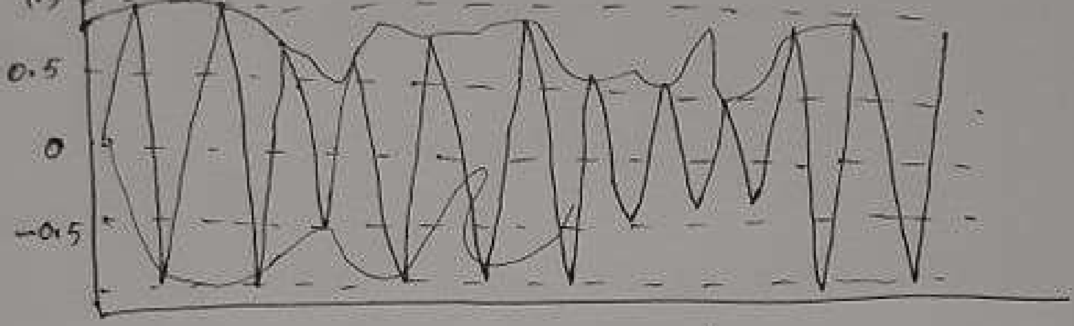
Basic Modulation 3 type:

(i) Amplitude modulation Index.

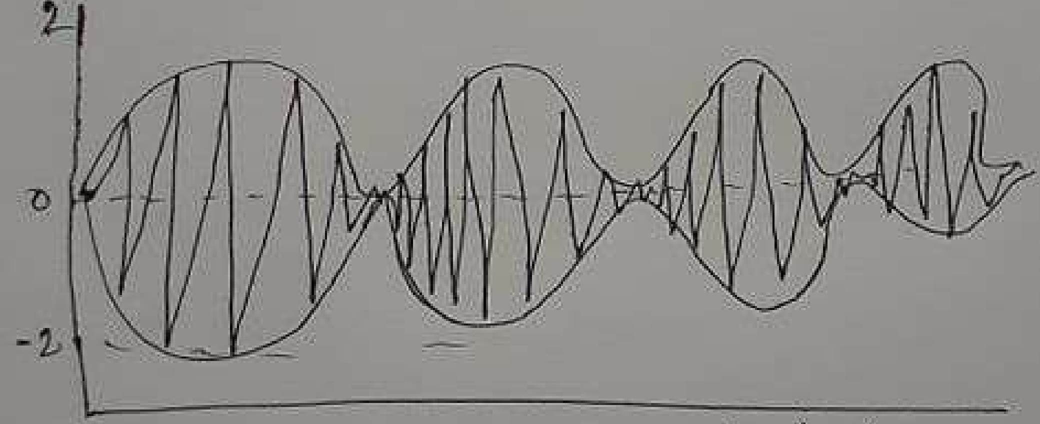
(ii) frequency modulation Index

(iii) Phase modulation Index.

Amplitude modulation:



50% modulation



100% modulation

Amplitude modulation:

$$S_{am}(t) = [A_c + k_a m(t)] \cos\omega_c t$$

$$= [A_c + k_a A_m \sin\omega_m t] \cos\omega_c t$$

$$= A_c\left[1 + \frac{k_a A_m}{A_c}\sin\omega_m t\right]\cos\omega_c t$$

$$= A_c[1 + \mu \sin\omega_m t]\cos\omega_c t$$

$$= A_c \cos\omega_c t + \mu A_c \sin\omega_m t \cos_c t$$

$$= A_c \cos\omega_c t + \mu A_c \sin\omega_m t \cos_c t$$

$$= \cancel{A_c \cos\omega_c t + \mu A_c \sin\omega_m}$$

$$= A_c \cos\omega_c t + \mu \frac{A_c}{2}[2\sin\omega_m t \cos\omega_c t]$$

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

$$S_{AM}(t) = A_c \cos\omega_c t + \mu \frac{A_c}{2}[(\sin(\omega_c + \omega_m)t - \sin(\omega_c - \omega_m)t]$$

1st term frequency $= f_c$

2nd term frequency $= f_c + f_m$

3rd term frequency $= f_c - f_m$

$S_{AM}(f) = FT\{S_{AM}(t)\}$

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

NOW,

$\cos\omega_c t = \frac{1}{2}\{e^{j\omega_c t} + e^{-j\omega_c t}\}$

$FT\{\cos\omega_c t\} = \frac{1}{2}\delta(f-f_c) + \frac{1}{2}\delta(f+f_c)$

$\sin\omega_c t = \frac{1}{2j}\{e^{j\omega_c t} - e^{-j\omega_c t}\}$

$FT\{\sin\omega_c t\} = \frac{1}{2j}[\delta(f-f_c) - \delta(f+f_c)]$

$S_{AM}(f)$

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

$= \frac{A_c}{2}[\delta(f-f_c) + \delta(f+f_c)] - \mu \frac{A_c}{4j}\delta(f-(f_c-f_m) +$
$\mu \cdot \frac{A_c}{4j}\delta(f+(f_c-f_m) + \mu \frac{A_c}{4j}\delta(f-(f_c+f_m))$
$- \mu \frac{A_c}{4j}\delta(f+(f_c+f_m)$