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Subject ≠ Communication System.

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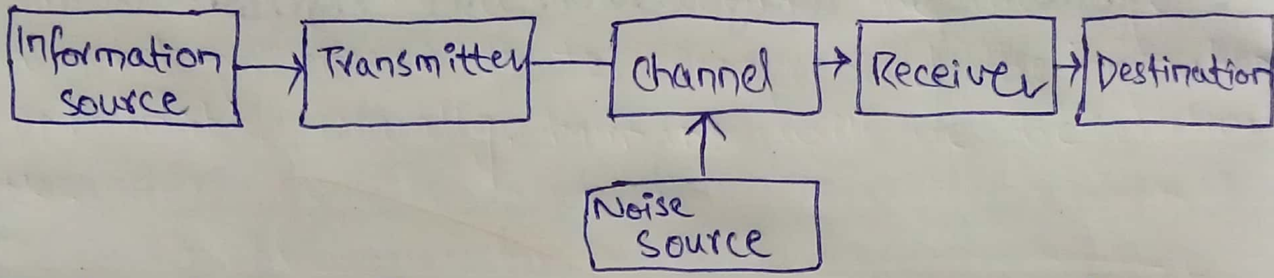
Question # 1
Part (a)

Ans:- In a wireless environment, it is the key that wireless devices are able to distinguish received signals as legitimate information they should be listening to an ignore any background signals on the spectrum. There is the the concept known as the Signal to Noise Ratio or SNR, that ensures the best wireless functionality. The SNR is the difference b/w the received wireless signal & the noise floor. The noise floor is simply erronous background transmission that are emitted from either other devices that are too far away for the signal to be intelligible, or by devices that are inadvertently creating interface on the same frequency.

Question # 1
Part (b).

Ans:-



(i) Information Source :- The objective of any communication system is to convey information from one point to other. The information comes from the information source, which originates it. The information source convert this into physical quantity.

(ii) Transmitter:-

The objective of the transmitter block is to collect the incoming message signal and modify in a suitable fusion, such that it can be transmitted via the chosen chanel to receiving point. channel is a physical medium which connects the transmitted block with the receiver block.

(iii) Channel:-

channel is the physical medium which connects the transmitter ~~ath~~ with that of the receiver. The physical medium includes copper wire, coaxial cable, fibre optics cable, wave guide & free space or atmosphere.

iv) Receiver:- The receiver block receives the incoming modified version of the message signal from the channel and processes it to recreate the original form of the message signal.

(IV) Destination:-

The destination is the final block in the communication system which receives the message signal and processes it to comprehend the information present in it, usually, humans will be the destination block.

X———X———X

Question # 1
part (c).

Ans:- When transmission distance increases the signal tend to loss, so carrier signal is added along with the message signal (to strengthen the original message signal) After reaching the receiver, the original signal is received by filtering or removing the carrier signal called demodulation.

Question #1
Part (D)

Ans:- 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. Similarly you can do this by digital modulation but due to harmonics you will impact other channel (modulation with a square signal has lots of harmonics) and during you demodulation depending on other channel your signal will be distorted. Moreover you can suffer of bandwidth problems of your power amplifier which will distorted also your transmission.

x ——— x ——— x

Question # 1
part (e).

Ans:-

$$g(t) = C \cos(\omega_0 t + \theta).$$

This is a periodic signal with period $T_0 = 2\pi/\omega_0$. The suitable measure of its size is 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 generality, we shall solve this problem by averaging over infinitely large time interval.

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

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

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

The first term on the right hand side equals $C^2/2$. while the second term is zero because the integral appearing in this terms represents the area under a sinusoid over a very large time interval T with $T \to \infty$. This area is at most equal to the area of half the cycle because of cancellations of the positive & -ve areas of a sinusoid. The second term is the area multiplied by $C^2/2T$ with $T \to \infty$. clearly this term is zero and.

$$P_s = \frac{C^2}{2}$$

This shows a well known fact that a sinuosid of amplitude C has a power $C^2/2$ regardless of its angular frequency $\omega_0 (\omega_0 \neq 0)$ and its phase θ: the rms value is $C/\sqrt{2}$ if the signal frequency is zero. the readers can show that the power is C^2 .

Question # 2
part (a).

Ans:-

$5 \cos 2\pi 10^6$

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

$S = 20 \text{ km}$

$f = 10^6$

put the values.

