Department of Electrical Engineering

Mid Assignment Summer 2020

Subject: Communication Systems

Max Marks: 30

NAME RAFI UDDIN ID 12401

Question No. 1 (10)

a. How SNR is related to quality of received signal in a wireless communication system?

b. Draw and explain the basic block diagram of a communication system

c. Why is it required to modulate the signal for distant wireless communication?

d. Digital signals are not preferred for the communication over wireless communication channel despite the fact they are easy to represent and analyze. please support the statement with your argument.

e. Determine the power and rms value of $f(t) \ C\cos(\ _0 t)$

Question No. 2 (10)

a. Two sinusoidal signals $5\cos 2 \ 10^6 t$ and $3\cos 2 \ 10^3 t$ are desired distance of 20 kilometers. Determine the height of antennas for each signal required to receive the transmitted signals efficiently.

b. Derive the expression for effective power accumulated in the spectrum of an AM wave

Question No. 3 (10)

a. Draw and explain the AM waveform for less than 100%, 100% and greater than 100% modulation cases considering carrier signal $e_c(t) \ 12\sin \ t$ and a sinusoidal message signal.

b. A sinusoidal carrier has amplitude of 7 V and frequency of 1 MHz It is amplitude modulated by the sinusoidal voltage of 3.5V and frequency 5 kHz.

   i. Write the equation for message, carrier and modulated waves

ii. Plot the AM wave in time domain as well as its frequency domain spectrum

iii. Find the depth of modulation and calculate the transmission efficiency

iv. Calculate the total power in spectrum

v. Calculate the percentage power in USB

NAME RAFI UD DIN

ID 12401

QNo1

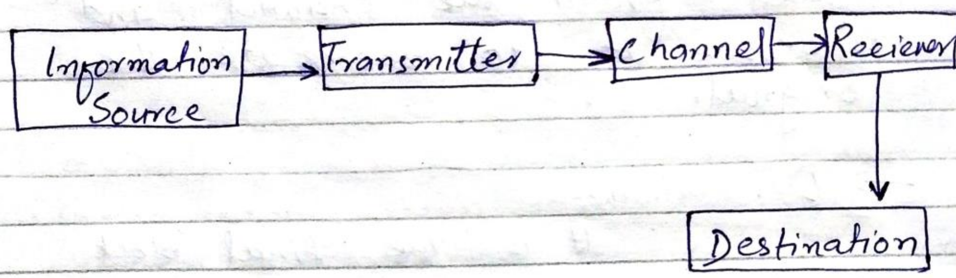
a) HOW SNR is Related to quality of recieving signal in a wirless communication?

Ans:- The SNR of an access point measured at the user device decreses the range to the user incresss because the applicable free space loss between the user and the asess point ~~increses~~ reduce signal level. SNR directly impacts the performance of a wirless LAN connection. A higher SNR value means the signal strength is stronger in relation to the noise level. A lower SNR requires wirless LAN device to operate at lower data rates.

QNO1

b) Draw and Explain the basic block diagram of communication system?

Ans:- The basic block diagram of a communication system will have 'five blocks.



Explaination:-

→ Information Source:-

The objective of any communication system is to convey information from one point to the another. the information comes from the information source which orignates it

→ **Transmitter:-**

The transmitter collect the incoming message signal and modify it in a suitable fashion such that it can be transmitted via the choosen chanel to the receiving point.

→ **Channel:-**

Channel is the physical medium which connets the transmitter with that of the reciever.

→ **Reciver:-**

It recieves the incoming modified version of the message signal from the channel and processes it to recreate the orignal.

→ **Destination:-**

It is the final block which recieves the message signal and proesses it to comprehend the information present in it.

QNo 1

C: **Answer:-**

The base band signal are incomplete for direct transmission for such signal to travel longer distance it strength to be incresed by modulating with higher frequeny carrier wave which doesnot effect the parameters of modulating signal.

QNo 1

D: **Answer:-**

If we send digital data directly through the air you will probably interfaing with other trammeler so to seprate different channel the signal is modulated in a given frequeny band. You can do this by digital modulation but ~~with a square signal~~ due to harmonics you will impect other chanal during you demodulation depending on the other chanel your signal will be distorted Moreover you can suffer of bandwidth problem of your power amplifier which will also your transmission.

