Ans to the Q. no → 1

1(a) Ans.

Modulation technique is used in communication channel because:

1) Reduction in the height of Antenna:

For the transmission of radio signals, the antenna height must be multiple of $\lambda/4$, λ = wavelength of the signal. for the electromachatic wave of frequency 15 KHz, the wavelength λ is 20km an one quarter of this will be equil to 5km. On the other hand, for a frequency of 1 MHz reduced to 75 m. This is achieved by the process of modulation.

p.t.o

2) <u>To separate different signals:</u> If the band sound signals are transmitted without using the modulation more then on transmitted then all the signals will be in the same frequency range (20 kHz). Therefore all the signals get mixed together and a receiver cannot separate them from each other. If each baseband sound signal is to used to modulated a different carrier then a and mixing of signals. Need for modulation.

3) <u>Increase the range of communication:</u> The frequency of baseband signal is low and low frequency signals can not travel long distance

P.T.O

when they transmitted. They get heavily attenuated. The attenuation reduce will increase the frequency of transmitted signal they travel in long distance. The modulation process are increase the frequency of the signal to be transmitted.

4) Multiplexing is possible: Multiplexing is the process in which two or more signals can be transmitted over the same communication channel simultaneously. This is possible only with modulation. The multiplexing Allows the same channel to be used by in many ways signals. Hence the TV channels can use

p.t.o

The same frequency range without getting mixed with each other.

1(b) Ans:

Here; Given;

$\delta f = (25-20) = 5\,MHz$

$= 5\times10^{6}\,Hz$

$T = 28^{\circ}C = (28+273) = 301\,K$

$K = 1.38\times10^{-23}\,JK^{-1}$

$R = 3\,K\Omega$

$= 3000\,\Omega$

$V_n = ?$

We know;

$V_n = \sqrt{4KT\delta f R}$

$= \sqrt{4\times1.38\times10^{-23}\times301\times5\times10^{6}\times3000}$

$= 1.578\times10^{-5}$

$= 15.7$ microvolts

$= 15.7\,\mu v$ (Ans)

—o—

Ans to the Q. no → 2

6a) Ans:

Here,

$V_c = 80\,V$

$V_m = 3\,V$

$m = \frac{V_m}{V_c} = \frac{3}{80} = 0.0375$

⇒ Amplitude of each side band;

$= \frac{mV_c}{2} = \frac{0.0375 \times 80}{2} = 1.5$

⇒ frequency of sidebands, USB = $f_c + f_m$

$= 10,000 + 50$

$= 10050\,Hz$

LSB $= (10,000 - 50)\,Hz$

$= 9950\,Hz$

— o —

Ans to the Q. no → 3

3(a) Ans: Single sideband is used instead of double sideband because SSB is considered to have good Electrical efficiency the modulation method where only a single band of double sideband suppressed carrier modulation is transmitted is known as SSB. It offers even better electrical efficiency and frequency band efficiency the DSB.

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

$$= P_c\left(1+\frac{0.8^2}{2}\right)$$

$$= P_c(1+0.32)$$

$$= 1.32 P_c$$

P.T.O

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$$P_{SB} = P_c \frac{m^2}{4} = P_c \frac{0.8^2}{4}$$

$$= 0.16 P_c$$

$$\text{Saving} = \frac{P_t - P_{SB}}{P_t}$$

$$= \frac{1.32 - 0.16}{1.32}$$

$$= 0.88$$

$$= 88\%$$

Ans: 88%

3(~~3~~) Ans: (c)

Noise figure: The noise figure F is defined as the ratio of the signal-to noise power supplied to the input terminals of a receiver or Am-

p.t.o

fliter to the signal-to-noise power supplied to the output on load resistor.

$$F = \frac{\text{Input } S/N}{\text{Output } S/N}$$

3(b) Ans:

In Amplitude modulation message signal is reconstructed only when modulation index is less than 1, because the envelope detector will be able to detect message signal. Only modulation ~~signal~~ index lesser than or equal to 1 for which Vmax is positive and Vmin is positive then only the

p.t.o

modulation is undermodulated. if not it is overmodulated for V_{max} is positive and V_{min} is negative that signal is DSBSC not AM.

