Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q1 a) Attempt any SIX of the following: (12 Marks)

i) Define the term polarization. (Definition – 2M)

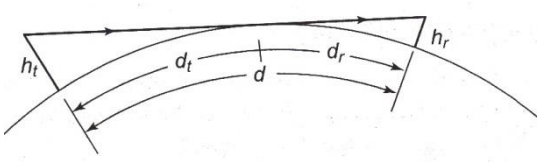
Ans:

Polarization is defined as the direction of the electric field in the electromagnetic wave radiated from an antenna.

- It is defined as physical orientation if radiated waves in space.
- Wave is said to be polarised if they all have the same alignment in space.
- In Electromagnetic waves electric field is parallel to wire.
- Therefore polarisation also indicates orientation of Electric waves.

ii) **With respect to space wave, what is radio horizon?**

Ans: (Diagram-1M, explanation 1M)



Space waves or direct wave travels in a straight line directly from the transmitting antenna to the receiving antenna. Due to the straight line nature of the space waves they will at same point be blocked due to curvature of earth

If the signal is to be received beyond the horizon then receiving antenna must be high.

iii) A piece of coaxial cable has characteristic impedance of 75Ω and a nominal Capacitance 69 PF/m. What is its inductance / meter.

Ans:

Zo = 75Ω

C = 69pf = $69*10^{-12}$ f

Zo = $\sqrt{\frac{L}{C}}$ **(1M)**

$Zo^2 = \frac{L}{c}$

$L = Zo^2.c$

$= (75)^2 * 69*10^{-12}$

= 0.38 µH/m **(1M)**

iv) Define the terms: Antenna resistance and ERP.

Ans:

Antenna Resistance:- **(1M)**

Radiation resistance is an antenna resistance and is equal to the ratio of the power radiated by the antenna to the square of the current at its feed point.

Mathematically $Rr(^{\Omega}) = \frac{\text{Prad (watts)}}{i2\ (Ampare)}$

ERP – (Effective radiated power) **(1M)**

Is the equivalent power that an isotropic antenna would have to radiate the same power density in the chosen direction at a given point as another antenna.

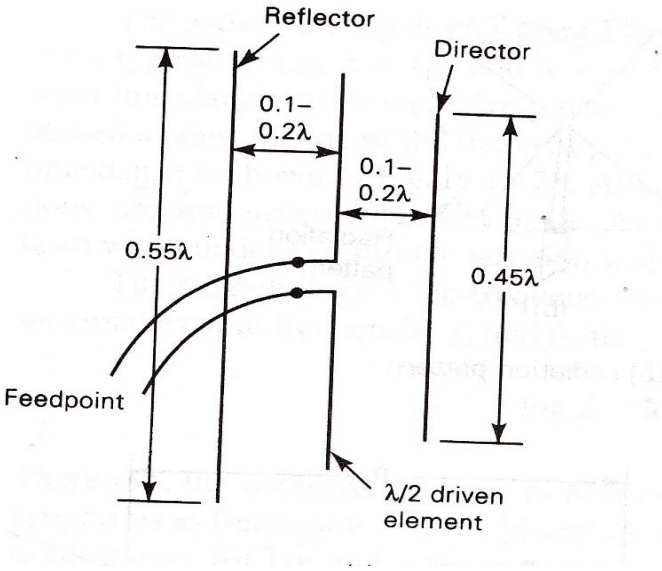
ERP = Prad Dt (watts)

Prad = total radiated power

Dt = transmit antenna directive gain

v) Draw neat sketch showing constructional details of Yagi Uda antenna.

Ans: **(2M-diagram)**



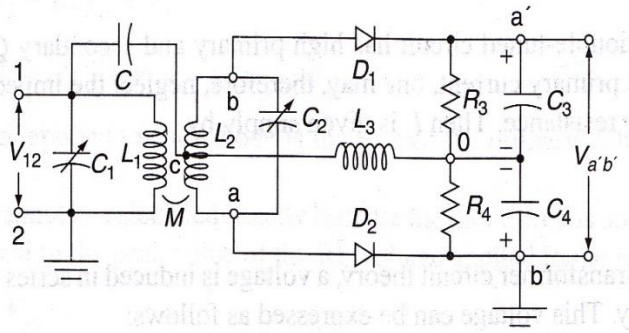
vi) Explain the term: adjacent channel selectivity in AM receiver.

Ans: **(1/2 M for Each Point)**

- This phenomenon manifests itself by picking up some short wave station at two nearby points on receiver dial.
- It is caused by poor front end selectivity i.e. inadequate image frequency rejection.
- It is harmful because a weak station may be masked by the reception of a strong station at the same point on the dial
- We can reduce double spotting by increasing the front end selectivity of the receiver.

vii) Draw neat circuit diagram of Foster Seeley Detector.

Ans: **(Diagram 2M)**



viii) List the factors on which choice of IF depends.

Ans: **(Any 4 points - 1/2 M for Each Point)**

Choice of IF depends on:-

i) If the intermediate frequency is too high, poor selectivity and poor adjacent – channel rejection result unless sharp cutoff (e.g., crystal or mechanical) filters are used in the IF stages.)
ii) A high value of intermediate frequency increases tracking difficulties.
iii) As the intermediate frequency is lowered, image – frequency rejection becomes poorer
iv) A very low intermediate frequency can make the selectivity too sharp, cutting off the sidebands.
v) If the IF is very low, the frequency stability of the local oscillator must be made correspondingly higher because any frequency drift is now a larger proportion of the low IF than of a high IF.
vi) The intermediate frequency must not fall within the tuning range of the receiver, or else instability will occur and heterodyne whistles will be heard, making it impossible to tune to the frequency band immediately adjacent to the intermediate frequency.

b) Attempt any TWO of the following: **(8 Marks)**

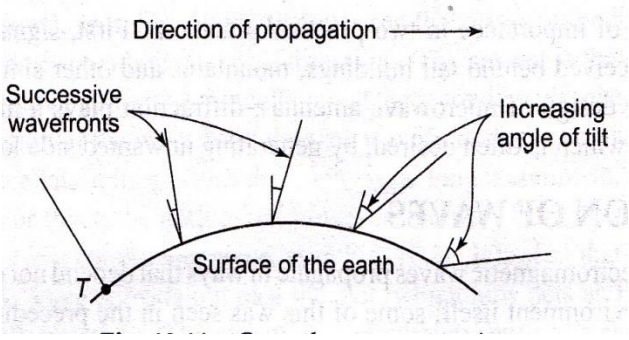
i) Describe ground wave propagation. What is angle of tilt? How does it affect field strength?

Ans:

(Ground wave propagation -1M, angle of tilt dia-1M, angle tilt descrp.-1M, affect- 1M)

Ground wave propagation:

- Ground waves leaves the antenna and propagate along the surface of the earth
- They follow the curvature of the earth and travel a distance beyond horizon
- Ground wave propagation is strongest at low and medium frequency(3KHz-3MHz)
- Ground waves must be vertically polarized to avoid short circuiting of electric field component.



