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Subject Communication system
Exam: Summer (MID)

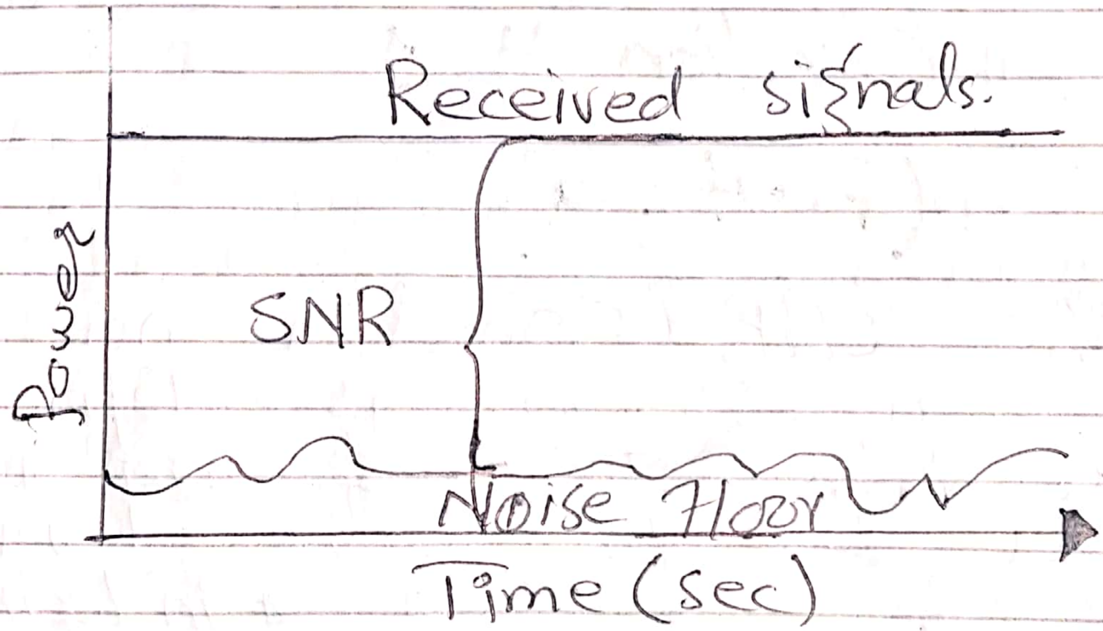
Question # 1
(Part: a)

The SNR (signal to noise ratio) of a system is defined as "the ratio of ~~nois~~ signal level to the noise level" It is expressed a in decibels. It is calculated by dividing signal power by noise power, if ~~the~~ the ratio is bigger than one/1 decibel, it indicates that the signal is more than the noise and signal is useable.

If the ration is less than one/1 decibel, it indicates that the noise level is bigger than the signal level and the signal is unuseable.

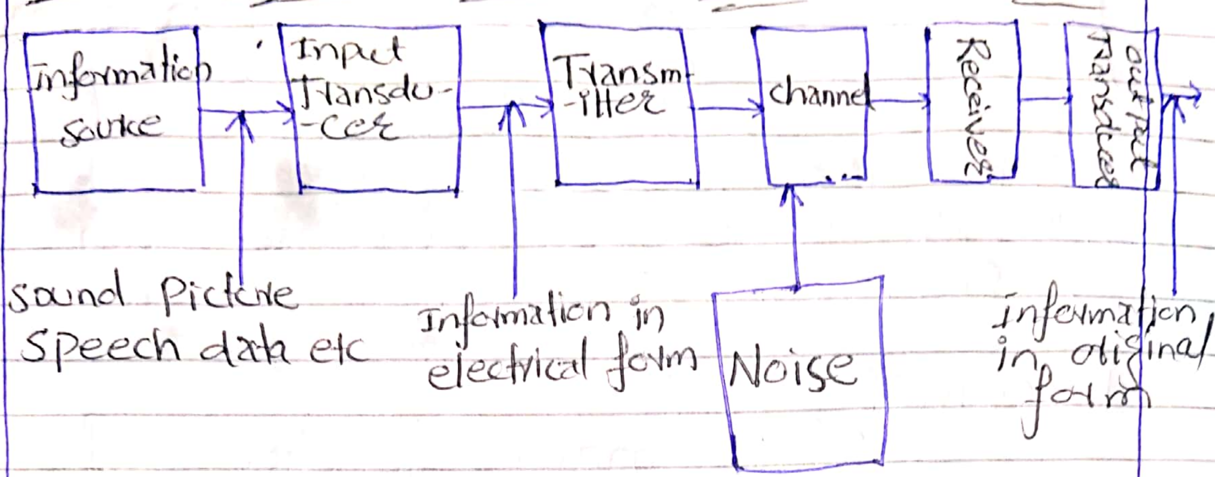
The signal close to the noise floor can subject to data corruption.

