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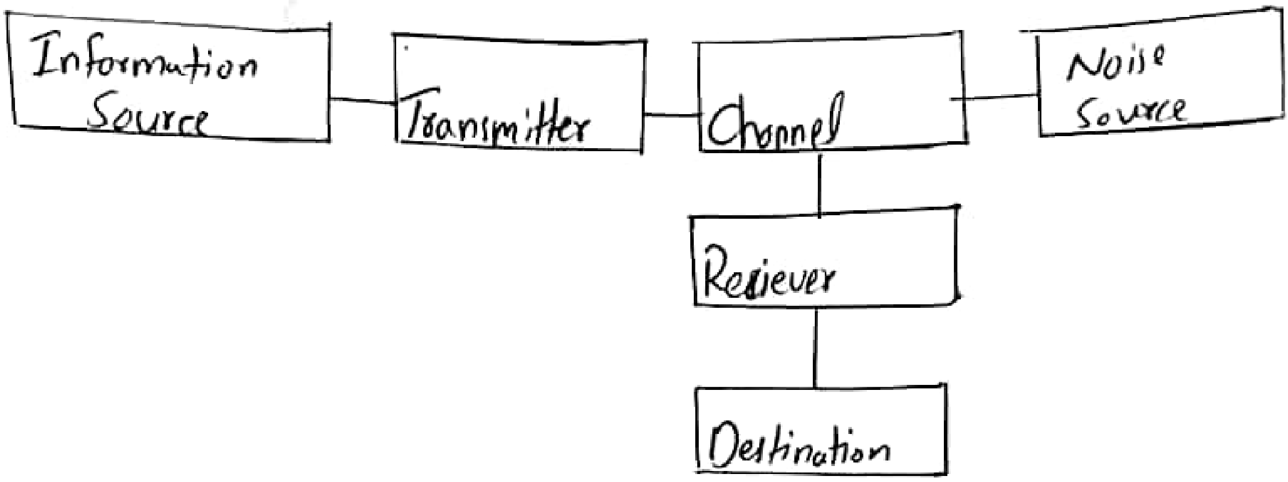
Communication System

Q.1
PART - B



Information source:-

The objective of any communication system is to convey information from one point to the other. The information comes from the information source. which originates it. Information is a very generic word signifying at the abstract level

ID: 13748
Name: Hamza Ishaq
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(2)

communication

anything intended from

which may include some thoughts.

news- feeling. visual scene, and so on

The information source converts this information into physical quantity.

② Transmitter:

The objective of the transmitter block is to collect the incoming message signal and modify it in a suitable fashion. such that it can be transmitted via the closen channel to the receiving point

ID 13748
Name Hamza Ishaq ③
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There are great variety of receivers in communication systems, depending on the processing required to recreate the original message to the destination.

③ Channel:-

Channel is the physical medium which connects the transmitter with that of the receiver.

The physical medium includes copper wire, coaxial cable, fibre optic cable, wave guide and free space or atmosphere.

ID : 13748
Name : Hamza Ishaq (9)
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The choice of a particular channel depends on the feasibility and also the purpose of the communication system.

(4) Receivers:-

The receiver block receives the incoming modified version of message signal from the channel and processes it to recreate the original from the message signal.

There are a great variety of receivers in communication system depending on the process require the orginal message signal.

ID · 13748
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Destination:- Destination receives the message signal and process it to comprehend the information present in it.

ID: 13748
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(6)

Q.1
Part a.

SNR:-
Signal to noise ratio.

A high quality communication requires a high SNR. SI unit of SNR is directly

$$SNR = \frac{\text{power of signal}}{\text{power of Noise}}$$

For example:

$$C = B\log_2(1 + SNR)$$

where c is the channel capacity.

SNR = 20dB
Band with = 9kz
Channel capacity = ?