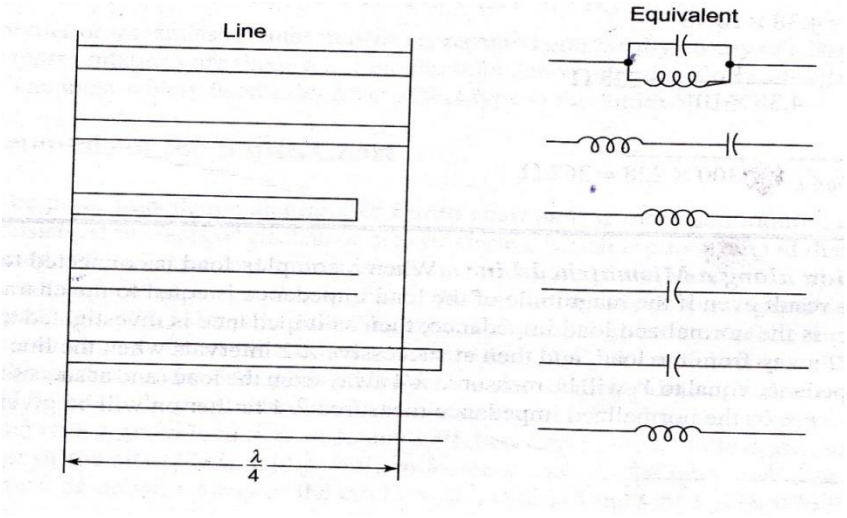
As the wave propagates over the earth, it tilts over more and more, and the increasing tilt causes greater short circuiting of the electric field component of the wave and hence field strength reduction. Eventually, at some distance (in wavelength) from the antenna, as partly determined by the type of surface over which the ground wave propagates, the wave "lies down and dies.

Affect:

By increasing angle tilt causes greater short circuiting of the electric field component of the wave and hence field strength is reduce.

ii) Describe the purpose of short length transmission line with open and short Circuit.

Ans: **(Diagram 2M & Explanation 2M)**



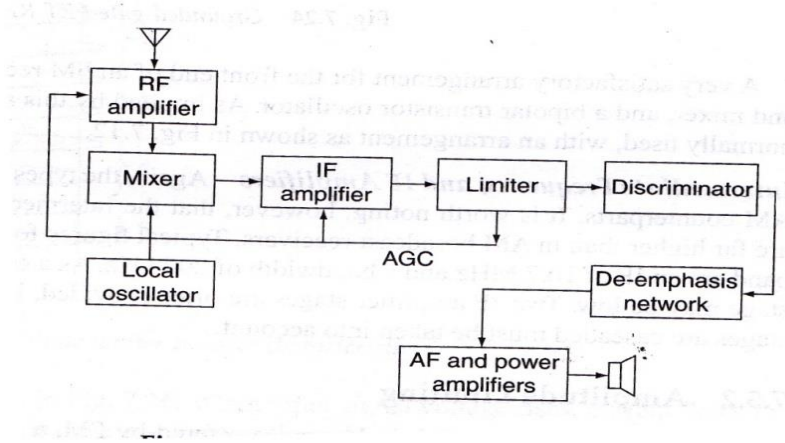
Explanation:

Restating the position, we know that a piece of transmission line µ4 long and short – circuited at the far end (or µ2 long and open –circuited at the far end) looks like an open circuit and behaves exactly like a parallel-tuned circuit. If the frequency of operation is lowered, the shunt inductive reactance of this tuned circuit is lower and the shunt capacitive reactance is higher. Inductive current predominates, and therefore the impedance of the circuit is purely inductive. Now, this piece at the new frequency is less than µ4 long, since the wavelength is now greater and the length of line is naturally unchanged.

We thus have the important property that a short circuited line less than µ4 long behaves as a pure inductance. An open-circuited line less than µ4 long appear as a pure capacitance. The various possibilities are shown in above diagram, which is really a table of various line length and terminations and their equivalent LC circuits.

iii) Draw neat block diagram of FM receiver.

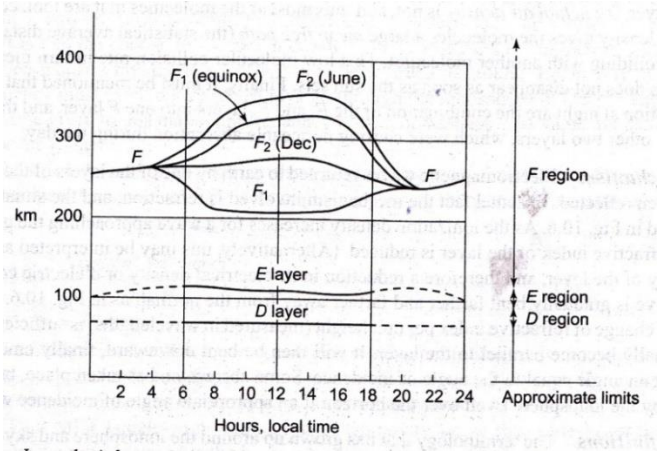
Ans: **(Diagram 4M)**



Q2) Attempt any FOUR of the following: **(16 Marks)**

a) Describe briefly structure of ionosphere and its effects on sky wave propagation.

Ans: **(Diagram 1.5M & Explanation 1.5M, Effects 1M)**



Explanation:

- The transmitted signal travels into the upper atmosphere where it is reflected back to earth due to the presence of layers called as ionosphere in the upper atmosphere.
- The D layer is the lowest and it exists at a height of about 70 Km from the earth surface.
- The E layer existing at an approximate height of 100 Km. the E layer also almost disappears at night due to recombination of ions and molecules.
- The E_s layer is a thin layer of very high ionization density, sometimes making an appearance with the E layer.

- The F_1 layer exist at a height of 180Km in daytime & combines with F_2 layer at night its daytime thickness is almost 20Km.
- The F_2 layer is by far the most important reflecting medium for high –frequency radio waves, its approximate thickness can be up to 200Km and its height ranges from 250 to 400Km in daytime. At night it falls to a height of about 300Km, where it combines with the F_1 layer.

Effect of Ionosphere on sky wave propagation:

- Different layers of ionospheres are of diff. Density.
- As we move up ionization density increases and refractive index decreases.
- Therefore incident wave gradually bend farther and farther away from the normal.
- If rate of change of refractive index per unit height is sufficiently high , refracted ray will bent down words

b) Describe the types of loses that may occur with RF transmission line. In what Units these loses are normally given?

Ans: (Any 3 Losses – 1M Each, Unit of Loss -1M)

i) **Conductor Losses: -** Conductor heating or D^2R loss, is proportional to current and therefore inversely proportional to characteristic impedance. It also increase with frequency, this because of the skin effect.

ii) **Dielectric heating loss:-**A difference of potential between two conductors of a metallic transmission line causes dielectric heating. Heat is a form of energy and must be taken from the energy propagating down the line. For air dielectric transmission lines, the heating loss is negligible. However, for solid-core transmission lines, dielectric heating with frequency..

iii) **Radiation Loss:-**If the separation between conductors in a metallic transmission line is an appreciable fraction of a wavelength, the electrostatic and electromagnetic fields that surround the conductor cause the line to act as if it were an antenna and transfer energy to any nearby conductive material. The energy radiated is called radiation loss and depends on dielectric material, conductor spacing, and length of the transmission line, Radiation losses are reduced by properly shielding the cable. Therefore shielded cables (such as STP and coaxial cable) have less radiation loss than unshielded cables (such as twin lead, open wire, and UTP). Radiation loss is also directly proportional to frequency.

iv) Coupling Loss:-Coupling loss occurs whenever a connection is made to or from a transmission line or when two sections of transmission line are connected together. Mechanical connections are discontinuities, which are locations where dissimilar materials meet. Discontinuities tend to heat up, radiate energy, and dissipate power.

v) **Corona:** Corona is a luminous discharge that occurs between the two conductors of a transmission line when the difference of a potential between them exceeds the breakdown voltage of the dielectric insulator, generally, when corona occurs, and the transmission line is destroyed.
Its unit is db/m.

c) Write the concepts of Hertzian dipole. Draw its radiation pattern.

