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D9A/47

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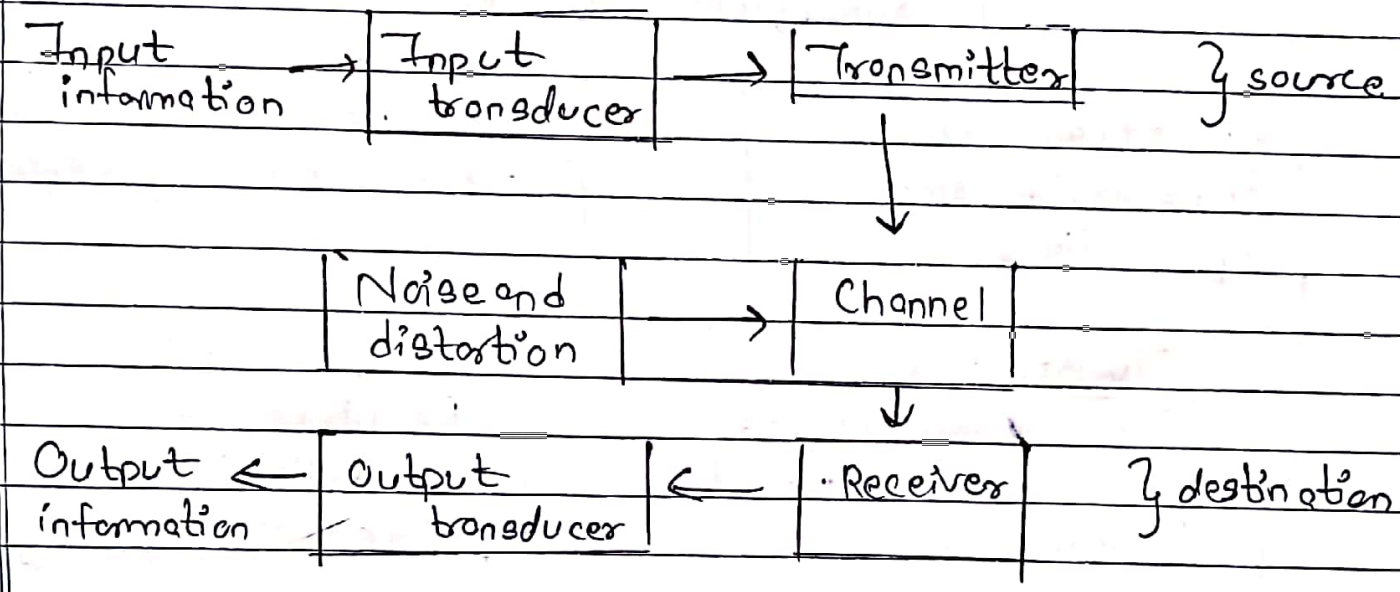
PCE Assignment 1

Q.1) Explain the block diagram of communication in detail.

→ ① Every communication system will have five blocks, including the information source and destination blocks.

② However from the practical view, we are interested in only three blocks, namely, transmitter, channel and receiver.

③ ~~Effect of~~ communication takes place mainly in three blocks



i) Source :- The input information is converted into electrical form which is easier to transmit by the transducer. This electrical form is then made suitable for efficient transmission via the channel by transmitter.

ii) Channel : It is the medium by which information is sent Distortion is the process of changing shape of communicating signal that may mislead the destination about the content of message. Noise is the random, unwanted interference on transmitted signal. Noise and distortion effects the efficiency