QNo1

e) Answers-

The periodic signal with period

$T_0 = 2\pi/w_0$

So

$$P_t = \lim_{T\to\infty} \frac{1}{T}\int_{-T/2}^{T/2} C^2\cos^2(\omega_0 t+\theta)\,dt$$

$$= \lim_{T\to\infty} \frac{1}{T}\int_{-T/2}^{T/2} \frac{C^2}{2}\left[1+\cos(2w_0 t+2\theta)\right]dt$$

$$= \lim_{T\to\infty} \frac{C^2}{2T}\int_{-T/2}^{T/2} dt + \lim_{T\to\infty} \frac{C^2}{2T}\int_{-T/2}^{T/2} \cos(2w_0 t+2\theta)\,dt.$$

The first term on the RHS equals $C^2/2$ while the second term is zero because the integral appears in this term represents the area under a sinosidal over a very large time interval T with $T\to\infty$ this area is the most equal to the area of half cycle because of cancellations of the postive and negative area of sinusoidal. the 2nd term area multiplied by $C^2/2T$

$$P_t = C^2/2$$

The rms value is $c/\sqrt{2}$.

Q No 2
part a)

Solution:-

Given That
Two sinusoidal signal
$5\cos 2\pi 10^6 t$
$3\cos 2\pi 10^3 t$
Distance = 20 KM

height of antennas = ?

Sol:
① $5\cos 2\pi 10^6$
② $3\cos 2\pi 10^3$

① $f_1 = 2\times10^6$
so $\lambda = c/f_1$
c = Speed of light

$\lambda = 3\times10^8 / 2\times10^6$

$\lambda = 3/2 \times 10^{8-6}$

$\lambda = 3/2 \times 10^2$

$\lambda = 1.5\times10^2\, m$

2) $f_2 = 2 \times 10^3$

$\lambda = c/f_2$

$= 3 \times 10^8 / 2 \times 10^3$

$\boxed{\lambda = 1.5 \times 10^5 \, m \quad Am}$

QNo 2

b) Answer:-

$X_m(t) = A_m \cos w_m(t)$

$X_c(t) = A_c \cos w_c t$

$X_{AM}(t) = A_c [1 + m \cos w_m(t)] \cos w_c(t)$

$\cos w_c(t)$ multiplied te equation.

$X_{AM}(t) = A_c \cos w_c(t) + X_m(t) \cos w_c t \rightarrow (1)$

$X_{AM}(t) = X_1(t) + X_2(t)$

As we know that

$\cos w(t) = \frac{1}{2}\left[e^{jwt} + e^{-jwt}\right] \rightarrow (2)$

$X_{AM}(t) = \frac{A_c}{2}\left(e^{jwt} + e^{-jwt}\right) + \frac{X_m(t)}{2}$

$\left(e^{jwt} + e^{-jwt}\right) \rightarrow 3$

$X_m(t) \, e^{jw_c t} \rightarrow X(w_c - w_m)$

$X_m(t) \, e^{-jw_c t} \rightarrow X(w_c + w_m)$

eq 3 becomes.

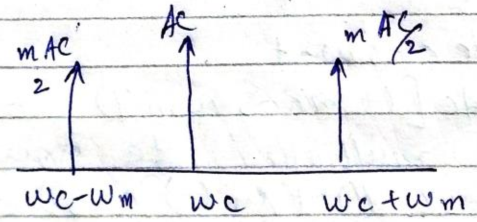
$X_{AM}(t) = \frac{1}{2} x_m(t) e^{j w_c t} + \frac{1}{2} x_m(t) e^{-j w_c t}$

$X_2(t) = \frac{1}{2} x(\omega_c - \omega_m) + \frac{1}{2} x(\omega_c + \omega_m)$

$X_1(t) = \pi A(\delta(\omega - \omega_c) + \delta(\omega + \omega_c))$

$X_{AM}(t) = \pi A \left[(\delta(\omega - \omega_c) + \delta(\omega + \omega_c)) + \frac{1}{2}(x(\omega_c + \omega_m) + x(\omega_c + \omega_m)) \right]$

POWER OF AM WAVE



$X_{AM}(t) = A_c \cos w_c t = m \frac{A_c}{2} \left[\cos(w_c - w_m t) + x(w_c - w_m) \right]$