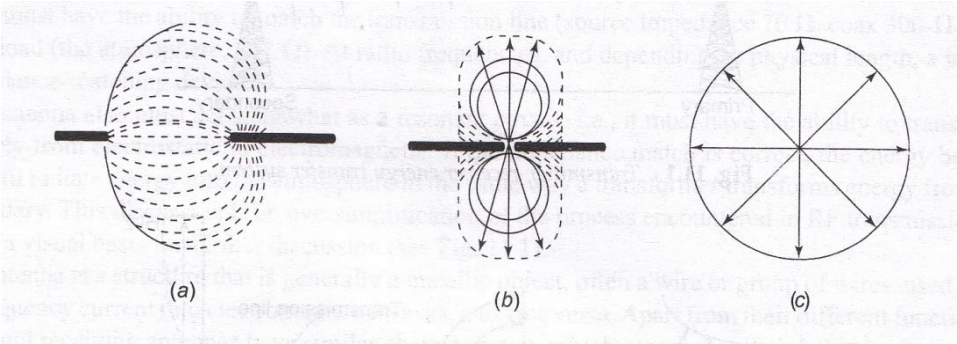
Ans: **(Radiation pattern 2M & Explanation 2M)**

The hertz dipole is a short linear antenna. It is assumed to carry uniform current along its length when it radiates. Such an antenna cannot be realized in practice but longer antennas can be assumed to be made up of a number of Hertzian dipoles connected in series.

The Hertzian Dipole is a theoretical antenna shorter than wavelength shown in figure a. It is used as a standard to which all other antenna characteristic can be compared.

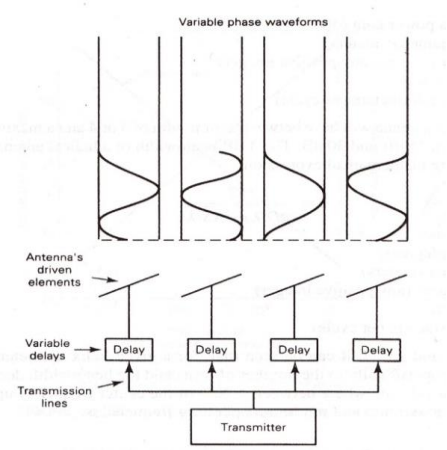
Radiation pattern of Hertzian dipole:

a) Side View b) angle of maximum radiation c) top view



d) Draw construction of phased array and describe its workings.

Ans: **(Diagram 2M & Explanation 2M)**



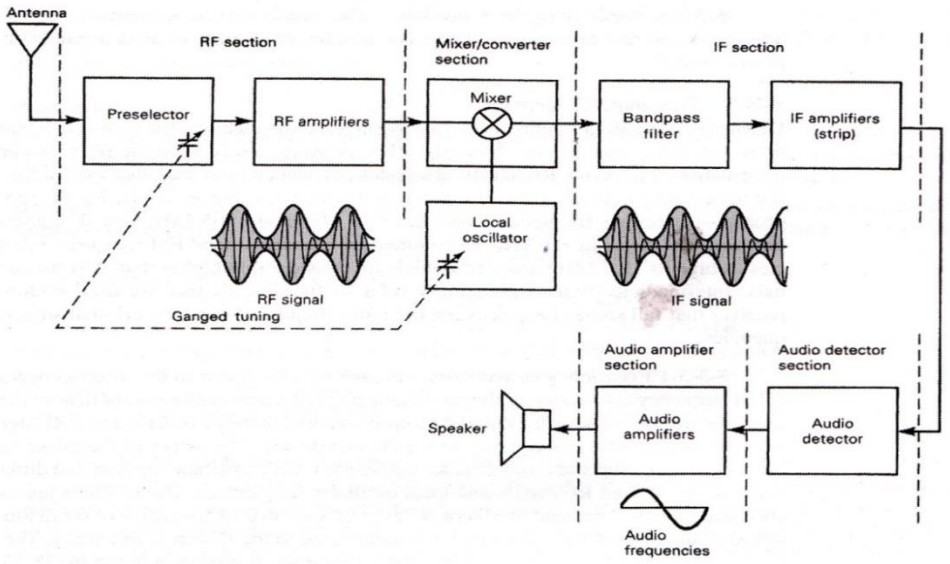
Explanation:

A phased array antenna is a group of antennas or a group of antenna arrays that, when connected together, function as a single antenna whose beam width and direction (i.e., radiation pattern) can be changed electronically without having to physically move any of the individual antennas or antenna elements within the array.

The primary advantage of phased array antennas is that they eliminate the need for mechanically rotating antenna elements. In essence, a phased array is an antenna whose radiation pattern can be electronically adjusted or changed. The primary application of phased arrays is in radar when radiation patterns must be capable of being rapidly changed to follow a moving object.

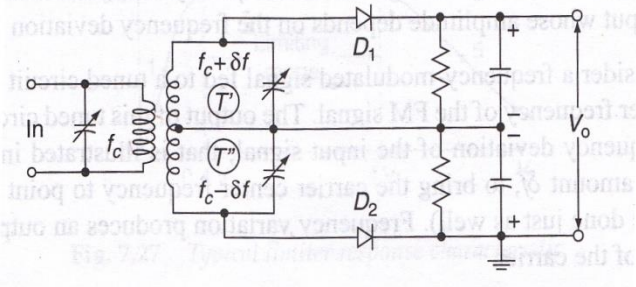
e) Draw neat block diagram of superheterodye AM receiver.

Ans: **(Diagram 4M)**



f) Draw diagram of balance slope detector and explain its operation.

Ans: **(Diagram 2M & Explanation 2M)**



Explanation:

- The circuit uses two slope detectors. They are connected back to back, to the opposite ends of a center-tapped transformer, and hence fed 180^o out of phase.
- When the input frequency is instantaneously equal to f_c, the voltage across T', that is, the input to diode D_1, will have a value somewhat less than the maximum available, since f_c is somewhat below the resonant frequency of T".
- A similar condition exists across T". In fact, since f_c is just as far from $f_c + \delta f$ as it is from $f_c - \delta f$ the voltages applied to the two diodes will be identical. The dc output voltages will also be identical, and thus the detector output will be zero, since the output of D_1 is positive and that of D_2 is negative.
- Now consider the instantaneous frequency to be equal to $f_c + \delta f$. Since T" is tuned to this frequency, the output of D_1 will be quite large. On the other hand, the output of D_2 will be very small, since the frequency $f_c + \delta f$ is quite a long way from $f_c - \delta f$.
- Similarly, when the input frequency is instantaneously equal to $f_c - \delta f$, the output of D_2 will be large negative voltage, and that of D_1 a small positive voltage. Thus in the first case the overall output will be positive and maximum, and in the second it will be negative and maximum.
- When the instantaneous frequency is between these two extremes, the output will have some intermediate value. It will then be positive or negative, depending on which side of f_c the input frequency happens to lie. Finally, if the input frequency goes outside the range described, the output will fall because of the behavior of the tuned circuit response. The required S-shaped frequency-modulation characteristic (as shown in figure) is obtained.