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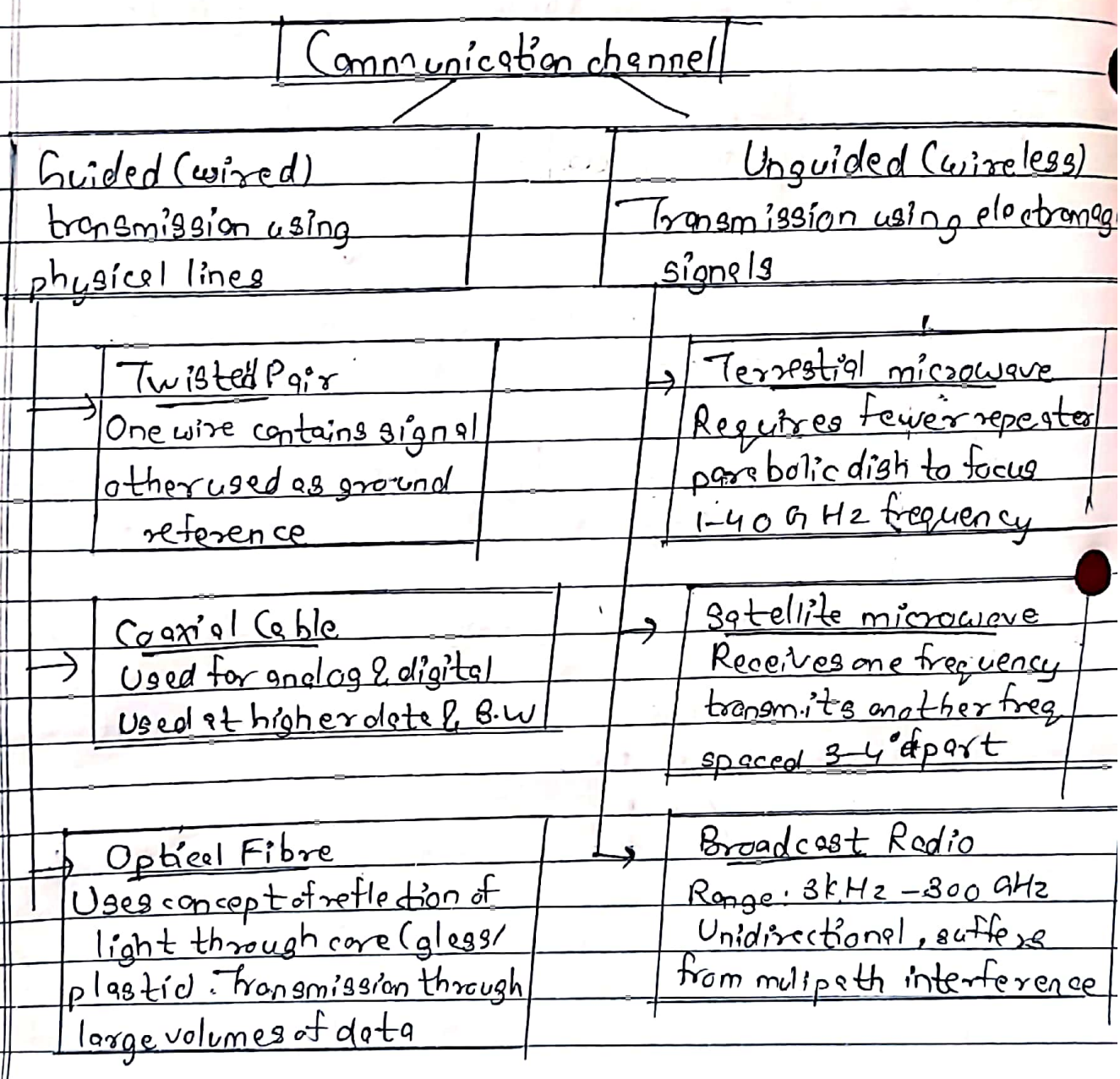
of transmission and must be minimized.

iii) Destination :- Receiver receives the information from chan and extracts the intended electrical message from it whic is converted into a form of message that can be understood user by output transducer.

Q.2) Explain different types of channels.



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Q.3) What is modulation and explain need for modulation?