Power = Power (LSB) + P(USB) + Pc

Ac/V Am/Vm

V_c Rms = $V_c/\sqrt{2}$

V_m, Rms = $V_m/\sqrt{2}$

$P_C = V_c^2/R \Rightarrow V_c^2/(\sqrt{2}\, R$

$\Rightarrow V^2/2R$

$P_M = V_m^2/R \Rightarrow V_m^2/R$

$\Rightarrow \left(\frac{m V_c}{2}\right)^2 / 2R$

$= \frac{m^2 V_c^2}{4-2R} \Rightarrow m^2 P_c$

$P_t = P_c \left(1 + \frac{m^2}{2}\right.$

Bandwidth $= f_H - f_l$

$B = (\omega_c - \omega_m)$

$B = 2\omega_m$.

Q# No3(a)

(i) if $m<1$
(ii) $m=1$
(iii) $m>1$

$x_m(t)$

$x_c(t)$

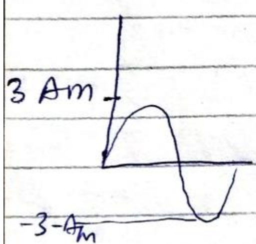
$m = \frac{A_m}{A_c}$

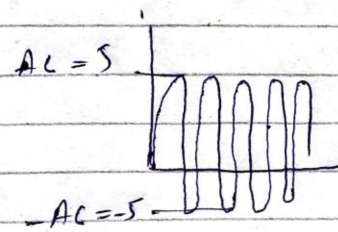
$m<1 \Rightarrow A_c > A_m$

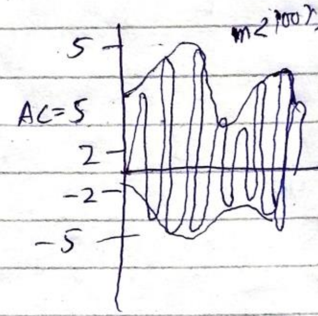
$m=1 \Rightarrow A_c = A_m$

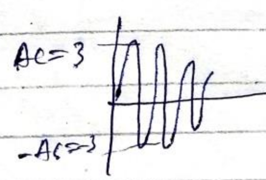
$m=1 \Rightarrow A_c < A_m$

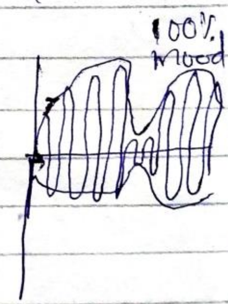
$x_{Am}(t)$

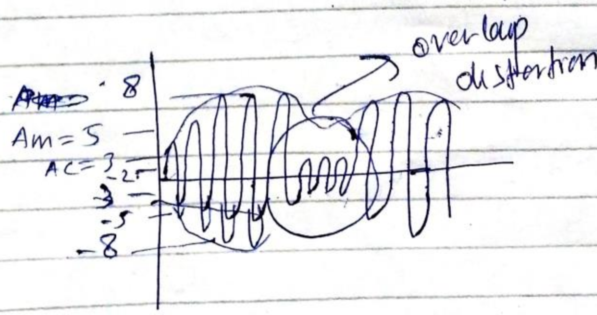












Q No 3

b) A Sinosiad carrier has amplitude of 7V and frequny of 1MHz it is amplitude moddulation by the sinosidal voltage of 3.5V and frequny of 5KHz.

(a) Write the equation for message carrier and modulated waves.

(2) Plot the AM wave in time domain as well as frequny domain spectrum.

3) Find the depth of modulation and calculatee the transmission effieny.

4) Calculate the total power in spectrum

5) Calculate the percentage of power in USB.

a) Sol: Message equation = $3.5\cos 5\times10^{3}$ Hz

Carrier equation = $7\cos 1\times10^{6}$ Hz

Modulated signal = $7(1+0.5\cos 1\times10^{3}t)\cos 1\times10^{6}t$.

Modulation Index E_m / E_c

$= 3.5/7$

$= 0.5$

② Equation of Modulated wave.

$$s(t) = E_c(1+m.\cos w_m t)\cos w_c t$$

$$s(t) = 7(1+0.5\cos(2\pi \times 5\times10^3 t)\cos(2\pi\times1\times10^6 t)$$

$$= 7(1+0.5\cos(10\pi\times10^3 t)\cos 2\pi\times10^6 t)$$