ID : 13748

Name. Hamza Ishaq

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(7) and (8)

Sol:

$C = B \log_2 (1 + SNR)$

putting values

$C = 4 \times 10^3 \times \log_2 (1 + 100)$

$C = 4 \times 10^3 \times \log_2 (101)$

$C = 4 \times 10^3 \times 6.65$

$C = 26.60\ K$ bits/c

$SNR = 10 \log_2 (100)$

$= 10 \times 2$

$SNR = 20\ dB$

ID 13748

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Q 1

PART C

The baseband signal are ~~incomplete~~ incompatible for direct transmission

For such signal to travel longer distance its strength has to be increased by modulating with high frequency carrier wave which doesn't effect the parmeters of modulating signal

ID 13748

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PART - D

If you send digital data directly through the air you will probably interfering with other transmitter so to separate different channel the signal is modulated in a given frequency band

Obviously you can do this by digital modulation but due to harmonis) you will impact other channel (modulation with a square signal has lots of harmonics) and during you demodulation depending on the other channels your signal

ID 13748

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will be distorted.

Moreover you can suffer of band width problem of your power amplifier which will distorted also your transmission

Part: E

This is a periodic signal with period $T_0 = 2\pi/\omega_0 t$. ~~$(\omega_0 t + \theta)\,dt$~~

The suitable measure of this signal is it power.

Because it is a periodic signal we may compute its power by averaging its energy over one period $2\pi/\omega_0$. However for the sake of generally, we shall solve this problem by averaging over

ID : 13748 (12)
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an infinitely large time interval

using Eq (2.3)

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

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

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

The first term on the right hand side is equal to $C^2/2$.

Moreover . the second term is zero because the integral appearing in this term represents the area

ID : 13748
Name : Hamza Ishaq
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under a very large time interval The second term is This area multiplied by $C^2/2T$ with $T \to \infty$ Clearly this term is zero.

Q.2

PART B

AM Modulation:-

$$Xm(t) = Am \cos \omega m(t)$$

$$Xc(t) = Ac \cos \omega ct$$

$$Xam(t) = Ac\,[1 + m \cos \omega m(t)] \cos \omega c(t)$$

$\cos \omega c(t)$ multiplied to eq

ID: 13748 (14)

Hamza Ishaq

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$$X_{AM}(t) = A_C \cos w_c(t) + X_m(t) \cos w_c t \quad \text{—} (1)$$

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

As we know that

$$\cos w_c(t) = \frac{1}{2}\left[e^{jwt} + e^{-jwc}\right] \quad \text{—} (2)$$

Comparing eq (1) and eq (2)

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

$$x_m(t)\, e^{jwct} \rightarrow X(wc - wm)$$

$$X_m(t)\, e^{-jwct} \rightarrow X(wc + wm)$$

The eq (3) becomes

$$X_{AM}(t) = \frac{1}{2} X_m(t)\, e^{jwct} + \frac{1}{2} x_m(t)\, e^{-jwct}$$

ID: 13748

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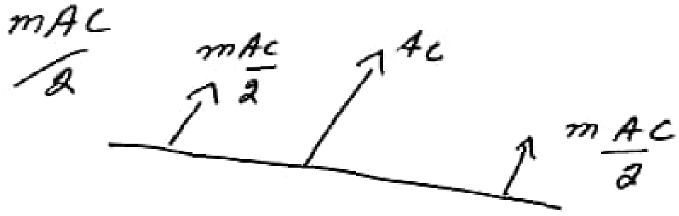
$X_2(t) = \frac{1}{2} X(\omega c - \omega m) + \frac{1}{2} X(\omega c + \omega m)$

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

$X_{Am}(t) = \pi A \, [(\delta(\omega - \omega c) + \delta(\omega + \omega c) + \frac{1}{2}(X(\omega c - \omega m) + X(\omega c + \omega m)]$

Power of Am wave:-



$X_{Am}(t) = Ac \cos\omega ct = \frac{mAC}{2} [\cos(\omega c - \omega m + \cos(\omega c + \omega m)]$

power = power (lower side band) + P (upper S.B) +

PC AC/VC

$VC_1 Rms = VC/\sqrt{2}$

$Vm_1 Rms = Vm/\sqrt{2}$

ID : 13748

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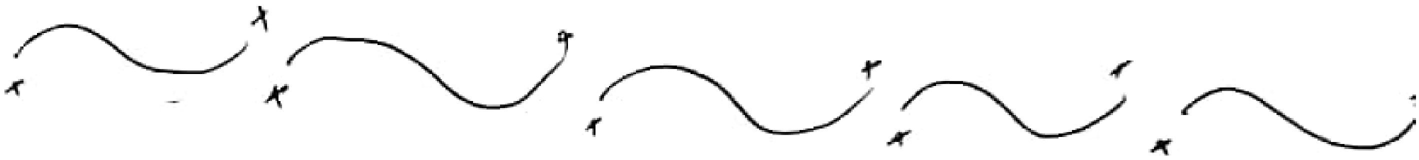
$P_c = \frac{V_c^2}{R} \Rightarrow V_c/\sqrt{2}\, R \Rightarrow V^2/2R$

