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 judgment 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: **12 M**

(a) Draw a sketch showing tropospheric scatter propagation.

Ans: ***[Note: Any other relevant diagram should be considered]*** **(Diagram-2M)**

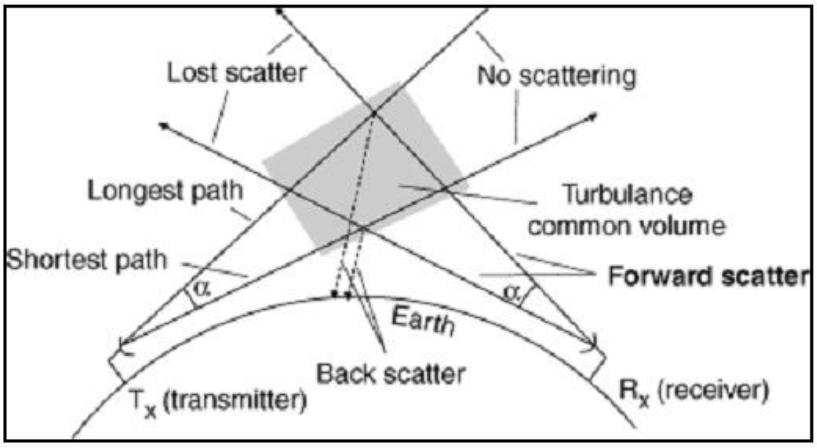


Fig. Tropospheric scatter propagation

(b) What is transverse electromagnetic wave?

Ans: **(Correct Definition- 2 Mark, Diagram is optional)**

- The wave in which electric field, magnetic field and direction of propagation are mutually perpendicular to each other.
- Electromagnetic waves are energy propagated through free space at the velocity of light, which is approximately $3x10^8$ m/s.
- Electromagnetic waves comprises of electrical and magnetic components.

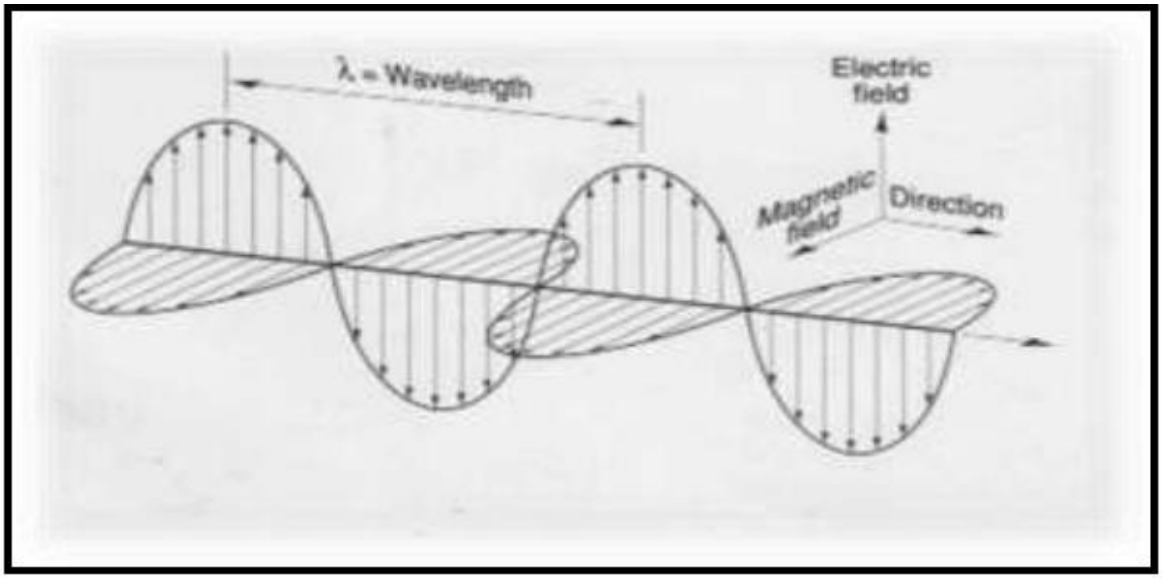


Fig. Transverse electromagnetic wave

(c) A load of 300 ohm is used to match 500 ohm transmission line to achieve SWR=1. Find out the required characteristics impedance of quarter wave transformer connected directly to the load.

Ans:

Since SWR=1 is to be achieved, the impedance Z_s at the output of quarter wave transformer must equal to characteristic impedance Z_0

Let the transformer characteristic impedance be Z'_0

$Z_s = Z'_0 / Z_L = Z_0$ **01M**

$Z'_0 = \sqrt{Z_0 Z_L}$

$= \sqrt{300 \times 500} = 387.3$ ohms. **01M**

(d) List the factors that govern the selection of feed point of dipole array.