Q.3 Attempt any four of the following: (16M)

a) What is a fading? List its major cause.

Ans: (fading 2M , cause 2M)

The interference between two waves which follow different paths to travel from transmitter to receiver is called trading.

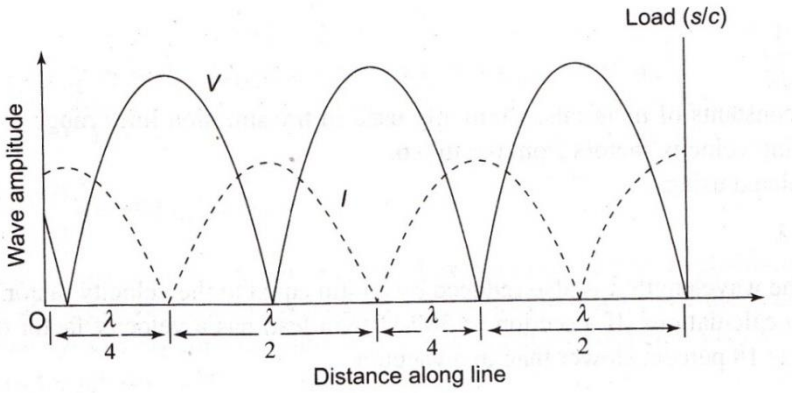
Due to fading variations or fluctuations occurs in the signal strength at the receiver.

 # Major cause

- **Multipath propagation**- Interference between lower and upper rays of a sky wave; between sky waves arriving by a different number of hops or different paths or even between ground waves and sky waves.
- **Variation in atmospheric condition along the path**- Fluctuations in the height or density of layer reflecting the wave

b) Explain how standing waves occur in an imperfectly matched transmission line.

Ans: (2M Diagram & 2 M Explanation)



- If $Z_L \neq Z_0$ some power is absorbed, and the rest is reflected.
- We have one set of V & I travelling toward the load, and reflected set travelling back to the generator.
- These two sets of travelling waves going in opposite direction (180^0 out of phase) set up an interference pattern known as standing waves.
- It is seen that stationary voltage & current minima (nodes) & maxima (antinode) have appeared.

c) **Define the terms: Beam Width and band width of antenna.**

Ans: (2 M for each definition)

Beam Width: The beam width of an antenna is described as the angles created by comparing the half- power points (3db) on the main radiation lobe to its maximum power point.

Band width: The term bandwidth is defined as the range of frequencies the antenna will radiate effectively

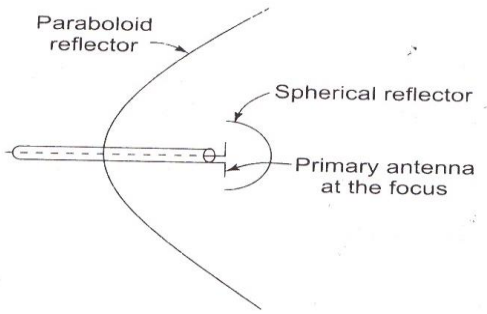
OR

The antenna will perform satisfactorily throughout this range of frequencies.

d) With sketches, describe any one method of feeding parabolic reflector in the primary antenna located at focal point.

Ans: (Any 1) (2M Diagram & 2 M Explanation)

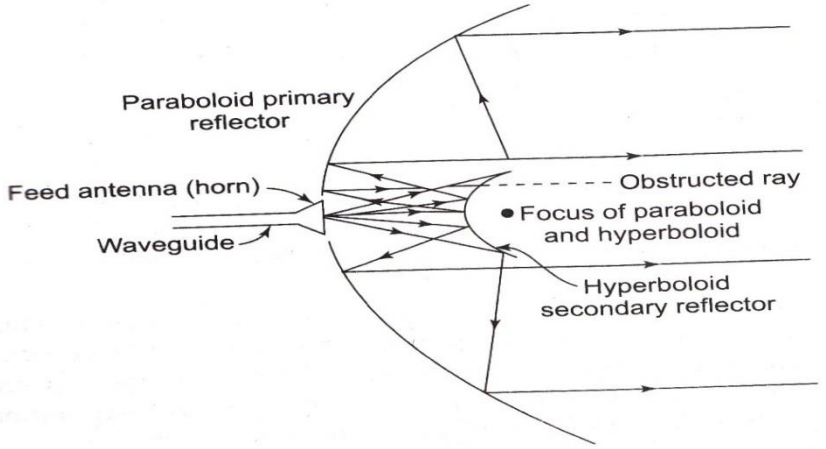
1. **Center-fed with spherical shell**.



- The primary antenna is placed at the focus of the parabolic for best results in transmission or reception.
- He direct radiation from the feed. Which is not reflected by the parabolic , tends to spread out in all directions and hence partially spoils the directivity.
- Several methods are used to prevent this, one of them being the provision of a small spherical reflector, as shown in fig.
- It redirect all such radiation back to the parabolic.

OR

2. Cass grain Feed.



- It uses a hyperboloid secondary reflector.
- One of its foci coincides with the focus of the parabolic, resulting in the action shown for transmission.
- The rays emitted from the feed born antenna are reflected from the parabolic mirror.
- The effect on the main parabolic reflector being the same as that of a feed antenna at the focus.
- The main reflector then collimates (renders parallel) the rays in the usual manner.

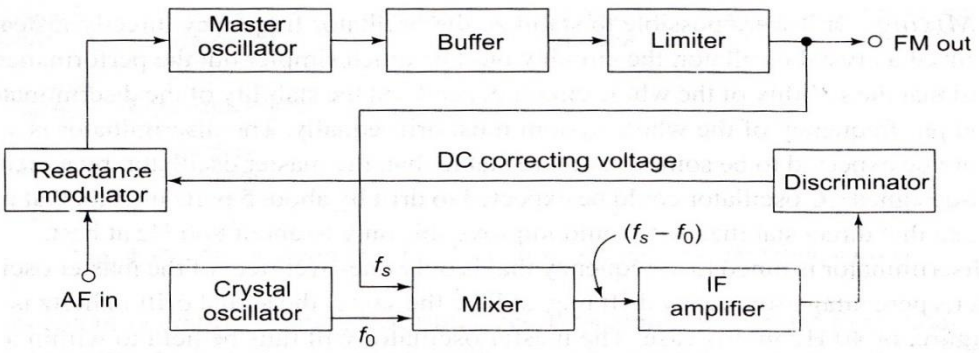
e**) Give the merits of simple AGC circuits.**

Ans: **(1M each)**

- Change the overall gain of a receiver automatically
- Maintain a constant output voltage level over a wide range of RF.
- Simplicity
- Lower cost

f) Describe the concept of AFC.