$P_m = V_m^2/R \Rightarrow V_m^2 \Rightarrow \left[\frac{m V_c}{2}\right]^2/2R$



Q.2

PART-A

$5 \cos 2\pi \, 106$

$h = \frac{d}{4} = C/4F$

$S = 20\,km$

$f = 106$

put the values

$h = C/4f$

ID : 13748

Name : Hamza Ishaq (17)

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$$h = \frac{3 \times 10^{8\,2}}{4 \times 10^{6}}$$

$h = 75$ meter

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

$$h = \frac{c}{4f}$$

$$f = 10^3 \Rightarrow h = \frac{c}{4f}$$

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

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

$h = 75.000$ meters

ID: 13748

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Q. 3

PART-B

Given that

$(E_C) = 7V$

$f_c = 1 MHz$

$E_m = 3.5V$ and

$f_m = 5 kHz$

(i) modulation Index = $\frac{E_M}{E_C} = \frac{3.5V}{7}$

$M = 0.5$

(ii) Equation for modulated wave ,

ID: 13748
Name. Hamza Ishaq (19)
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$$S(t) = E_C \left[1 + m \cdot \cos \omega_m (v) \, \omega_s (\omega_c t) \right]$$

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

$$\cos \left(2\pi \times 1 \times 10^6 t \right)$$

$$S(t) = 10 \left[1 + 0.3 \cos \left(10 \pi \times 10^3 t \right) \right.$$

$$\cdot \cos \left(2\pi \times 10^6 t \right)$$

(3) The modulated wave form has shown in the figure.

ID: 13746

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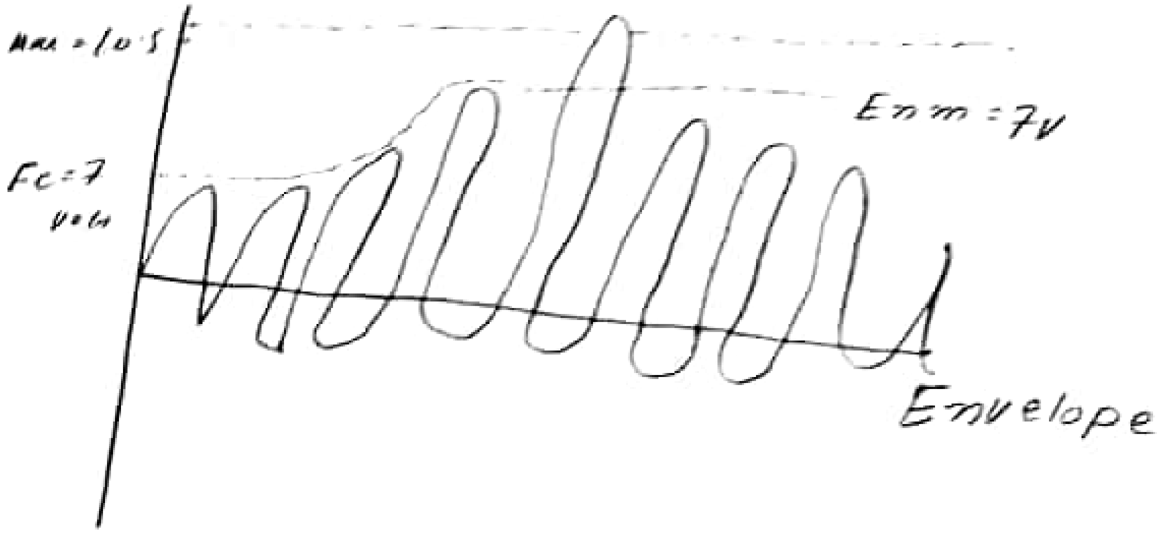
(20)



