Q A message signal of $10\cos 2\pi \times 10^4 t$ is given to 10 bit PCM system. Sampling rate is twice to the Nyquist rate ($NR = 2f_m$). The resulting digital signal is transmitted through free space by using binary signaling. Find the transmission bandwidth of modulating scheme:- (i) ASK (ii) PSK (iii) FSK with $f_{Higher} = 2MHz$ and $f_{lower} = 1MHz$

Sol- $NR = 2f_m$; $f_s = 2(NR) = 4f_m$

$\omega = 2\pi f \Rightarrow 2\pi \times 10^4 = 2\pi \times f$

$\Rightarrow f_m = 10^4 Hz$

$R_b = nf_s$; $n = 10$

$R_b = 10(4 \times 10^4)$

$= 40 \times 10^4$ bits/sec.

(i) ASK ; $BW = 2(40 \times 10^4) = 80 \times 10^4 Hz$

(ii) PSK ; $BW = 2(40 \times 10^4) = 80 \times 10^4 Hz$

(iii) FSK ; $BW = (f_1 - f_2) + 2R_b$

$= 1MHz + 2(40 \times 10^4)$

$= 1MHz + 80 \times 10^4$

$= 10^6 + 8 \times 10^5$

$= 1 \times 10^6 + 0.8 \times 10^6$

$= 1.8 \times 10^6$

$= 1.8MHz$ → Ans

24/10/18

Note Book
Date
Page

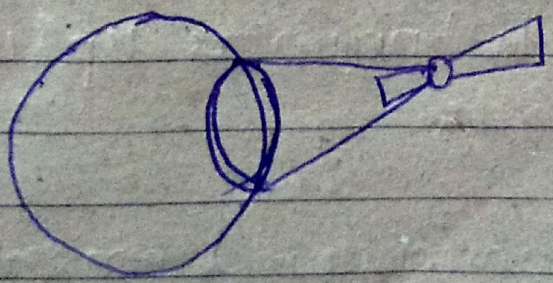
Satellite Communication

In satellite communication, an artificial satellite placed in earth's orbit for the purpose of sending and receiving communication data between source and destination. This communication uses microwave frequency.

Satellite - It is an artificial body placed in orbit around the earth or moon or other planet in order to collect information or for communication.

Orbit :- A predictable curved path in space that followed by an object or satellite to move around a planet.

Satellite footprint :- The area which receives a signal of useful strength from the satellite is known as satellite footprint.



Inclination angle - It is defined between the equito-rial plane and the plane described by the satellite orbit. If it is zero means that

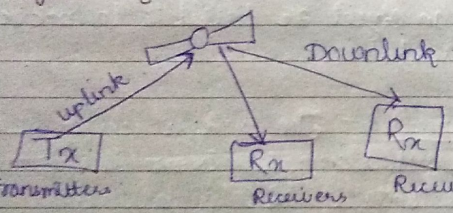
Note Book
Date
Page

satellite is exactly above the equation.

Orbits are of three types :-
① Equitorial orbit (inclination angle 0°).
② Inclined orbit (inclination angle can be b/w 0 & 90°).
③ Polar orbit (inclination angle is 90°).

Earth station
Station on earth that control the satellites.

Control system of satellite



Uplink :- Signal transmision from earth station to satellite is known as uplink.
Frequency → 6-7 GHz.

Downlink :- Signal transmision from satellite to earth. Frequency → 3 to 5 GHz

Tx → earth station
Rx → like our home, can be earth station, etc.

Note Book
Date
Page

Types of satellite services.

(1) Fixed satellite service (FSS)
(A) Broadcasting satellite service (BSS)
(B) Mobile satellite service (MSS)
(4) Navigational satellite service (NSS)

Applications of satellite communication

① Weather forecasting
② Radio and TV broadcasting
③ Military purposes
④ For internet

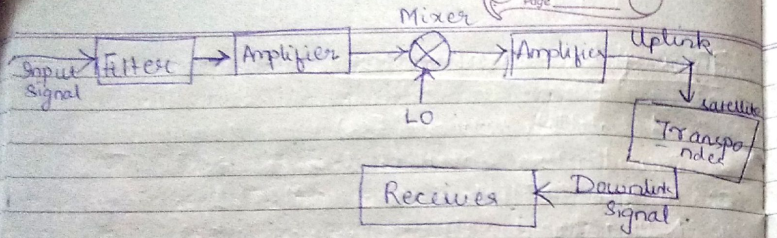
* Sputnik is first satellite launched in 1957 by Russia in equitorial orbit.

* INTEL SAT is also a satellite (Inter telecommunication satellite)

29/10/18

Block diagram of satellite communication

Travelling wave tube amplifier → This is used for higher frequencis (of microwave ran so normal amplifier can't be used.