→) Modulation refer to the act of adding information to an electronic or optical waveform (baseband signal).
It can also be defined as the process of changing for more properties of the analog carrier in proportion of info signal.

Need of modulation:

(1) i) Modulation is needed because most of time info is generated and transmitted via signals having low frequencies
ii) A low freq signal is highly susceptible to attenuation and it cannot be transferred to long distant signals.
iii) In order to rectify this problem, the original carrier wave having low freq is superimposed upon high freq carrier wave. This is modulation. (AM, FM)

(2) Height of Antenna –
For efficient transmission & reception, the antenna height should be atleast 1/4th the signal wavelength ($\lambda/4$).

$$\text{freq} \propto \frac{1}{\text{wavelength}}$$

(3) To avoid mixing of signals –
All sound concentration with in range 20Hz to 20kHz. If no modulation is used, all signals get mixed up, the receiver would not be able to separate them from each other
If each baseband signal is used to modulate a different

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carrier, then they will occupy different slots in freq domain.

(4) Allows Multiplexing –
Two or more signals can be transmitted over the same simultaneously.

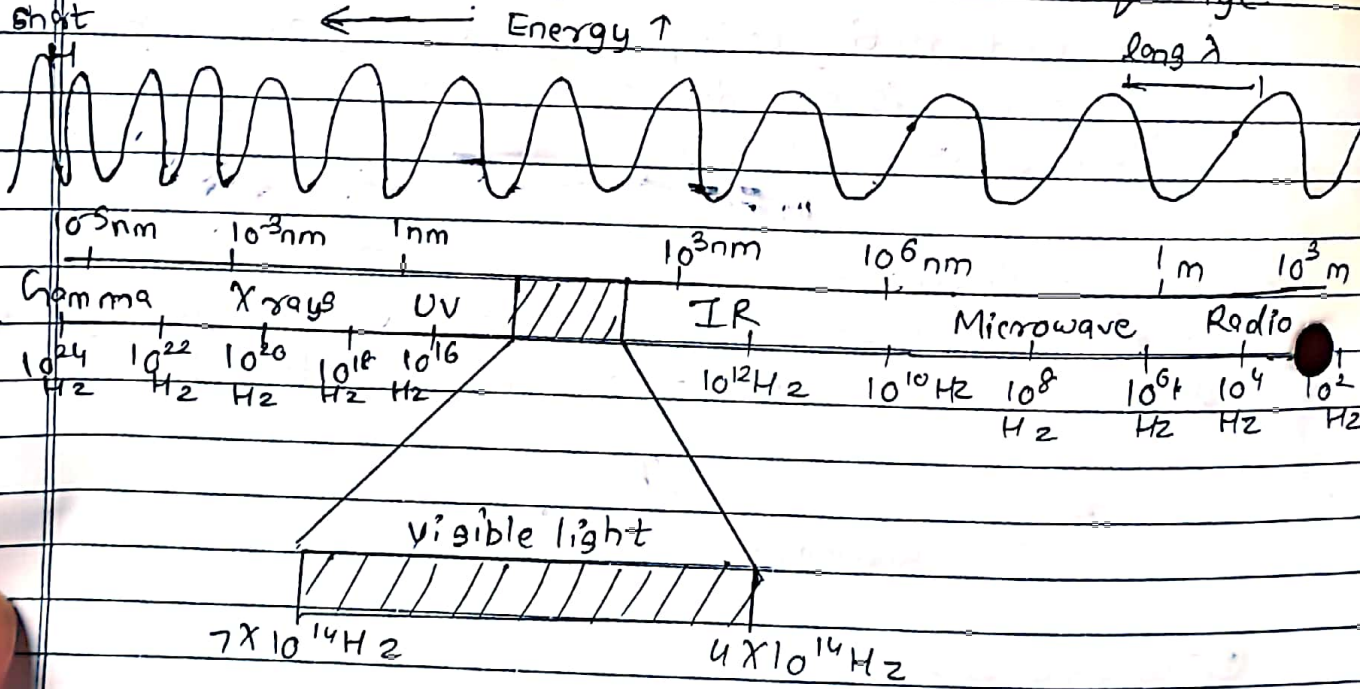
(5) Increases Range of communication.