— o —

Ans to the Q. no→4

4(a) Ans:

Let; V_c and V_m is the carrier and modulating voltage, respectively and represented by;

$$v_c = V_c \sin \omega_c t$$

$$v_m = V_m \sin \omega_m t$$

We know that;
modulation index, $m = \frac{V_m}{V_c}$
$V_m = mV_c$

Now; amplitude of Amplitude modulated wave is;

$A = V_c + V_m = V_c + V_m \sin \omega_m t$
$= V_c + mV_c \sin \omega_m t$
$= V_c(1 + m \sin \omega_m t)$

The instantaneous voltage of resulting AM wave is;

$v = A \sin\theta = A \sin \omega_c t$
$= \cancel{V_c(1+\sin}$
$= V_c(1+m \sin \omega_m t) \sin \omega_c t$
$= V_c \sin \omega_c t + mV_c \sin \omega_c t \sin \omega_m t$
$= V_c \sin \omega_c t + \frac{mV_c}{2}[2 \sin \omega_c t \cdot \sin \omega_m t]$

p.t.o

(11)

$$= V_c \sin \omega_c t + \frac{mV_c}{2}\left[\cos(\omega_c - \omega_m)t - \cos(\omega_c + \omega_m)t\right]$$

$$\left[\because 2\sin a \sin b = \cos(a-b) - \cos(a+b)\right]$$

$$= V_c \sin \omega_c t + \frac{mV_c}{2}\left[\cos(2\pi f_c - 2\pi f_m)t - \cos(2\pi f_c + 2\pi f_m)t\right]$$

$$= V_c \sin \omega_c t + \frac{mV_c}{2}\left[\cos 2\pi \underbrace{(f_c - f_m)}_{LSB}t - \cos 2\pi \underbrace{(f_c + f_m)}_{USB}t\right]$$