Ans: (2M Diagram & 2 M Explanation)

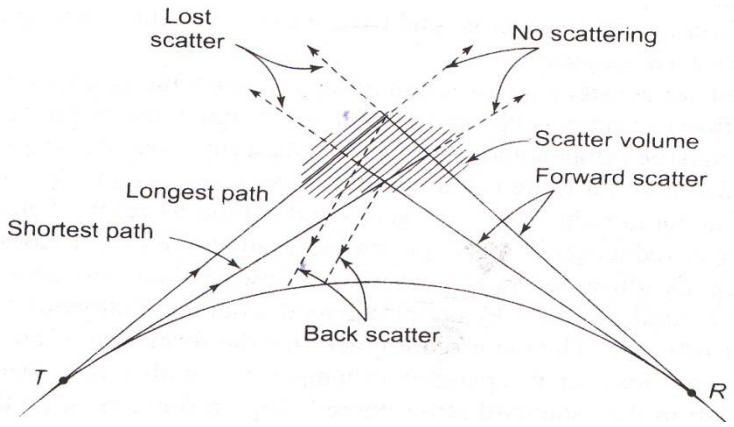


- The oscillator on which reactance modulator operates cannot be crystal-controlled
- It must have the stability of a crystal oscillator if it is to be part of a commercial transmitter.
- This suggests the frequency stabilization of the reactance modulator is required.
- The drift in frequency may take place due to temperature changes or aging of the components etc. so in order to correct the frequency of the local oscillator automatically the AFC is used.

Q4 Attempt any four of the following (16 Marks)

a) Draw neat sketch and explain tropospheric scatter.

Ans: (2M Diagram & 2 M Explanation)



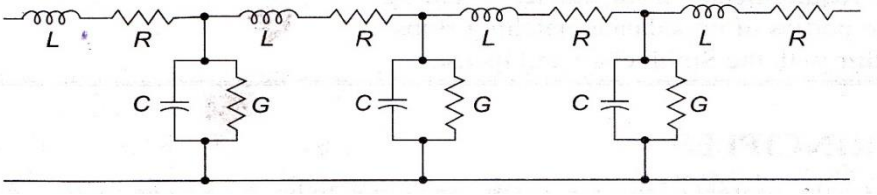
- Also known as troposcatter, or forward scatter propagation ,tropospheric scatter propagation is a means of beyond- the –horizon propagation for UHF signals.it use certain properties of the troposphere, the nearest portion of the atmosphere

- Although forward scatter is subject to fading, with little signal scattered forward which forms a very reliable method of over the horizon communication.
- This method of propagation is often used to provide long distance telephone and other communication links.
- It causes two forms of fading
    1) Rayleigh or fast fading – due to multipath propagation
    2) Slow fading – due to variation in atmospheric condition along the path.

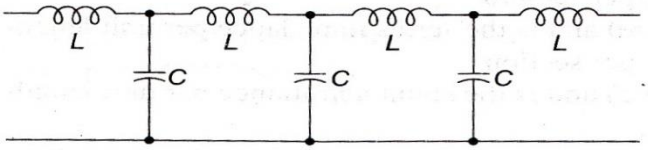
b) Draw equivalent circuit of transmission line at low frequency and for RF frequency.

Ans: **(2M each diagram)**

Transmission line at low frequency



Transmission line at RF frequency



c) Explain meaning of term resonant antenna .Draw radiation patterns of resonant dipoles with length l=λ/2 and l= λ

Ans: **(Meaning 2M , Radiation Patterns 1M each)**

Meaning of term resonant antenna

1) A resonant antenna is transmission line the length of which is exactly equal to multiples of half wavelength (l=λ/2) and it is open at both ends.
2) Resonant circuit has a very narrow bandwidth which establishes the useful limits for this type of radiator.
3) The radiation patterns of a wire radiator in free space depend mainly on its length.
4) So the length of the resonant antenna can be λ/2,λ, 3λ/2 etc.

Radiation patterns

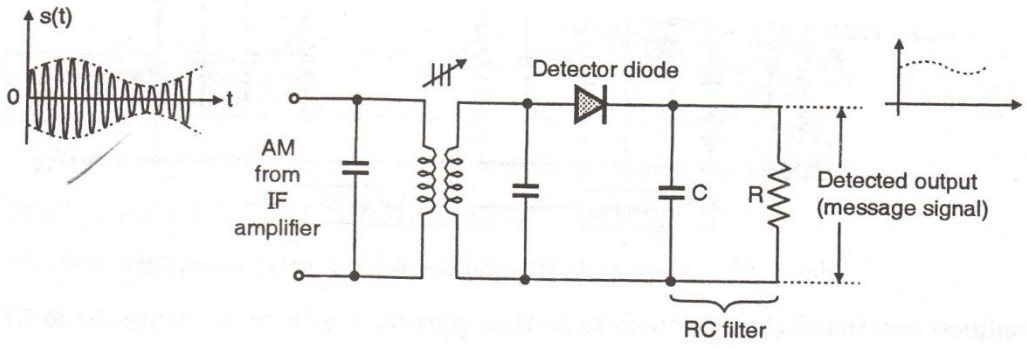
d) List function of RF amplifier in AM receiver.

Ans: **(1/2 M each point)**

1) It reduces the noise figure.
2) Match the i/p impedance of the receivers to that of antenna.
3) Acts as a filter.
4) It improves the gain.
5) It provides better image frequency rejection
6) It improves the Signal to Noise ratio
7) It prevents the radiation of local oscillator frequency through antenna.
8) It provides better sensitivity & selectivity

e) Draw neat circuit diagram of simple diode detector and explain its operation.

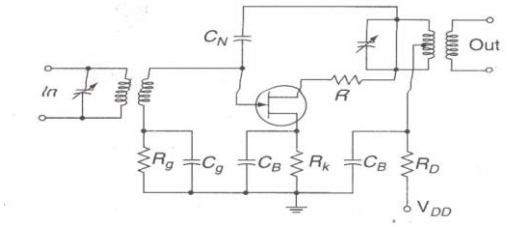
Ans: **(2M Diagram & 2 M Explanation)**



- The Standard AM wave is applied at the input of the detector.
- In every positive half cycle of the input the detector diode is forward biased and it will charge the filter capacitor C connected across the load resistance R to almost the peak value of the input voltage.
- As soon as the capacitor charges to the peak value, the diode stops conduction and the capacitor will discharge through R between the positive peaks.
- The discharging process continues until the next positive half cycle. when the input signal becomes grater then the capacitor voltage, the diode conducts again and the process repeats itself.

f) With neat circuit diagram, explain operation of amplitude limiter circuit.

Ans: **(2M Diagram & 2 M Explanation)**



- When input signal voltage rises, current flows in the R_g-C_g bias circuit, and a negative voltage is developed across the capacitor.
- It is seen that the bias on the FET is increased in proportion to the size of the input voltage.
- As the result the gain of the gain of the amplifier is lowered, and the output voltage tends to remain constant.
- Although some limiting is achieved by this process, it is insufficient by itself.
- To overcome this, early saturation of the output current is used which is achieved by means of a low drain supply voltage
- The supply voltage for a limiter is typically one-half of the normal dc drain voltage.
- The result of early saturation is to ensure limiting for conveniently low input voltages.