Q.4) Explain electromagnetic spectrum of communication.

⇒ (1) The purpose of an electromagnetic communication system is to communicate info between two or more stations

(2) Electromagnetic energy is distributed throughout an almost infinite range of frequencies.

(3) Electromagnetic frequency spectrum is divided into bands with each band having a different name and freq range



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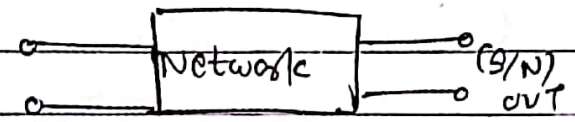
Explain Noise figure and Noise factor -

→ ① The amount of noise added by ~~factor~~ network is embodied in Noise factor F, which is defined by

$$\text{Noise factor } F = \frac{(S/N)_{IN}}{(S/N)_{OUT}}$$

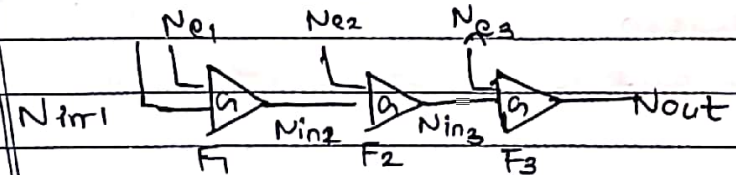


② F equals to 1 for noiseless network and in gen F>1. The noise figure in noise factor quoted in dB
i.e Noise figure F dB = 10 log 10 F, F ≥ 0 dB

③ The noise figure/factor is measure of how much network degrades the (S/N)IN, the lower value of F, the better the network

Q.6) Explain Friss transmission formula and derive.

A) Assuming foll system



$$N_{out} = G_B(N_{in3} - N_{e3}) = G_B(N_{in3} + (F_3 - 1)N_{in})$$
$$= G_B[G_2(N_{in2} + N_{e2}) - (F_3 - 1)N_{in})$$
$$= G_B[G_2[G_1 N_{in} + G_1(F_1 - 1)N_{in}) + G_2(F_2 - 1)N_{in} + G_2 G_B (F_3 - 1)N_{in}$$

$$F_{sys} = \frac{N_{out}}{G_N N_{in}} = \frac{N_{out}}{G_1 G_2 G_N N_{oe}} = 1 + \frac{(F_1 - 1)N_{in}}{N_{oe}} + \frac{(F_2 - 1)N_{in}}{G_1 N_{one}} + \frac{(F_3 - 1)N_{in}}{G_1 G_2 N_{one}}$$

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Friss transmission formula :- $F_1 + \frac{(F_2-1)}{G_1} + \frac{(F_3-1)}{G_1G_2} + \cdots \frac{(F_n-1)}{G_1G_2 \cdots G_{n-1}}$

Q.7) What are types of internal and external noises -

→ ① External noise -

i) Atmospheric Noise -

a) The majority of these radio waves come from natural sources of disturbance called atmospheric noise or static noise.

b) Static is caused by lightning discharges in thunderstorms and other natural electric disturbances occuring in atmosphere.

ii) Extra-terrestial Noise -

1) Solar : surface temp over 6000°C.

2) Cosmic noise

Space noise range from 8 MHz to 1.43 GHz

iii) Industrial Noise -

Sources of industrial Noise are automobiles, aircraft, ignition of motors, switching gears.