Bandwidth

$= USB - LSB$

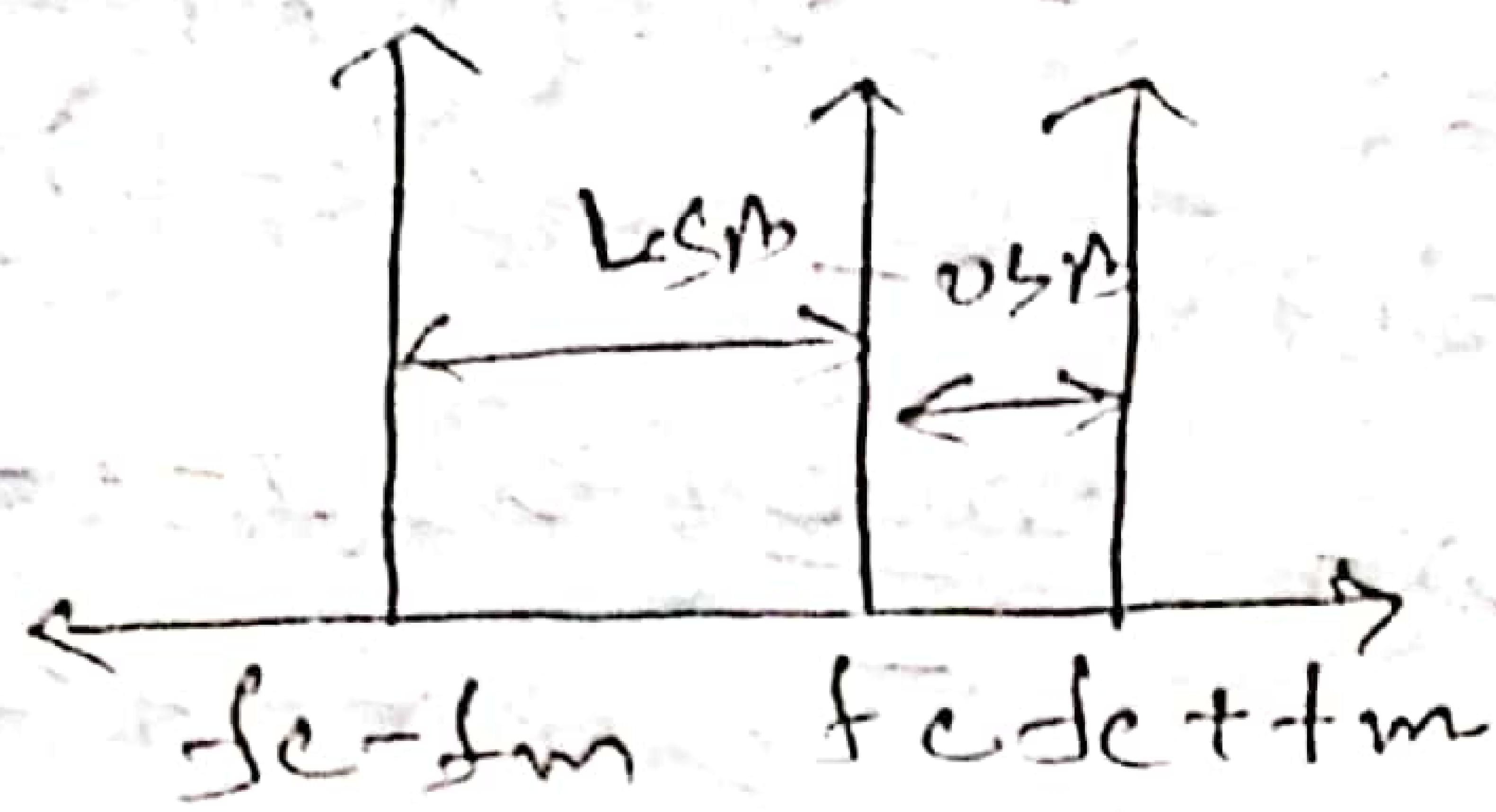
$= f_c + f_m - (f_c - f_m)$

$= \cancel{f_c} + f_m - \cancel{f_c} + f_m$

$= 2f_m$

$= 2 \times$ frequency of modulating signal. (Proved)

P.T.O



—o—

4(b) Ans:

Envelop (Diode) detection:

The simplest and most widely used amplitude demodulation is the diode detecton. As show AM signal is usally transformar coupled and applied to a basic half wave retifier circuit ~~applied~~