$h = c/4f$

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

$\boxed{h = 75 \text{ meter.}}$

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

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

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

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

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

$\boxed{h = 75{,}000 \text{ meters}}$

Question # 2
part (b).

Ans:-

Spectrum of an AM Wave:-

$x_m(t)$, $x_c(t)$, $x_{Am}(t)$.

$A_m \cos w_m t$, $A_c \cos w_c t$, $A_c[1+m\cos w_m t]\cos w_c t$

$x_m(t) \longleftrightarrow X_m(t)$, $x_c(t) \xleftrightarrow{F} X_c(t)$, $X_{Am}(t) \longrightarrow X_{Am}(t)$.

$$x_{Am}(t) = \underbrace{A_c \cos w_c t}_{x_1(t)} + \underbrace{x_m(t)\cos w_c t}_{x_2(t)}$$

$$X_{Am}(t) = x_1(t) + x_2(t)$$

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

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

$$X_{Am}(t) = A_c \cos w_c t + X_m(t)\cos w_c t$$

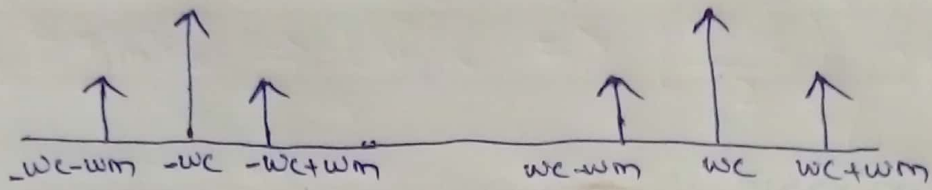
$$\frac{A_c}{2}\left[e^{jw_c t} + e^{-jw_c t}\right] + \frac{x_m(t)}{2}\left[e^{jw_c t} + e^{-jw_c t}\right]$$

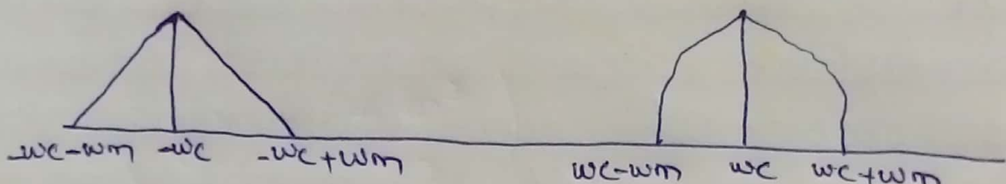
$$= \frac{1}{2}x_m(t)e^{jw_c t} + \frac{1}{2}x_m(t)e^{-jw_c t}$$

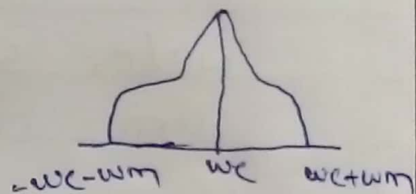
$$X_2(t) = \frac{1}{2}X(w_c - w_m) + \frac{1}{2}X(w_c + w_m)$$

$$X_1(t) = \pi A(\delta(w - w_c) + \delta(w + w_c))$$

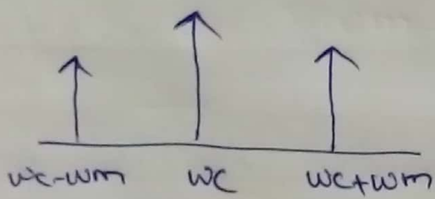
$$X_{Am}(t) = \pi A\left[\left(\delta(\omega-\omega_c) + \delta(\omega+\omega_c) + \frac{1}{2}\left(X(\omega_c-\omega_m) + X(\omega_c+\omega_m)\right)\right]\right.$$







Power of AM wave:-



$$x_{Am}(t) = A\cos\omega_c t = m\frac{A_C}{2}\left[\cos(\omega_c-\omega_m + \cos(\omega_c+\omega_m)\right]$$

$$X_m(t) = \pi A\left(\delta(\omega-\omega_c) + \delta(\omega+\omega_c) + \frac{1}{2}\left[X(\omega_c-\omega_m) + X(\omega_c-\omega_m)\right]\right.$$