(4) Spectrum of modulated wave form

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

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

$= 1005\ kHz$

ID 13748

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$f_{USB} = f_c + f_m = 1000$ KHz

Amp of each side frequency =

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

$= \frac{0.5}{2} \times 7 = 1.75$ V

ID: 13748

Name: Hamza Ishaq (22)

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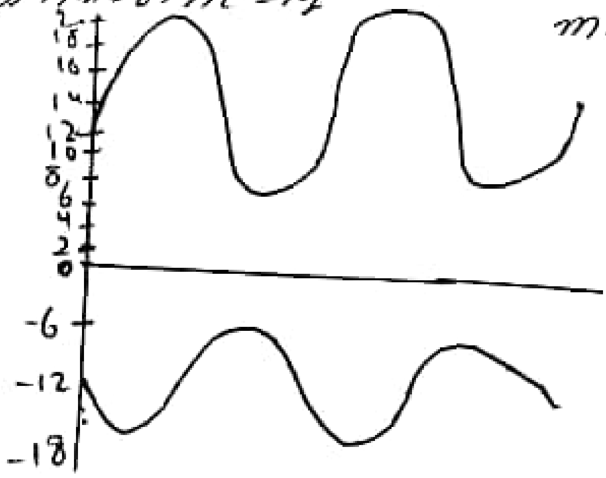
Q3 PART (a)

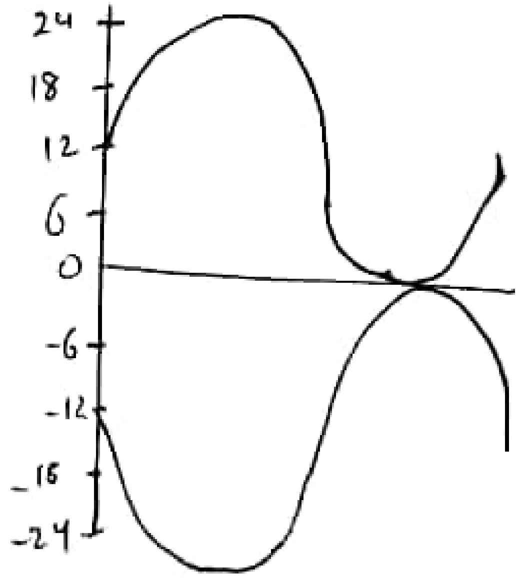
$e_c(t) = 12 \sin \omega t$

$e_m(t) = ?$

① $A_m = 6$, $A_C = 12$ ($A_C > A_m$) $m < 100\%$



② $A_m = 12$, $A_C = 12$ ($A_C = A_m$)



$m = 100\%$

ID 13748

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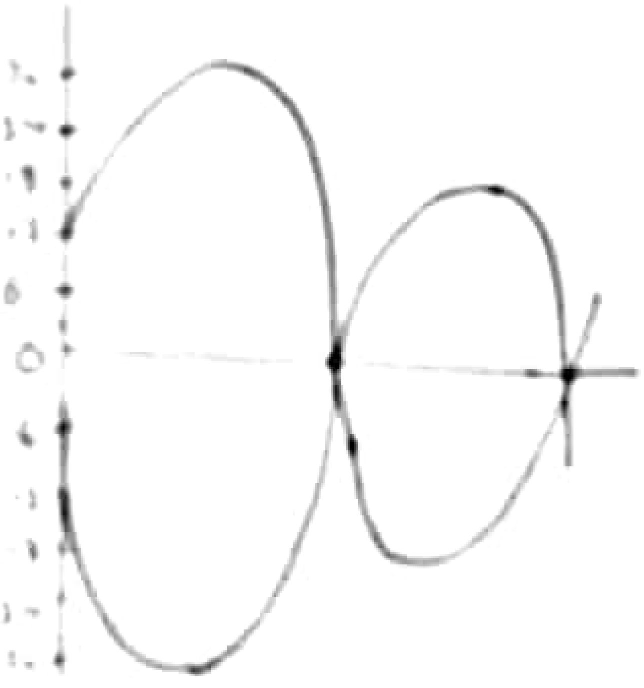
Am = 1.8

Ac = 1.2 (Ac < Am)



m > 100%