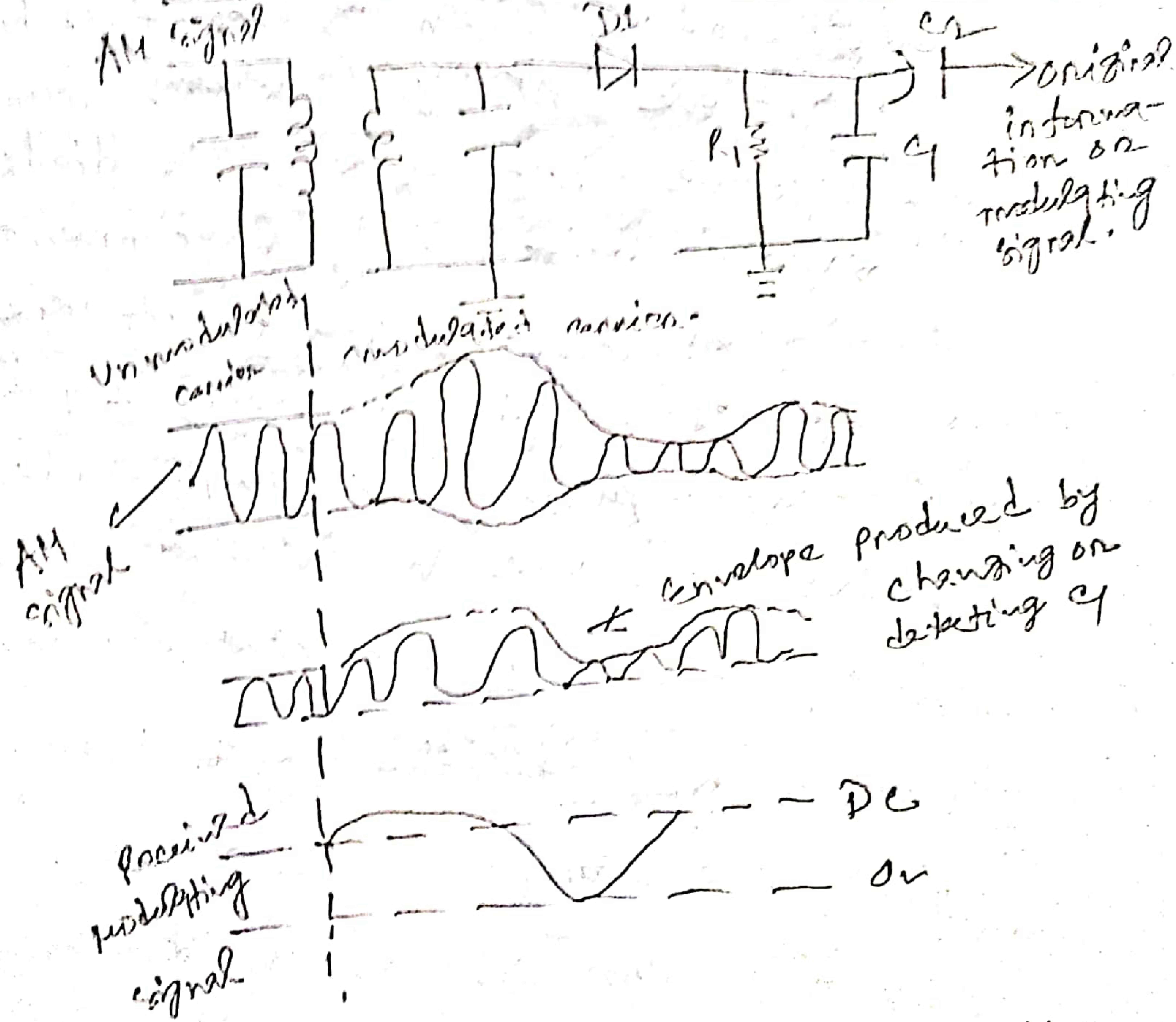
p.t.o

circuit consisting of D1 and R1. The diode conducts when the positive half cycles of the AM signal occurs. During the negative half cycles, the diode is reverse baised and no current flows through it. As a result the voltage across R1 is a series of positive of positive pulse whose amplitude varies with the modulating signal.

A capacitor C1 is connected across resistor R1, effectively filtering out the carrier and thus re-covering the original modulating signal.

p.t.o

A diode detector: AM demodulation:



one way to look after operation of a diode detection is to analyze its operation in the time domain

p.t.o

The waveforms from figure illusted that on each positive alternation of the AM signal the capacitor changes quickly to the peak value of pulse passed by the diode. When the pulse voltage drops to zero. the capacitor discharges into Resistor R1 the time constant of C1 and R1 is chosen to be long compared to the period of the carrier.