Ans: **1M Each**

1. Antenna Impedance
2. Antenna length

(e) Draw Yagi-Uda antenna.

Ans: **labeled Diagram 02M**

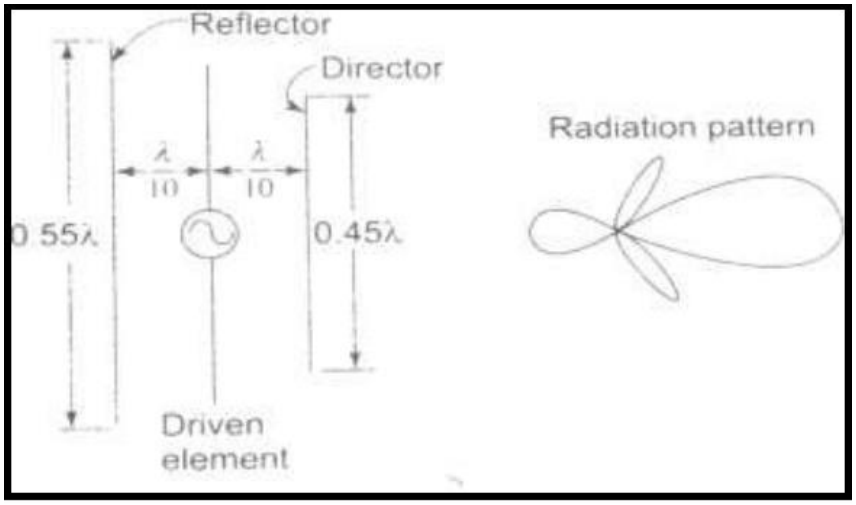


Figure:-Yagi-uda antenna

OR

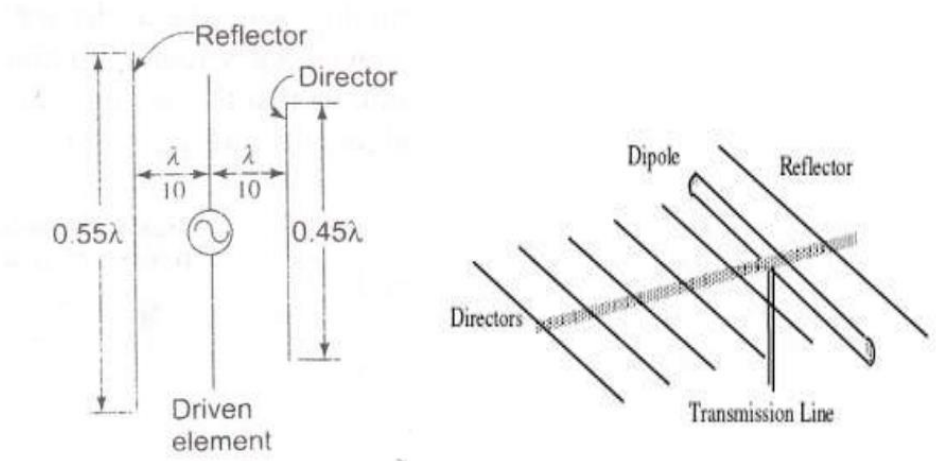


Fig.Yagi uda antenna

(f) State the value of IF frequency in FM receiver and AM receiver.

Ans: **01M Each**

- IF of AM= 455 KHz (for M.W. band)

OR

IF of AM=1.6 to 2.3 MHz (for S.W. band)

- IF of FM= 10.7 MHz

(g) Why intermediate frequency (IF) has constant value?

Ans: **(Any 2 points 2M)**

- The frequency spectrum has been distributed for various purposes.
- Otherwise, the people may use the frequencies of their choice & there will be wide range of interference. So, in order to ensure proper reception of signals, the standards have been fixed for the transmission of frequencies & also for the intermediate frequency. If the intermediate frequency is varied the overall frequency value will also vary.
- The intermediate frequency value should be so designed that it should not lie within the range of mixer stage. Otherwise, there is the production of noise signal due to the interference of mixer frequency & intermediate frequency.
- The intermediate frequency should not be too high. Otherwise, it will reduce the selectivity of the receiver because of increase in bandwidth.
- Considering all these factors intermediate frequency is kept constant.

(h) Draw the I/P and O/P waveforms of diode detector.