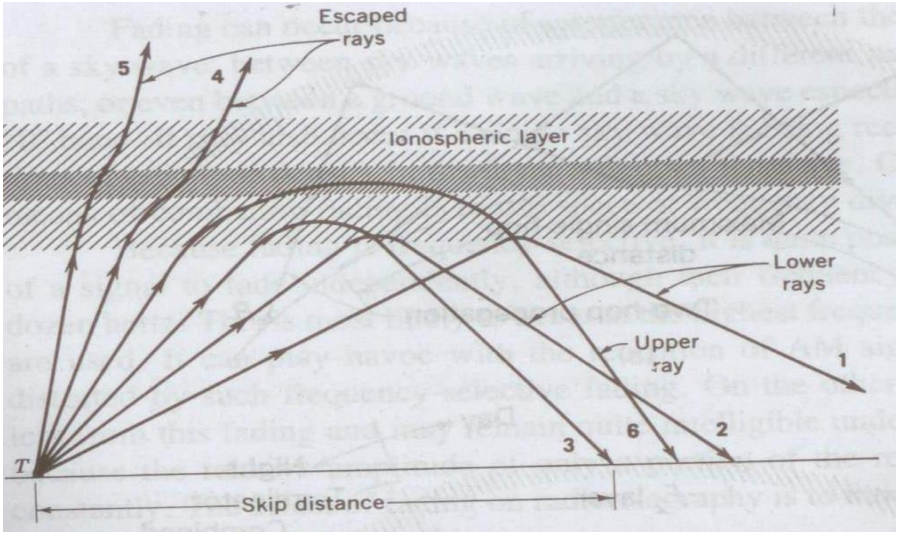
Q.5. Attempt any FOUR of the following (16 Marks)

a) With neat sketch, explain effect of increasing angle of incidence of radio waves in sky propagation.

Ans:- (2M Diagram & 2 M Explanation)

At particular frequency if angle of incidence is varied then skip distance also varies in proportion. If angle of incidence is increased & moved away from normal, then skip distance also starts increasing & received signal becomes weak near the transmitter. But as the incidence angle decreases (after certain frequency) the rays escapes in the space. As shown in figure ,ray 1 is having maximum incident angle hence it is having maximum skip distance .

The ray 3 is having less angle of incidence hence it is having less skip distance .Ray 4 & ray 5 escapes in the space as these rays are having very less angle of incidence .



b) Define and explain the term standing wave ratio. Give its formula for purely resistive load.

$$SWR = \frac{V_{max}}{V_{min}}$$

Ans:-

For a transmission line ,if ZR ≠Z0, some of the power is absorbed in the load and rest is reflected back.

The two sets of travelling wave travelling in opposite direction set-up an interference pattern known as standing waves.

Standing Wave Ratio (SWR) - The ratio of maximum and minimum magnitudes of current or voltage on the line having standing wave is called Standing Wave Ratio (SWR). **(2 M)**

=Imax/Imin **(1M)**

Standing wave ratio for a purely resistive load is given as RL/ZO or ZO/RL (whichever value is less than 1) **(1 M)**

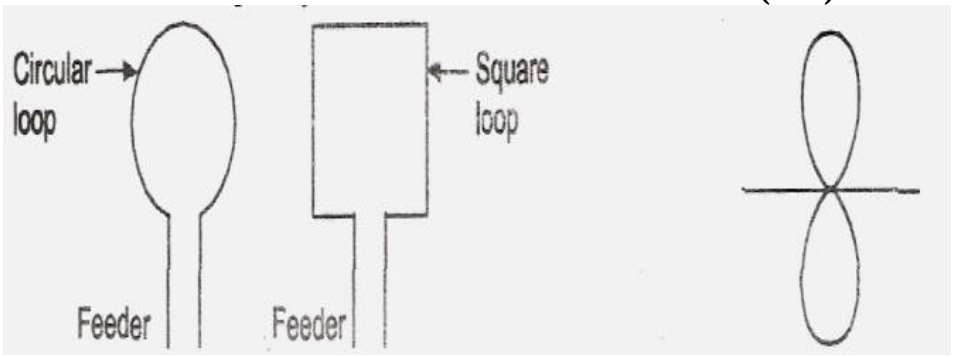
c) Draw neat sketch and explain construction and working of loop antenna.

Ans:-

A loop antenna is a single-turn coil carrying RF current.

The dimensions of the coil are much smaller than wavelength and current flowing through the coil is assumed to be in phase. So that when current flows through the loop formed by coil, a magnetic field is generated everywhere perpendicular to the loop. The directional pattern is independent of the shape of the loop and identical to that of frequency doublet. The circular and square loops in figure shown have the same radiation pattern and short horizontal dipole, except that, unlike horizontal dipole, a vertical loop is verticallv polarized. No radiation is received that is normal to the plane of loop, because the radiation pattern of the loop antenna is the familiar doughnut pattern. Thus, it makes the loop antenna suitable for direction finding applications. A simple direction finder consists of a small loop, vertical and rotatable about vertical axis, that may be mounted on top of a portable receiver whose output is connected to meter. Loop are provided sometimes with several turns and also ferrite cores.

(2 M)



Construction (1 M) **Radiation pattern (1 M)**

d) Draw neat diagram and describe tracking .How is it carried out in AM receiver?

Ans:-

The receiver has a number of tunable circuits such as the antenna or mixer or a local oscillator tuned circuits, they need to be tuned correctly for any station is to be tuned. So various circuits are ganged tuned .The local oscillator frequency need to be preciously adjusted to the value which is above the signal frequency Fs by IF ie. Fo= Fs +IF. If this tuning is not done precisely then the frequency difference Fo-Fs is not correct. These errors are called as tracking errors.

Tracking is a process in which the local oscillator frequency follows or tracks the signal frequency to have a correct frequency difference.

Due to tracking errors the stations will appear away from their correct position on the frequency dial of the receiver. Also practically it is not possible to always to keep a constant difference between Fo and Fs. Hence some tracking errors are always present. **(1 M)**

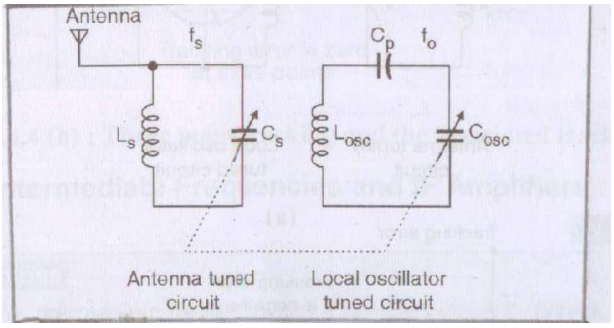
Tracking is carried way in two ways- **(1 M)**