Main cause of industrial noise is high vtg wires. (1 to 600 MHz)

② Internal noise -

a) Thermal agitation (White / Johnson noise)

It is the noise generated by resistance or a resistive component due to rapid and random motion of molecules inside the component itself.

b) Shot Noise-

Occurs in all amplifying devices and active devices like diodes and transistors. It is caused by random variations in arrival of electrons/holes at output electrodes of an amplifying device.

c) Transmit time noise-

The noise caused by the transmit time effect ie if the time taken by an electron to travel from emitter to collector of a transistor becomes significant to period of signal being amplified.

Q. 8) Summarise: Equivalent Noise Temperature-

→ Equivalent Noise Temperature is a hypothetical value that cannot be directly measured. It indicates reduction in SNR a signal undergoes as it propagates through a receiver.

Lower the T_0, better quality of a receiver

$$T_e = T(F-1)$$

$$\boxed{F = 1 + \frac{T_e}{T}}$$

Q.9) Explain Shot noise and equivalent temperature. Discuss Friss formula.

→ ① Shot noise is the noise due to random fluctuations in electron emission from cathodes in vacuum tubes, can also occur in semiconductors.

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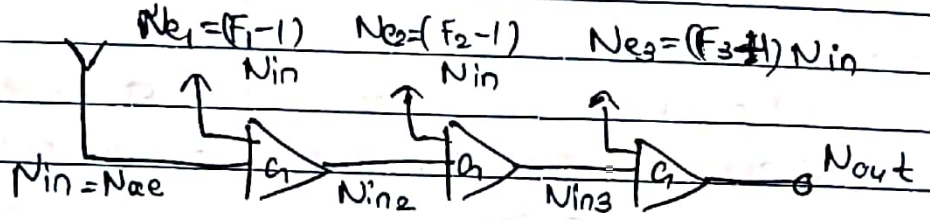
② Equivalent Noise Temp (T_e) - indicates the reduction in the SNR a signal undergoes as it propagates through a receiver. Lower the T_e, better quality of receiver.

$$T_e = T(F-1) \qquad F = 1 + \frac{T_e}{T}$$

③ For system,



$$N_{out} = G_3(N_{in3} + N_{e3})$$
$$= G_3(N_{in3} + (F_3 - 1)N_{in})$$

As $N_{in3} = G_2(N_{in2} + N_{e2}) = G_2(N_{in2} + (F_2 - 1)N_{in})$

$N_{in2} = G_1(N_{ae} + (F_1 - 1)N_{in})$

$\therefore N_{out} = G_3(G_2(G_1 N_{ae} + G_1(F_1 - 1)N_{in}) + G_2(F_2 - 1)N_{in}) + G_3(F_3 - 1)N_{in}$

Overall system Noise factor

$$\therefore F_{sys} = \frac{N_{out}}{G N_{in}} = \frac{N_{out}}{G_1 G_2 G_3 N_{ae}}$$

$$= F_1 + \frac{(F_2 - 1)}{G_1} + \frac{(F_3 - 1)}{G_1 G_2} + \frac{(F_4 - 1)}{G_1 G_2 G_3} + \cdots + \frac{(F_n - 1)}{G_1 G_2 \cdots G_{n-1}}$$

is FRIIS formula

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t is meant by signal to noise ratio. Discuss imp of SNR.
It is defined as ratio of signal power to noise power
t some time. $\frac{S}{N}$ = $\frac{\text{Signal power}}{\text{Noise Power}}$

② It measures quality of system and indicates its strength
③ Its first purpose is comparison of kinds of equipment in evaluating their performance.
④ The second purpose is comparison of noise and signal to ensure noise is not excessive

$(S/N)_{dB} = 10 \log_{10} (S/N)$

Q. (1) Define the terms

① Noise Figure –
It is the measure of much a device degrades the signal to noise ratio with lower values indicating better performance.

② Noise temperature –
It is the reduction in SNR a signal undergoes as it propogates through a receiver

③ Noise factor – The amount of noise added by neturer k.

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Q.12) Define SNR. Apply the concept to explain the effect of cascade connection on it. An amp with 20 dB noise figure and a 6 dB power gain with a 2nd amp which has 15 dB power gain. Estimate overall noise figure.