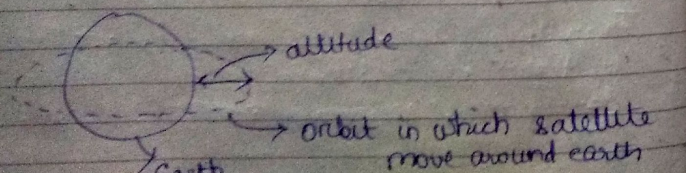


→ In Transponder, we use a special amplifier known as TWT.
→ We also have multiplexers and DeMux.

→ In transmitter section of earth station → we have dish antennae, modulator and demodulator.
→ this are also present in receiver section.

Based on altitude of satellite :- (Types :-)

→ LEO = Low earth orbit. (500 - 1500 km)
→ MEO = Middle " " (6000 - 20000 km)
→ GEO = Geosynchronous earth orbit (36000 km) or geostationary " "



Altitude → the distance of orbit from the earth surface.

LEO → The orbit lies 500 - 1500 km from earth.

All these orbits are parallel to the equitorial or equitorial.

→ In Geosynchronous → the speed of earth is same as the speed of satellite.
We call this geostationary because the satellite is stationary wrt to earth.

→ We generally take satellites at a larger distance from earth as its footprint will be larger.

GEO

→ It gives a large coverage area because of long distance from earth.
→ GEO satellite revolve around the earth at the same speed as the earth rotates.
→ 3 satellites are required to cover the whole earth.
(The angle b/w all these 3 satellite is 120°)

→ It remains stationary wrt earth's surface so it is called geostationary.

Active and Passive Satellites

Passive satellite → It will only have reflector. No other changes will be there; no amplifiers, etc. so we have to keep the distance less and more no. of satellites are require to cover whole earth.

Active satellite → will have everything.

Passive

(1) simply reflects a signal back to earth, it does not require any gain devices to amplify or repeat the signal.

Active

It requires transponder, modulator, repeators to amplify and regenerate the signals.

Q A carrier signal; $c(t) = 10 \cos 2\pi \times 10^6 t$ is amplitude modulated by message signal $m(t) = 4 \cos 4\pi \times 10^3 t$ with $\mu = 0.5$. Resistance = 5Ω.
Find all the parameters of AM.
Plot AM spectrum and identify spectral components.

Sol

$$P_c = \frac{A_c^2}{2R} = \frac{10 \times 10}{2 \times 5} = 10 \text{ Watt}$$

$$P_{SB} = \frac{A_c^2}{2R} \times \frac{\mu^2}{2}$$

$$= \frac{10 \times 0.25}{2}$$

$$= 1.25 \text{ Watt}$$

$$P_t = P_c + P_{SB}$$

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

$$= 10 + 1.25 = 11.25$$

$$P_{USB} = \frac{1.25}{2} = 0.625 \text{ Watt}$$

Note Book

Date
Page

BW = $2f_m$ = $2 \times 2 = 4$ kHz

$(K_a = \frac{\Delta f}{A_m} = \frac{0.5}{5} = 0.1)$

$s(t) = A_c [1 + K_a m(t)] \cos 2\pi f_c t$

$= 10 \cos 2\pi \times 10^6 t + 10 K_a \cdot 4 \cdot \cos 4\pi 10^3 t \cdot \cos 2\pi \times 10^6 t$

$= 10 \cos 2\pi 10^6 t + 1.25 \times 4 \times \cos 4\pi \times 10^3 t \cdot \cos 2\pi \times 10^6 t$

$= 10 \cos 2\pi 10^6 t + 5 \cos 4\pi \times 10^3 t \cdot \cos 2\pi 10^6 t$

$10 \cos 2\pi 10^6 t + \frac{5}{2} [\cos 2004\pi \times 10^3 t + \cos 1996\pi \times 10^3 t]$

$e^{j2\pi f_1 t} + e^{-j2\pi f_1 t}$

$= \delta(f - f_1) + \delta(f + f_1)$

$\delta(f - f_2) + \delta(f + f_2)$

$+ \delta(f - f_3) + \delta(f + f_3)$

$A_c \cos 2\pi f_c t$

$\frac{A_c}{2} [\delta(f - f_c) + \delta(f + f_c)] + A_c K_a m(t) \cos 2\pi f_c t$

$\frac{A_c K_a}{2}$ 0.125 $\frac{A_c K_a}{2} [M$

Note Book

Date
Page

$= 10 \cos 2\pi \times 10^6 t + 5 \cos 4\pi \times 10^3 t \cdot \cos 2\pi \times 10^6 t$

10^6 Hz

$= 1000$ kHz

$\frac{A_c}{2}$

$\omega_m = 4\pi \times 10^3 t$

$f_m = 4\pi \times 10^3$

$f_m = 2$ kHz