1.Two point tracking- a) Padder tracking

b)Trimmer tracking

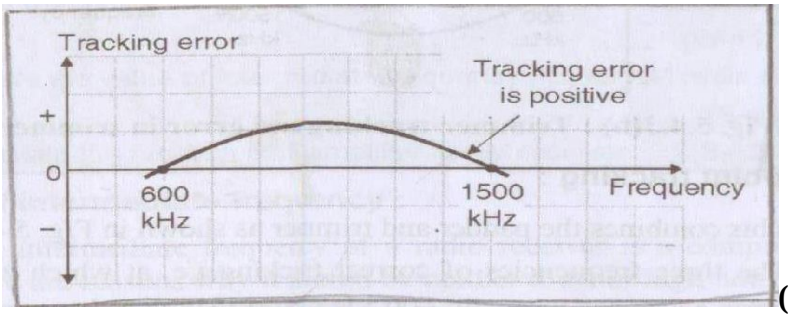
2. Three point tracking

Padder tracking-A small variable capacitor Cp called as the padder capacitor is connected in series with the oscillator coil as shown in the figure below-



(1 M)

Due to series connection of C_p and C_{osc} the effective capacitance will be less than C_{osc} alone .This will increase the oscillator frequency making the tracking error positive. The padder capacitor is adjusted to have zero tracking error on two extreme points on the frequency dial as shown below-

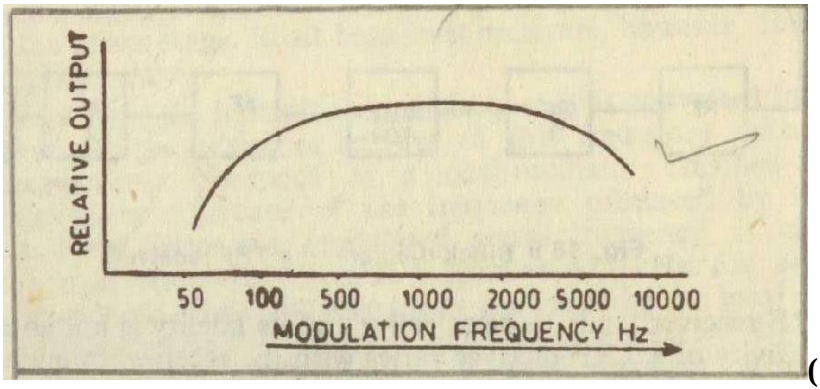


(1 M)

e) Explain the terms fidelity and dynamic range of AM receiver.

Ans:-

Fidelity- It is the ability of a receiver to produce faithfully all the audio frequencies with which the carrier is modulated. This is expressed in as a frequency response curve as shown- **(1 M)**



(1 M)

Dynamic Range- The dynamic range of a radio receiver is essentially the range of signal levels over which it can operate. The low end of the range is governed by its sensitivity whilst at the high end it is governed by its overload or strong signal handling performance.

To gain a feel for the figures which may be obtained where inter-modulation is the limiting factor figures of between 80 and 90 dB range are typical, and where blocking is the limiting factor figures around 115 dB are generally achieved in a good radio receiver used for professional radio communications applications**. (2 M)**

f) Draw neat sketch and explain operation of PLL based FM demodulator.

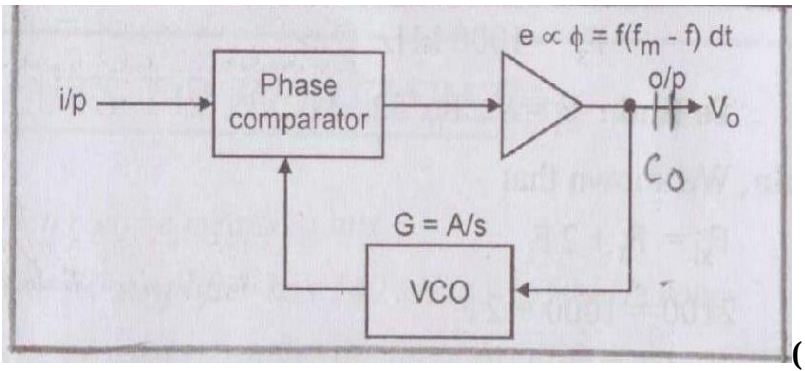
Ans:-

FM detector using PLL-

As shown the VCO is the voltage controlled oscillator .The phase locked loop detector requires no frequency selective LC network to accomplish demodulation. In this system a voltage controlled oscillator is phase locked by a feedback loop, which forces the VCO to follow the frequency variations of the incoming FM signal.

The low frequency error voltage that forces the VCO s frequency to track the frequency of the modulated FM signal is the demodulated audio signal.

(2 M)



(2 M)

Q.6.Attempt any FOUR of the following (16 marks)

a) Define and explain the term characteristics impedance of transmission line. When the i/p impedance of transmission line is becomes equal to the characteristics impedance?

Ans:-

Characteristic impedance of a transmission line, Zo is the impedance measured at the input of this line when its length is infinite**.** **(1 M)**

Method of Calculation :

If a line has infinite length, all the power fed into it will be absorbed, because the voltage drops across the inductance and leakage current through capacitance.

Zo is given as -

$$Z_0 = \sqrt{\frac{Z}{Y}}$$

where, Z_0 = Characteristic impedance

Z = Series impedance per section

$= R + j\omega L\ (\Omega/m)$

Y = Shunt admittance per section

$= G + j\omega C\ (s/m)$

Therefore,

$$Z_0 = \sqrt{\frac{R + j\omega L}{G + j\omega C}}$$

(2 M)

For a properly terminated transmission line,
Load impedance = Characteristic impedance i.e. ZL = Z0

No reflection takes place. Thus for no reflections and hence no losses SWR should be maximum. **(1 M)**

b) State the features of directional high frequency antenna .List its two examples.

Ans:-

Features- **(any 4 points 2 M)**

1) The frequency band from 1 Ghz to 100 Ghz is called as the microwave frequency region .

2) These antennas are highly directional antennas .

3) Their physical dimensions should be many wavelengths so as to have high gain.

4) Provides point to point communication.

Examples:- **(any 2 points 2 M)**

1. Horn antenna

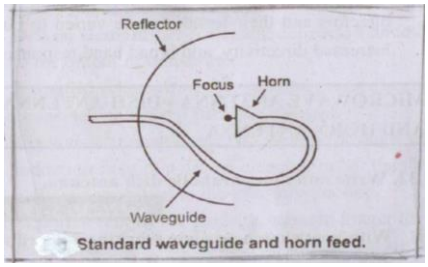
2. Dish antenna

c) What is horn antenna? How is it fed ? List its applications.

Ans:-

A waveguide can radiate energy (i.e act like an antenna) into space if we excite it from one end and if its other end is left open. The waveguide radiates a large amount of energy as compared to that radiated by a two wire transmission line. But the problem is waveguides is that a very small amount of energy out of the total is actually radiated and a large part of energy is reflected back due to open circuit. Similar to transmission line, the open circuit at the far end actually acts as a discontinuity. So that waveguide is very poorly matched to the space. A poor end non directional pattern will result due to the diffraction taking place around the edges of a waveguide. In order to improve the radiation, we have to open out the mouth of waveguide. When a transmission line is opened it results into a dipole antenna but when a waveguide is opened, it results in an electromagnetic horn **(1 M)**

Horn feed:-The waveguide feeds through the centre of the parabolic dish and is curved around so that the horn is positioned exactly at the focal point.This also improves impedance matching. **(1 M)**



Standard waveguide and horn feed.