Power = Power(lower side band) + P(upper side band) + P_c

A_C/V_C $\qquad$ A_m/A_{xm}

V_c, $R_{ms} = V_c/\sqrt{2}$

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

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

$$P_m = V_m^2/R \Rightarrow V_m^2/R \Rightarrow \left(\frac{mV_c}{2}\right)^2 / 2R$$

$$\frac{m^2 V_c^2}{4 \cdot 2R} \Rightarrow m^2 . P_c$$

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

Bandwidth $= f_H - f_L$

$$B = (w_c + w_m) - (w_c - w_m)$$

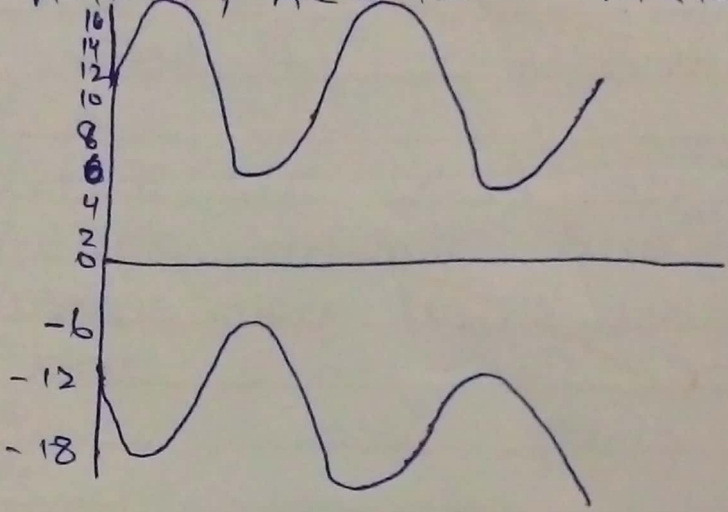
$$\boxed{B = 2w_m.}$$

Question # 3.
part (A).

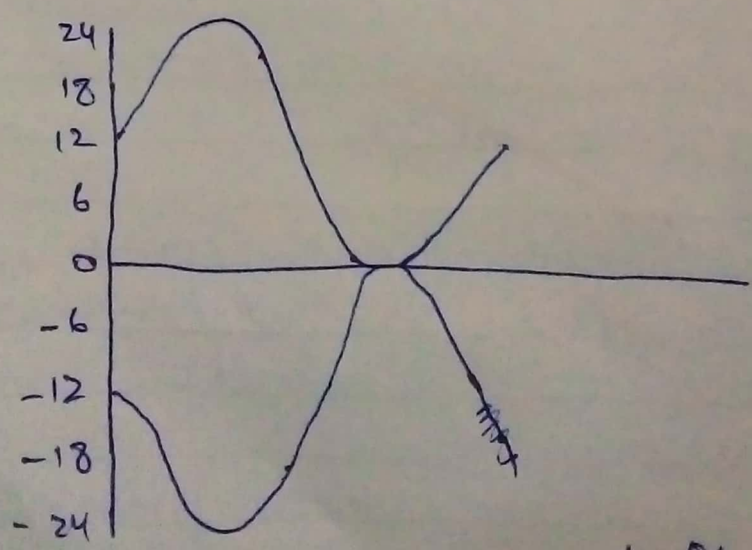
Ans:- $e_c(t) = 12 \sin \omega t$

$e_m(t) = ?$

(i) $A_m = 6$, $A_c = 12$ $(A_c > A_m)$
$m < 100\%$.