—o—

Ans to the Q. no → 5

a) Ans:

Keplar's law:

There are 3 keplar's law;

i) The path of the planets about the Sum is elliptical inshape with the center of the Sum being located at one focus.

p.t.o

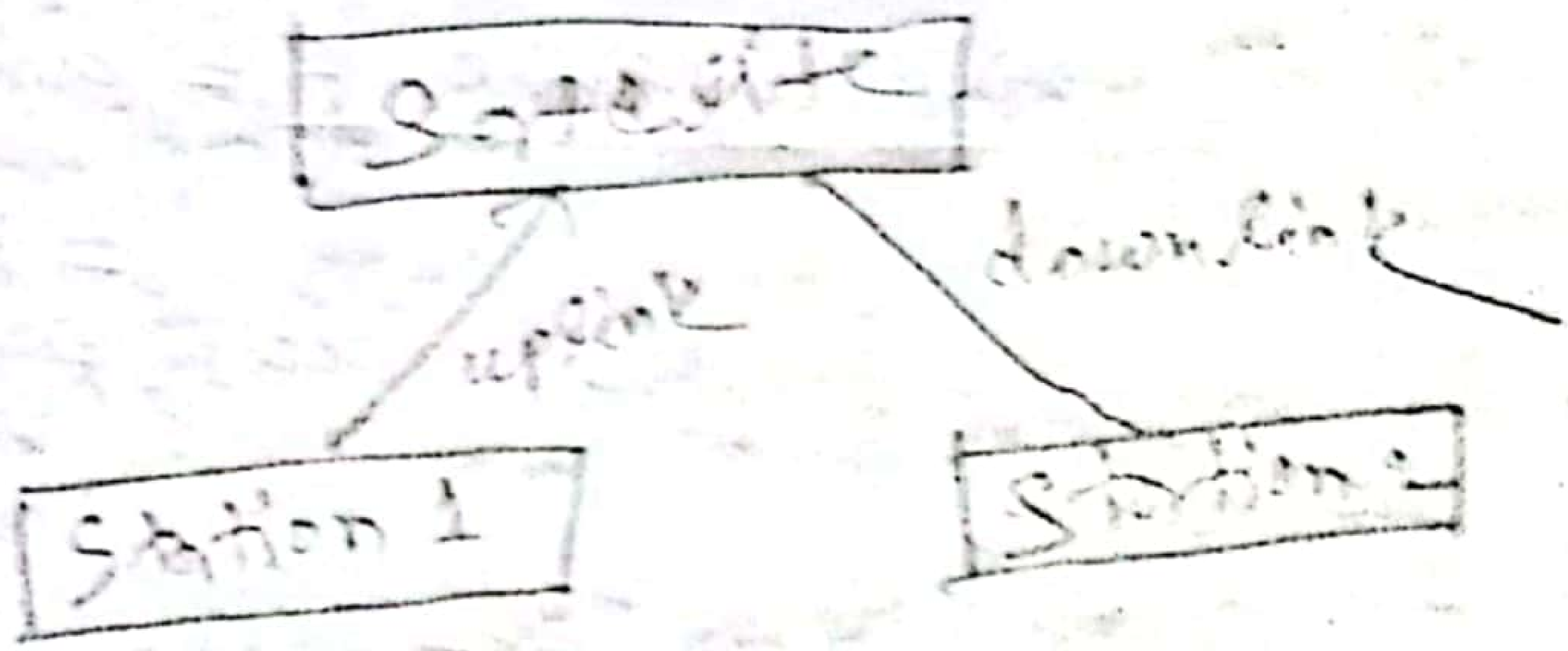
2) An ~~imagining~~ imaginary line drawn from the center of the sun to the center of the planet will sweep out equal areas inequal interval of time.

3) The ratio of the squares of the period of any two planets is equal to the ratio of the cubes of their average distance from the sun.

The satellites have at least two parts in almost every cases. An Antenna and a power source. The Antenna sends sends and receive information, often to and from earth.