The SNR Provides more accurate deciption of health of the signals in wireless communication.



Question #1 (Part : b)

Block Digram of communication system:



① **Information source:** It Produces required message which is tobe transmitted.

② **Input Transducer:** The message Produced by the information source is converted into electrical signals by the input transducer.

③ **Transmitter:** The main function of transmitter is to Process the electrical signals. In transmitter there is emplification and modulation of signals.

④ **Channel in the Noise:** The medium through which the signal travel from transmitter to receiver is called channel.

It provides Physical connection between transmitter and receiver. Noise is unwanted signals that interfere with the required signals.
It is always random in character.

Receiver:
The main function of receiver is demodulation to reproduce the message signals in electrical form from distoted received signals.

Distenation:
It is the final stage, the electrical message is converted into its original form.

Question # 1

Part : C

When the message frequency is too low fo travel and reach the long distance during the transmission, we modulate it with a carrier signals and sended. and modulation process som parameter of carrier wave (implitude, frequency) is varied according to the modulating signal. and is than transmitted.

It is necessary to modulate a signals because.

① It avoids miking of signals without ; using modulation all the signals of same frequency will get mix. and can not be seperated from each other

② It increases the range of communication. as we know that low frequency signals can not travel for long distance and get attenuated so modulation is required.

③ Reduction in the hight of antenna.

(4) With modulation multiplexing is possible

(5) It improved quality of reception

★ ——— ★

Question # 1

Part:(d)

=> Digital is an abstract information it dond actually exist in reality. All signals are analog. It is a meaning we choose to assign to Physical values. You can not send a digital signals over the air. It must be first converted into something that exist in reality like an analog signals which represent the information to be transmitted.

The real signal is madeup of physical analog values like voltage light current.

★ ——— ★

(Part:e)

$F(t) = C\cos(\omega_0 t + \theta)$ This is the periodic signal with period $t_0 = 2\pi/\omega_0$

its power is computed by

averaging its energy over a one period $2\pi/\omega_0$.

we shall solve this Problem by averaging energy over infinitly.

we Know that

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

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

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

The first term $C^2/2$ represnts the right side while the second term is zero/0 because it represents the area under ~~sinusoide~~ sinusoide over a large time interval.

⇒ The second term it this area multiplied by $C^2/2T$ as $T\to\infty$ then this term is zero.

~~[illegible]~~

$$\left(P_f = \frac{C^2}{2}\right)$$

The rms value is

$$\boxed{rms = \frac{C}{\sqrt{2}}}$$

Question # 2
(Part : a)

<u>Answer</u>:

$5 \cos 2\pi 10^6$

$h = \lambda/4 = c/4f$

$S = 20$ Km

$f = 10^6$

By putting the values

$h = c/4f$

$$h = \frac{3 \times 10^{8\,5}}{4 \times 10^{3}}$$

$h = 75$ meter.