Ans: **(1M for Each Waveform)**

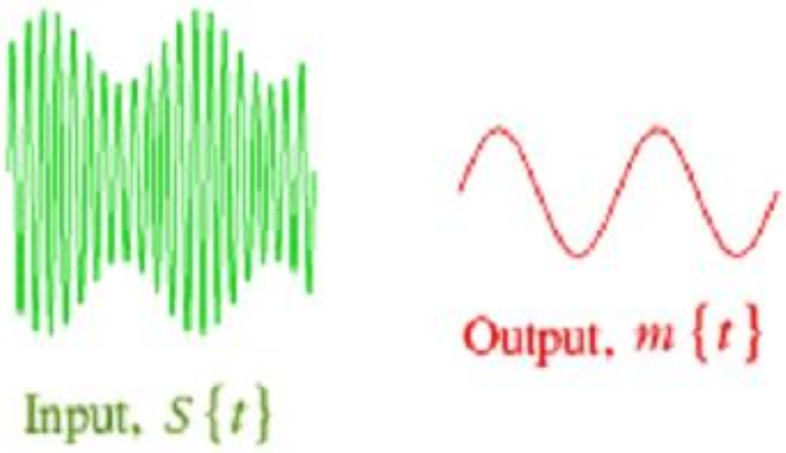


Fig. Input and output waveforms

(B) Attempt any TWO: **4x2=8**

(a) With respect to sky wave propagation define the following terms.

(i) Virtual height

(ii) Skip distance

(iii) Maximum usable frequency

(iv) Critical frequency

Ans: **(1M for each)**

(i) Virtual Height:

Virtual height is the height above earth's surface from which a refracted wave appears to have been reflected.

OR

The maximum height that the hypothetical reflected wave would have reached is the virtual height.

(ii) Skip Distance: Skip distance is defined as the minimum distance from a transmitter antenna that a sky wave at a given frequency will be returned to earth.

(iii) Maximum Usable Frequency: Maximum usable frequency (MUF) is also a limiting frequency but for some specific angle of incidence other than normal. If the angle of incidence is θ, it follows that, it is defined as the highest frequency that can be used for sky wave propagation between two given points on earth.

(iv) Critical Frequency: Critical frequency is the highest frequency that can be propagated directly upward and still be returned to earth by the ionosphere.

$$\text{MUF} = \frac{Critical\ frequency}{cos\theta}$$

$$= f_c\ sec\theta$$

OR

The highest frequency that will be returned to earth in the vertical direction is the critical frequency.

(b) Derive the relation between reflection coefficient (K) and VSWR(S).

Ans: Relation between reflection coefficient and standing wave ratio:

Relation between reflection co-efficient (e) and VSWR:

$$SWR = \frac{V_{max}}{V_{min}} \quad \text{1M}$$

V_{max} = Ei +Er 1/2M

V_{min} = $E_i . E_r$ 1/2M

Therefore equation can be written as

$e E_i = E_r$

$$SWR = \frac{Ei + Ei\,e}{Ei - Ei\,e} \quad \text{1M}$$

$$SWR = \frac{Ei\,(1+e)}{Ei\,(1-e)} = \frac{(1+e)}{(1-e)}$$

SWR(1-e)= (1+e)

SWR= SWR e= 1+e

SWR= 1+e+(SWR)e

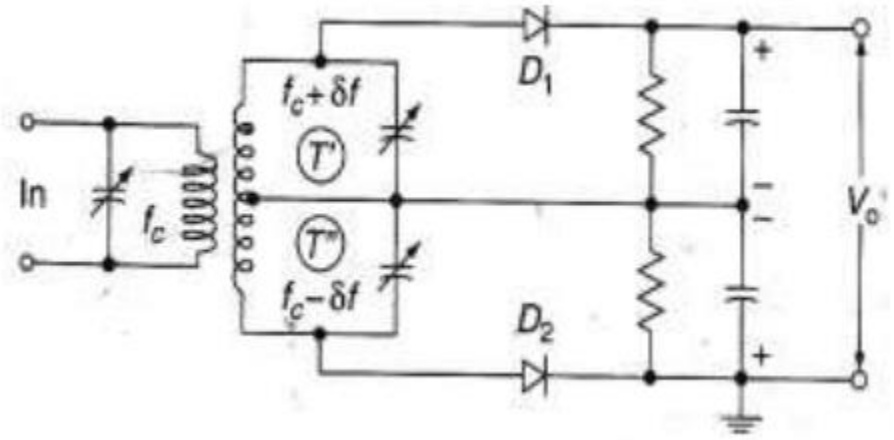
`SWR-1= e(1+SWR)

$$E = \frac{SWR-1}{SWR+1} \quad \text{1M}$$

(c) Describe balance slope detector with neat circuit diagram.