→ The ratio of Signal power to Noise power at some time is called signal to noise ratio.

$G_1 = 60$ dB, $G_2 = 15$ dB, $F_1 = 20$ dB

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Explain briefly mechanism of propagation. What are the different types of wave propagation.

→ (1) Once the signal leaves the antenna, it can take any of the following path to travel in free space.
(2) The type of propagation is decided by path adopted by signal to reach from transmitter to receiver.
There are 3 types of wave propagation-

i) Ground wave propagation:
→ Frequencies below 2MHz
→ The movement tend to follow the contour of the earth with large antenna size.

ii) Sky wave propagation:
→ Frequency between 2-30 MHz
→ Coverage is obtained by reflection of wave at ionosphere and at earth boundaries
→ Radio waves radiated at from transmitting antenna in a direction toward ionosphere.
→ Sky wave strike the ionosphere, is refracted to ground, strikes the ground, reflected back towards ionosphere, until reaches receiving antenna.

iii) Space Wave Propagation-
→ Dominants mode for frequencies above 30 MHz where in propagates in straight line.
→ No refraction and can almost propagate through ionosphere
eg: Satellite communication.

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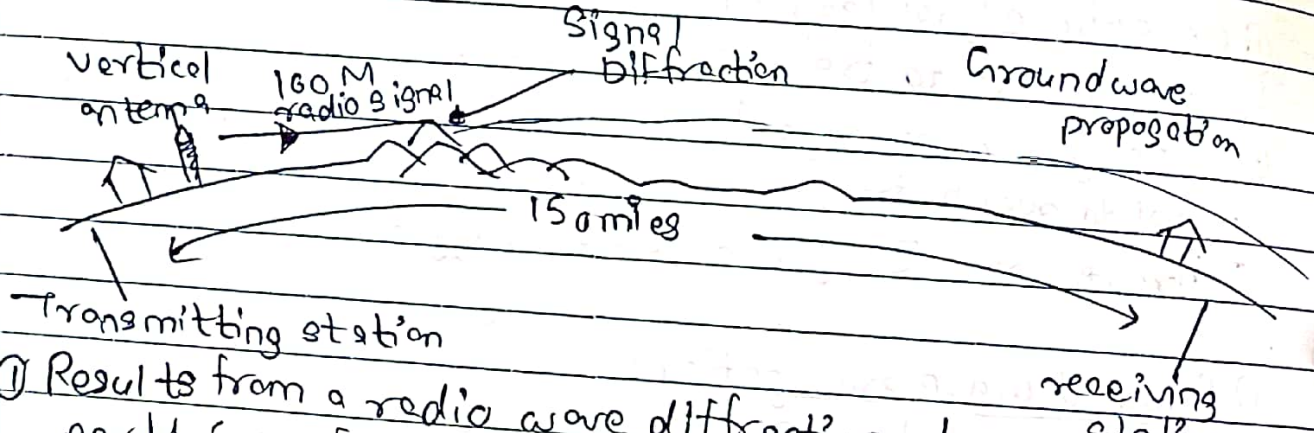
Q.15) Explain Ground wave propogation with help of diagram. State advantages and disadvantages

→



① Results from a radio wave diffraction along earth's surface.
② Primarily affects longer wavelength radio waves that have vertical polarization.
③ Most useful during day at 1.8 MHz and 3.5 MHz

→ Advantages- ① Very reliable communication link
② Reception not affected by daily or seasonal weather changes
③ Used to communicate with submarines

Disadvantages- ① Loses increase with increase in freq.
② Not very effective at freq above 2 Mhz
③ Only for short ranges.