$3 \cos 2\pi 10^3 t$

$h = c/4f$

$f = 10^3 \Rightarrow h = c/4f$

$$h = \frac{3 \times 10^{8\,5}}{4 \times 10^{3}} = \frac{3 \times 10^5}{4}$$

$h = 75\,000$ meters.

Question # 2
(Part : b)

Power of AM wave is equal to the sum of power of carrier, upper side band, lower side band frequency components.

$$P_t = P_c + P_{USB} + P_{LSB}$$

We know that the standard formula for Power of cos signal is

$$P = \frac{V_{rms}^2}{R} = \frac{(V_m/\sqrt{2})^2}{2}$$

Where
V_{rms} is the rms value of cos signal
V_m is the peak value of cos signal.

First, let us find the powers of the carrier, the upper and lower sideband one by one.

carrier power

$$P_c = \frac{(A_c/\sqrt{2})^2}{R} = \frac{A_c^2}{2R}$$

upper sideband power:

$$P_{USB} = \frac{(A_c\mu/2\sqrt{2})^2}{R} = \frac{A_c^2\mu^2}{8R}$$

Similarly, we will get the lower sideband power same as that of the upper sideband power.

$$P_{LSB} = \frac{A_c^2 \mu^2}{8R}$$

Now, let us add these three powers in order to get the power of AM wave

$$P_t = \frac{A_c^2}{2R} + \frac{A_c^2 \mu^2}{8R} + \frac{A_c^2 \mu^2}{8R}$$

$$\Rightarrow P_t = \left(\frac{A_c^2}{2R}\right)\left(1 + \frac{\mu^2}{4} + \frac{\mu^2}{4}\right)$$

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

We can use the formula to calculate the power of AM wave, Then the carrier power and the modulation index are know.

If the modulation index $\mu = 1$ then the power of AM wave is equal to 1.5 times the carrier power. So, the power required for transmitting an AM wave is 1.5 times the carrier power for a perfect modulation.

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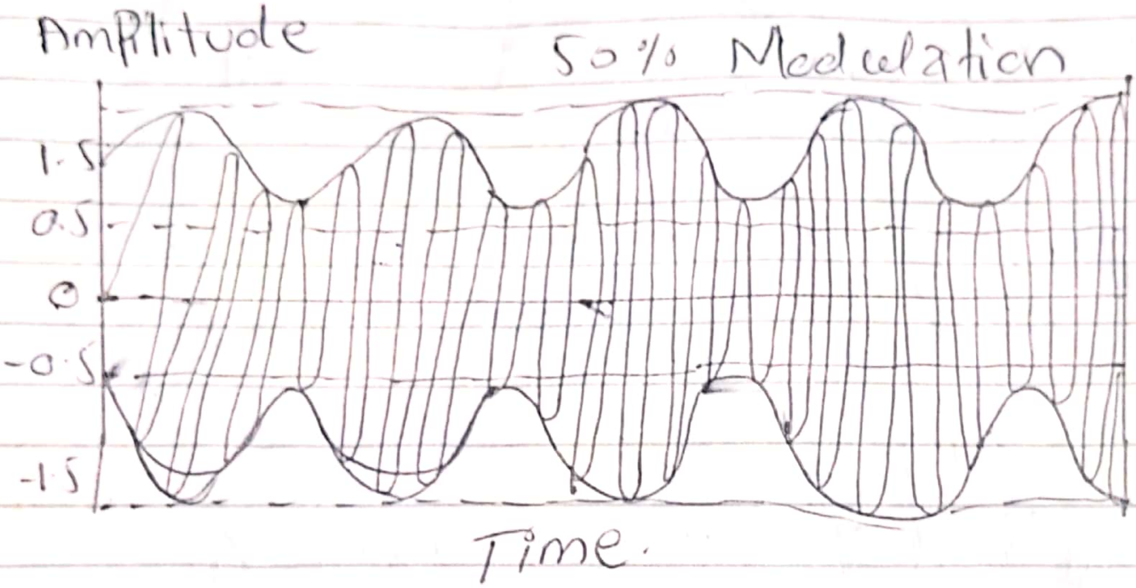
Question #3
(Part : a)