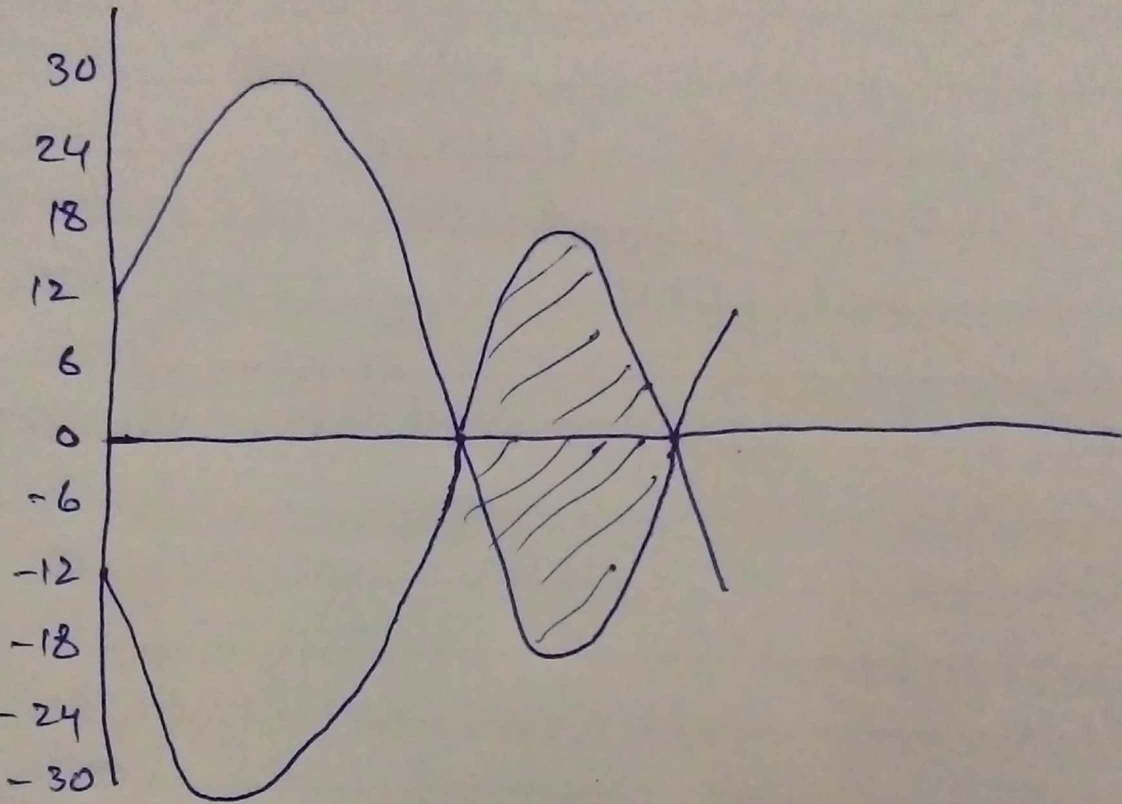
(2) $A_m = 12$, $A_c = 12$ $(A_c = A_m)$



$m = 100\%$

③ $A_m = 18$

$A_C = 12$ $(A_C < A_m)$



$m > 100\%$

Question # 3.
part (b).

Ans:-

Given that.

$E_c = 7V$

$f_c = 1MHz$

$E_m = 3.5V$ and.

$F_m = 5kHz$

(i) Modulation Index $= \frac{E_m}{E_c} = \frac{3.5}{7}$

$\boxed{m = 0.5}$

(ii) Equation for modulated wave is

$$S(t) = E_c(1 + m \cdot \cos w_m(t) \cos w_c t].$$

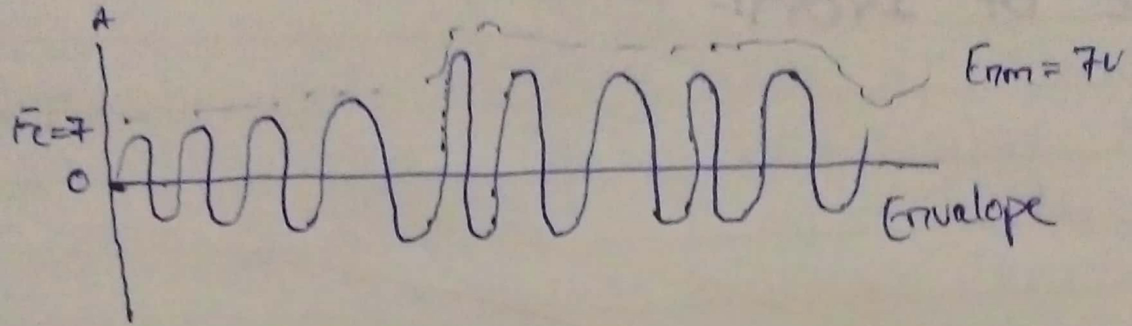
$$f(t) = 7[1 + 0.5\cos(2\pi \times 5 \times 10^3 t)$$

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

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

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

(iii) The modulated waveform has shown in fig



(iv) spectrum of modulated wave form.

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

$$= 100 \times 10^3 + 5 \times 10^3$$

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

$$= 1005 \text{ KHZ}.$$

f—V $\quad f_{LSB} = f_c - f_m = 1000 \text{ KHZ}$

Am of each Sinuosidal =

$$m/2 \times E_c$$

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

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