(1 M)

Applications:- **(any two- 1 M)**

1. Highly directional microwave antennas
2. Satellite antennas
3. Spacecraft antennas
4. As feed antennas

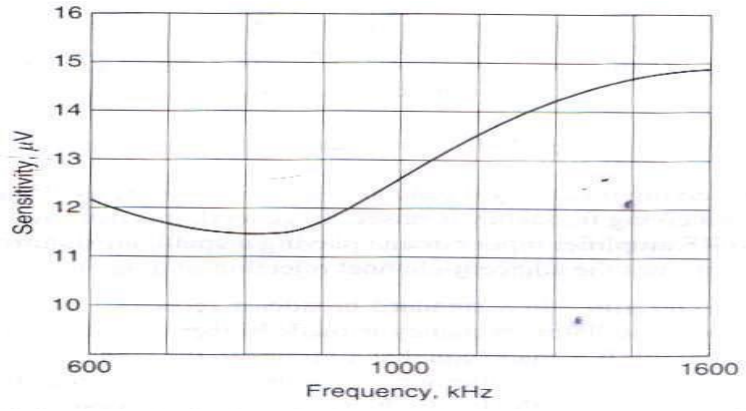
d) Define

i) Selectivity

ii) Sensitivity for AM receiver.

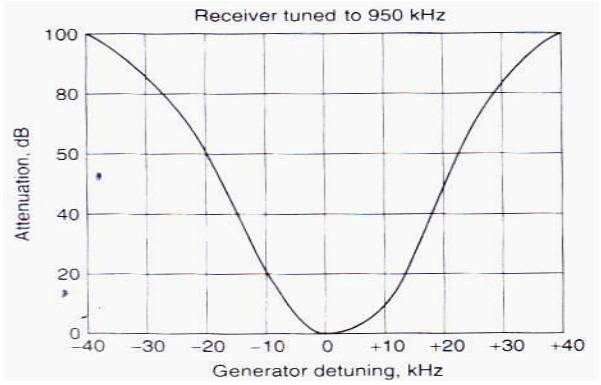
Ans:-

Sensitivity- Sensitivity for a radio receiver is defined as the ability to amplify weak signals. It is measured in μV. **(1 M)**



(1 M)

Selectivity :- (**Definition 01 M, Curve 01 M)** Selectivity is defined for a radio receiver as the ability to reject unwanted Signals .It decides the adjacent channel rejection of a receiver. **(1 M)**



(1 M)

e) Give step by step procedure to be carried out for IF alignment.

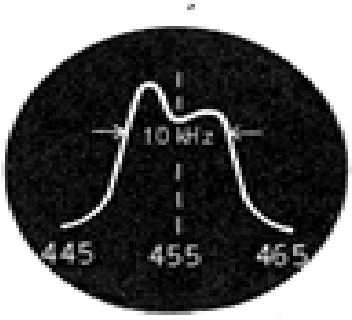
Ans:- **(Proper procedure 4 M)**

In radio system alignment, IF alignment is performed first. IF alignment requires sweep frequency signal generators and oscilloscopes . by aligning the intermediate frequency (IF) stages by setting the generator's dial to 455, 456, 460 or whatever, and then peaking the IF stages. This was due to the oscillator not tracking with the RF stage(s) to generate the correct IF frequency across the dial. This was not very critical on the larger sets which used tuning capacitors with all sections alike and "padder" capacitors in the oscillator circuits, which adjusted the tracking at the low end of the dial, since the padder can usually make up for the IF error

1. Using a signal generator at the prescribed frequency connected to the mixer grid circuit (and the RF stage disabled so as to prevent some broadcast station from interfering),
2. Some form of an output meter; each stage is adjusted for maximum output.
3. Take care to use the lowest signal level that will give a steady output indication; too much can overload the circuits, and too little might not give a reliable output indication.
4. Generally you use the lowest level that will give an accurate reading so that the automatic valume control (AVC) circuit will be inoperative.
5. With this done, the signal generator is loosely coupled to the input of the receiver, and set to, say, 1400kHz.
6. The oscillator is set to bring the 1400 kHz in at 1400 on the dial, and then the RF sections are adjusted to also peak on the output meter.
7. The generator is now set to about 600, and hopefully the signal will come in at 600 on the dial. If it doesn't, and the receiver has an oscillator padder, the padder is adjusted to bring the signal in at 600.
8. Since this effects the high end, we must now go back and reset the 1400 oscillator trimmer to track and then go back to 600 repeating as often as necessary to bring both ends of the dial into tracking.

"High Fidelity" receivers sometimes require a better method of IF align

Selectivity curve

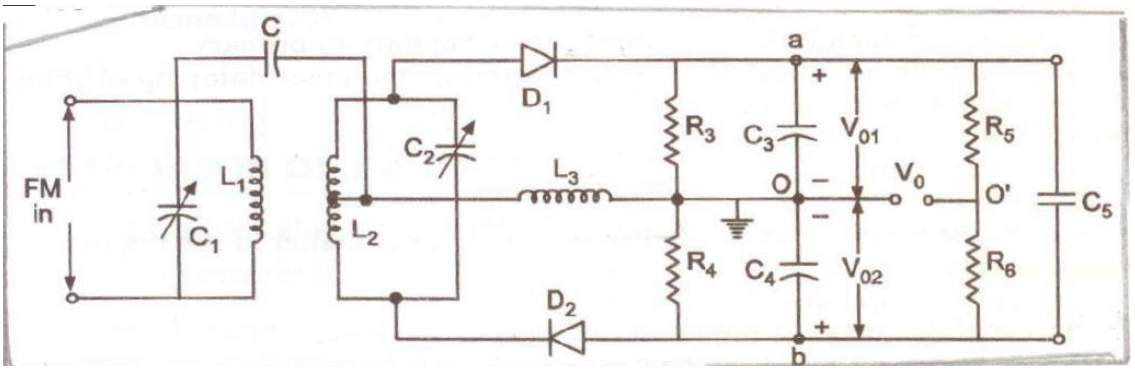


Typical IF response curve. Note that one side of the center frequency is higher than the other. Ideally both sides should be equal, with a minimum of dip in the center

f) Draw neat circuit diagram of ratio detector and describe its working principle.

Ans:-

Ratio detector is the modification in phase discriminator by adding amplitude limiting.



(2 M)

Limiter stage is not required in ratio detector because of large capacitor C5 connected across it.

DC voltage is constant; there will be no current either flowing in to charge the capacitor or flowing out to discharge it. In other words the input impedance of C5 is infinite.

If DC voltage tries to increase, C5 will tend to oppose any rise on Vo. As soon as the input voltage tries to rise, extra diode current flows but these excess current flows in to the capacitor C5. Charging it.

The output voltage remains constant at first because it is not possible for the voltage across capacitor to change instantaneously. The situation now is that the current in the diodes load has risen, but the voltage across the load has not changed

With diode D2 reversed biased , point O is now positive with respect to b, so that Vab is now sum voltage. Large capacitor C5 is connected to keep the o/p sum voltage constant, even though the load current increases. Thus provides the amplitude limiting.

Output voltage Vo is equal to half of the difference between the output voltages from the individual diodes.

Vo= (Vo1-Vo2) /2

Thus output voltage is proportional to the difference between the individual output voltages.

L3 matches the low impedance secondary to primary and provides voltage step down to prevent too great damping of primary by the ratio detector action.

(2 M)