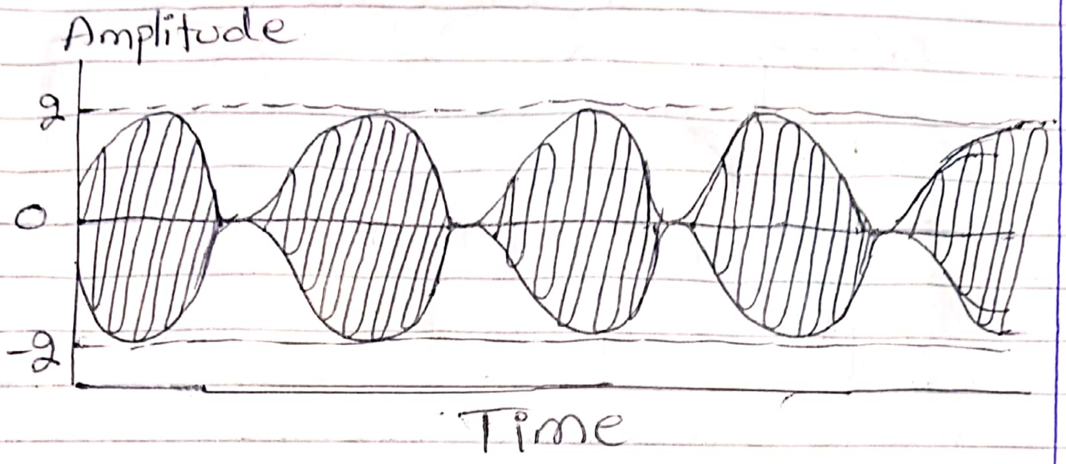
Modulation Diagrams

(a) : Less than 100 %



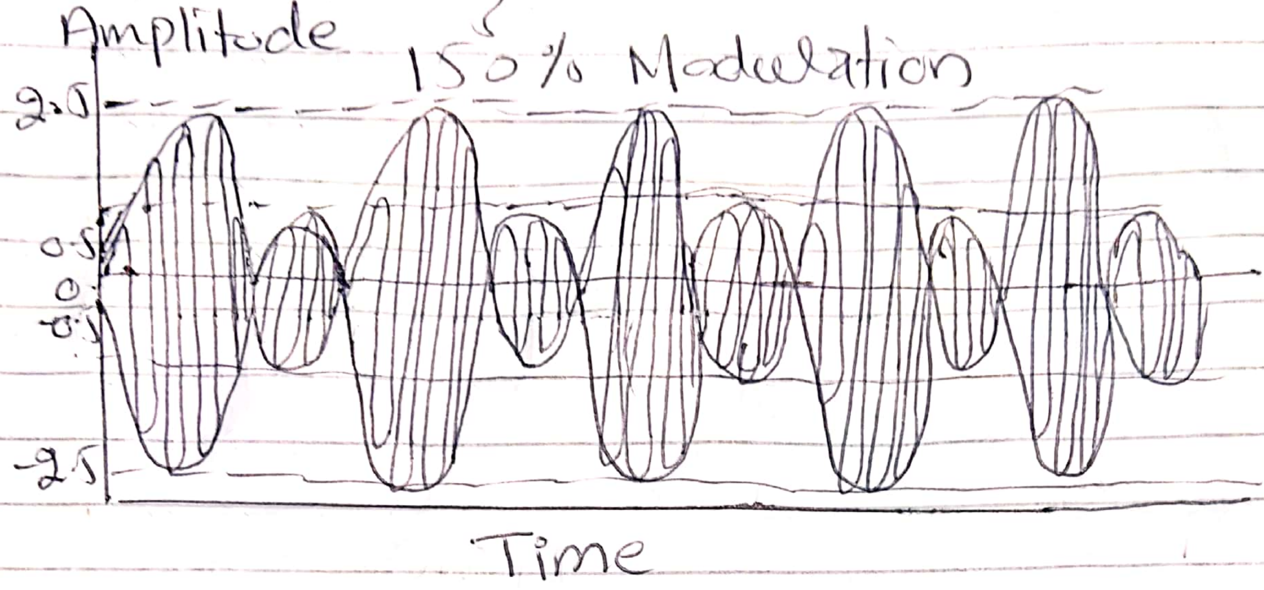
⇒ When the modulation index is less than 100 is called under modulation. and the wave is called under modulated wave.
Such systems attempts a radical reduction of the carrier level compare to the side bands. ~~for such cases~~
It is also called double side band suppress carrier transmission.