P.t.o

The satellite has works on two links. They are;



5(b) Ans:

Peak pulse power, P_t = 5 mW
= 5×10^{6} W

Wavelength, $\lambda = \frac{30}{1 GHz}$
= 30 cm
= 30×10^{-2} m

R_{max} = 200 km = 200×10^{3} m

Cross section δ = 1 m^2

P.T.O

(5)

Receiver bandwith, $\delta f = 1.9 KHz$

$= 1.9 \times 10^3 Hz$

noise figure, $F = \text{antilog}\left(\frac{10}{10}\right)$

$= 10$

A w min radius, $R = ?$

We know;

$$r_{max} = 18 \left[\frac{P_T D^4 s}{\delta f \lambda^2 (F-1)}\right]^{1/4} = \frac{r_{max}}{48}$$

$$\Rightarrow \frac{P_T D^4 s}{\delta f \lambda^2 (F-1)} = \left(\frac{r_{max}}{48}\right)^4$$

$$\therefore D^4 = \left(\frac{r_{max}}{48}\right) \times \frac{\delta f \lambda^2 (F-1)}{P_T s}$$

$$= \frac{200 \times 10^3}{48} \times \frac{1.9 \times 10^3 \times (30 \times 10^{-2}) \times (10-1)}{5 \times 10^6 \times 1}$$

$D^4 = 4.275 \times 10^{10}$

$D = 427.05 m$

Radious; $R = \frac{D}{2} = \frac{427.05 m}{2}$

$= 213.525 m$

2(a) Ans:

The power efficiency of amplitude modulation is very low. To see why this is that case, It is necessary to look at the composition of the radio signal and relative power levels of its constituents.