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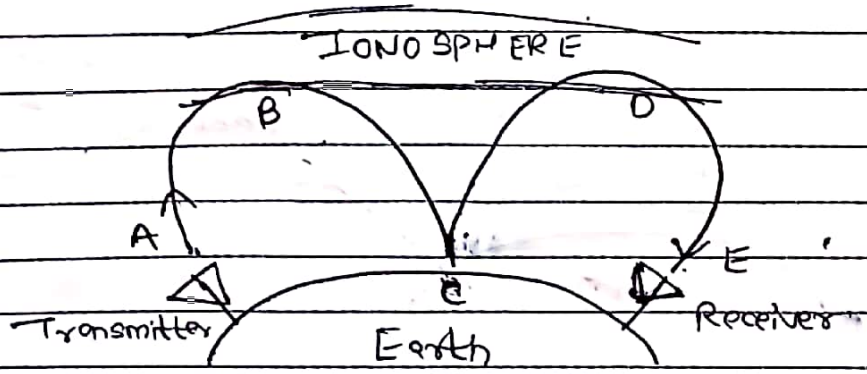
16) Explain principles of sky wave propagation. State its advantages and disadvantages.

→ ① Radio waves radiated from the transmitting antenna in a direction towards the ionosphere.
② Long distance transmission.
③ Sky wave strike the ionosphere, is refracted back to ground, strike the ground, reflected back towards the ionosphere, till it reaches the receiving antenna.



→ Advantages
① Supports propagation at large distances.
② Loss of radio waves is low.
③ Provides continuous support in diff types of communication.

→ Disadvantages
① Long distance propagation requires large ionized antenna.
② Variation in signal transmission in day & night.

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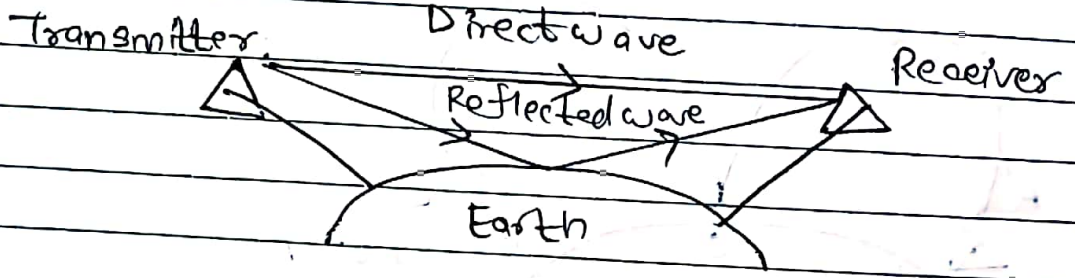
Q.17) Explain space wave propogation, List its advantages and disadvantages

→ ① Spacewave or line of sight propogation is useful at higher frequencies above 30 MHz because sky and ground waves fail to reach such frequencies.
② Because of diffraction, a direct space wave can travel 4/3 greater than LOS. This distance is knownes radio horizon.



→ Advantages -
1) Absorption of space waves is almost negligible due to them being propogating to very high freq
2) Communication system is more reliable.

→ Disadvantages
1) Radius of earth limitation to their range.

→ Application
① Signal communication
② Radar communication
③ Microwave linking

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8 Compare sky wave, Ground wave, space wave propagation

Parameter	Propogation Groundwave	Sky wave	Space wave
Frequency Range	30kHz-3 MHz	3MHz-30MHz	30 MHz to 300MHz
Polarization used	Vertical	Vertical	Horizontal
Applications	Used for AM radio broddcasting MW band	Used for AM radio broadcasting SW band.	Used for TV & FM broadcasting
Limitation	Ground wave tilt progressively and die This limits range of comm.	The transmission path limited by skip distance and curveture of earth	The transmission path limited by line of sight and radio horizon
way of Propogation	Along the contour	Reaches the iono sphere, refracts back to ground again reflects	Wave can go pass ionosphere
Power loss	Due to absorption of energy	Due to absorption of energy by ionosphere	Due to absorption and scattering

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