(b) 100 % Modulation



⇒ With 100 % modulation the wave amplitude some times reach to zero. and this represents full modulation using standard amplitude modulation. And to obtain the highest possible signal to noise ratio.

Modulation greater than 100 %



⇒ The modulation index is above 100 % is called over-modulation.
In this case negative excursion ~~by~~ beyond zero enteils a reversal of the carrier phase.
It can not be produce using high efficient level modulation techniques.
It is also called double sideband reduced carrier transmission.

Q#3 (Part:b)

Given data:

$E_c = 7V$
$f_c = 1 MHz$
$E_M = 3.5 V$ and
$f_m = 5 KHz$

(i) Modulation index:- $\frac{E_m}{E_c} = \frac{3.5v}{7}$

$M = 0.5$

(ii) Equation for modulation wave.

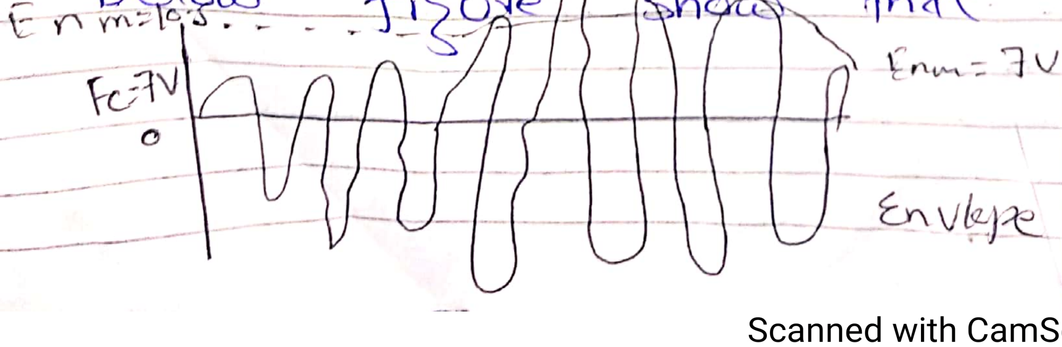
$S(t) = E_c [1 + M . \cos \omega_m(t)) \cos(\omega_c t)]$

$= 7.[1 + 0.5 \cos(2\pi \times 5 \times 10^3 t)$
$\cos(2\pi \times 1 \times 10^6 t)$

$S(t) = 10 [1 + 0.3 \cos(10\pi \times 10^3 t)$
$\cos(2\pi \times 10^6 t)$

(iii) Modulation wave form:

Below figure show that



(IV) Spectrum of Modulation:-
wavelength:-

$f_{USB} = f_c + f_m = 1 \times 10^6 + 5 \times 10^3$

$= 1000 \times 10^3 + 5 + 10^3$

$= 1000 \times 10^3 + 5 \times 10^3$

$= 1005$ KHz.

$f_{LSB} = f_c - f_m = 1000$ KHz

Am of each sinusoidal =

$\frac{m}{2} \times E_c$

$= \frac{0.5}{2} \times 7$

$= 1.75V$