Ans: (Diagram 2M, explanation- 2M)

Circuit Diagram:-



Explanation:-

- The circuit uses two slope detector connected back to back. The secondary side is divided into two sides T'and T'' circuit tuned to $f_c + \delta_f$ and T''circuit is tuned to $f_c - \delta_f$ as shown in fig.. When input signal frequency equals Centre frequency f_c under this condition, the voltages generated by the tuned

circuits are 180^0 out of phase and generated and equal anf opposite signal voltages which provides resultant zero output voltages.

- When input signal frequency is near to $f_c + \delta_f$ then the T' tuned circuit will resonate and tries to give maximum voltages while T'' is not resonating, so its output will minimum.
- If the input signal frequency is near to to $f_c - \delta_f$ then the T'' will resonate giving maximum voltage while T' gives minimum voltages.

Q2. Attempt any FOUR: 4x4=16M

(a) Describe ground wave propagation with the help of neat diagram.

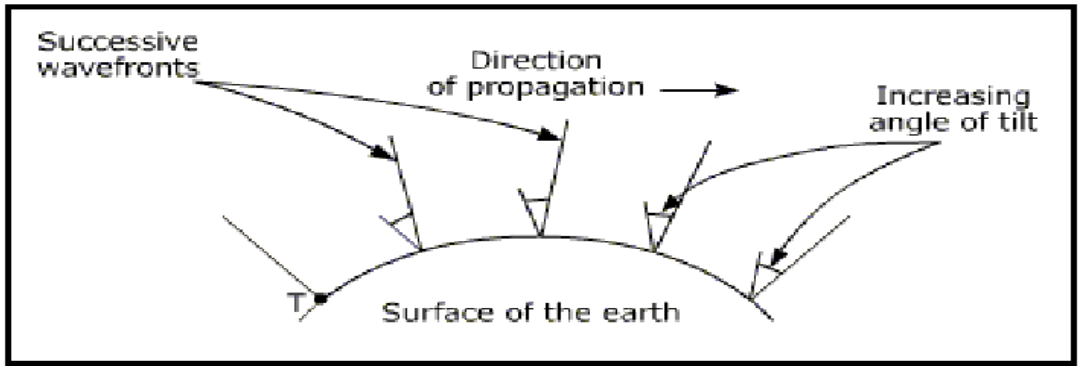
Ans: (Diagram-2 Marks, Explanation-2Marks)

Ground waves propagates along the surface of the line, also it is vertically polarized to avoid short circuiting the electrical component.

A wave induces current in the ground over which it passes and thus losses some energy by absorption.

Explanation:

- As the wave propagates over the surface of 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 decreases.
- It is important to realize this, since it shows that maximum range of such transmitter depends on its frequency as well in its power.
- Thus in VLF band, insufficient range of transmission can be cured by increasing the transmitting power.
- This will not work for MF range, since propagation is limited to tilt.
- Thus the angle of tilt is the main determining factor in the long distance propagation.



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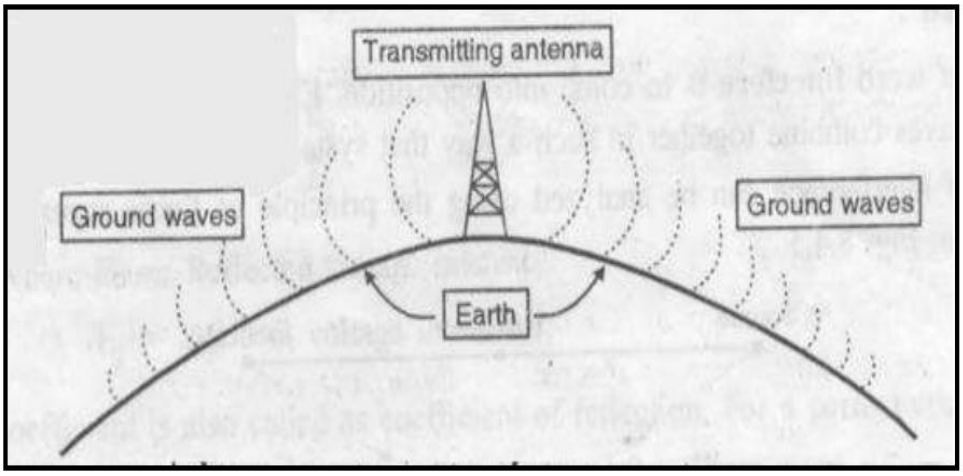


Fig.Ground wave propagation

(b) What is transmission line? What are its types?