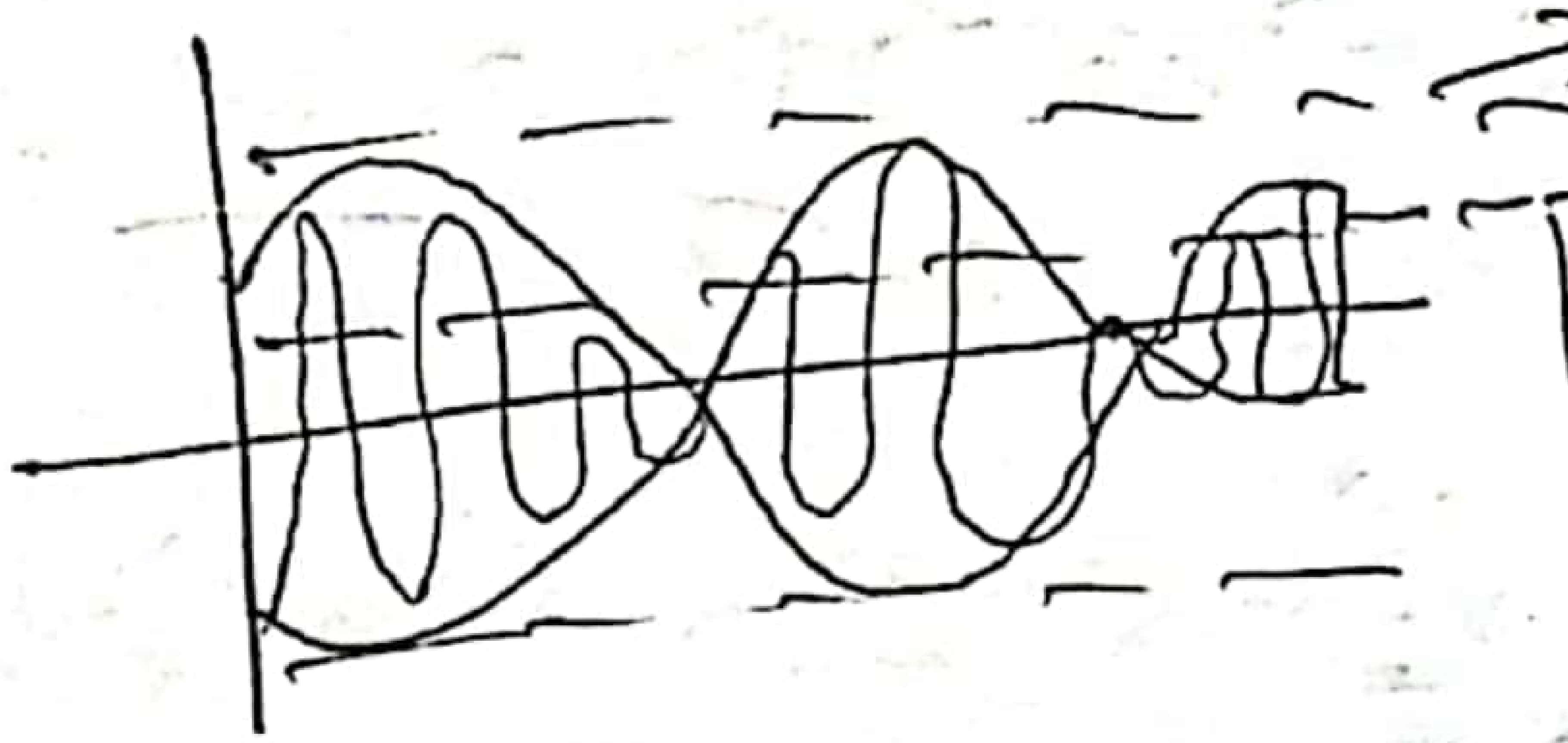
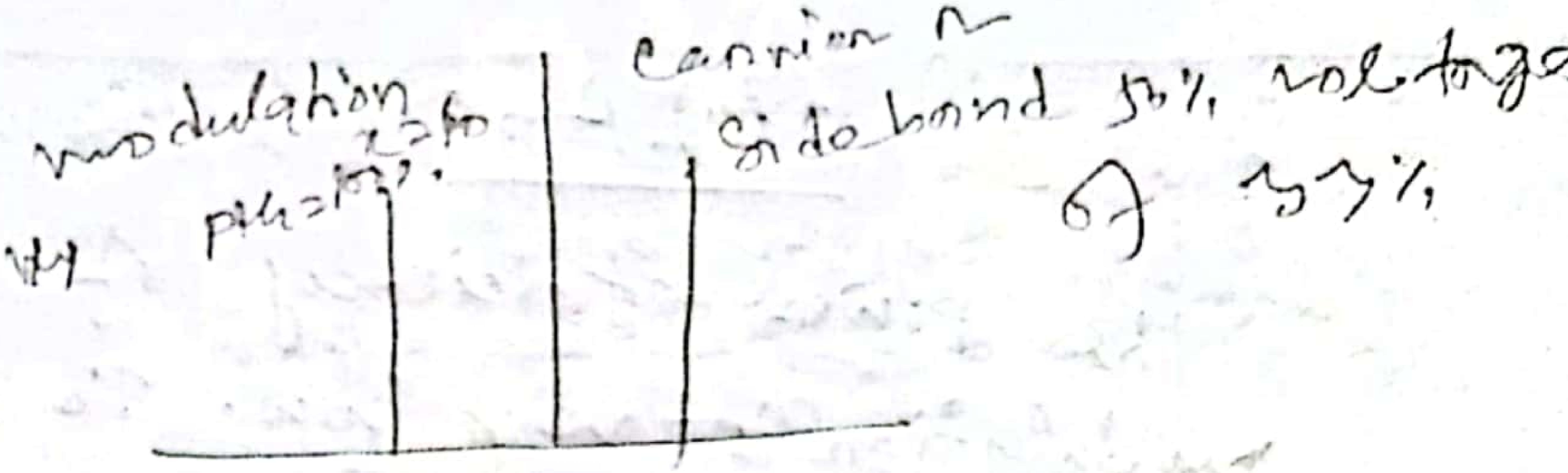


fig: Amplitude modulated signal with 100% modulation.

Even with 100% modulation, i.e modulation index is 1.0, the power utilisation is very poor.

p.t.o



When 67% power is lost to transmit the carrier signal it's only have 33%.

— o —