Ans: **Definition-2M, Types-2M**

Definition:

- A transmission line is a pair of electrical conductors carrying an electrical signal from one place to another.

OR

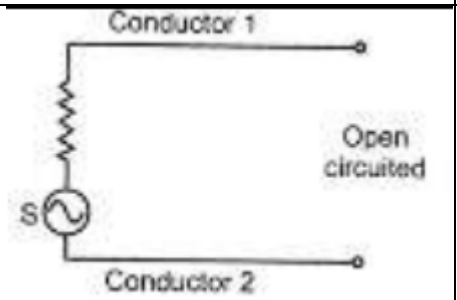
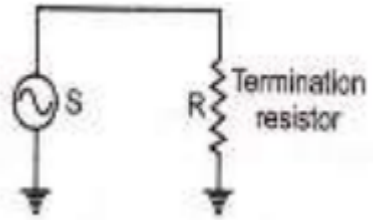
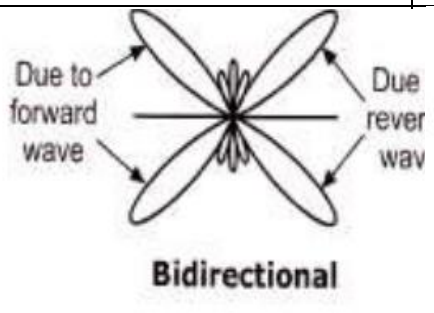
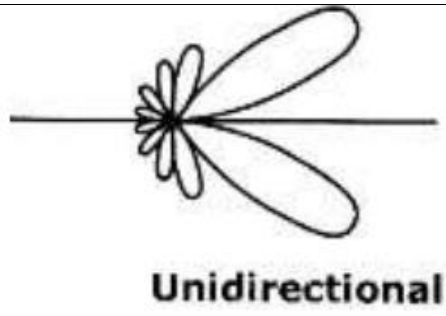
- Transmission Lines are considered to be impedance matching circuits designed to deliver power from transmitter to antenna and from antenna to receiver.

Types of transmission line:

1. Coaxial cable or unbalanced transmission line.
2. Twisted pair cable or parallel wire or balanced transmission line.

(c) Compare resonant and non-resonant antenna (any four points).

Ans: **(Any four points-1 mark each)**

SR. NO.	PARAMETER	RESONANT ANTENNA	NON-RESONANT ANTENNA
1	**Definition**	Resonant antennas are open-circuited transmission line at one end.	Non-resonant antennas are like a properly terminated transmission line by correct termination resistor.
2	**Circuit**		
3	**Standing Waves**	Present.	Not present.
4	**Reflection**	Takes place so forward and reflected waves are present.	No reflections so only forward waves are present.
5	**Radiation Pattern**		

(d) With the help of diagram describe the function of super-heterodyne receiver.

Ans: (Diagram-2 marks, function of each block-2 marks)

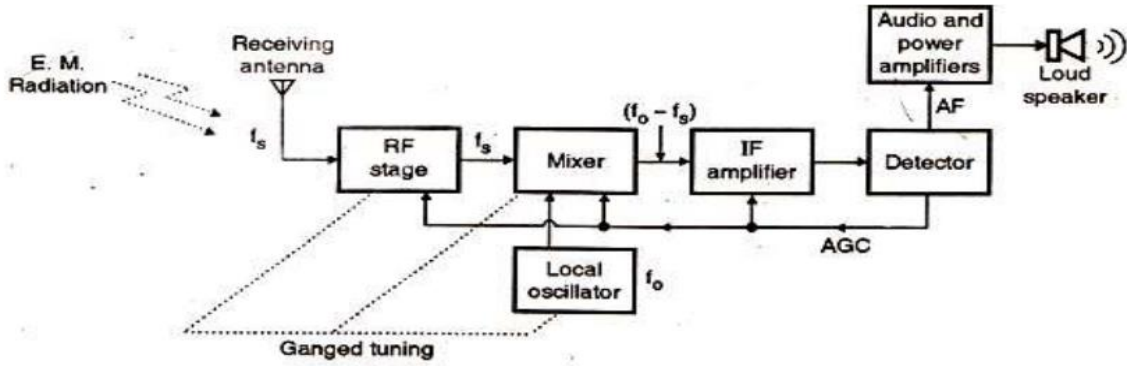


Fig.: The superheterodyne receiver

[Note: Any other relevant diagram to be considered]

OR

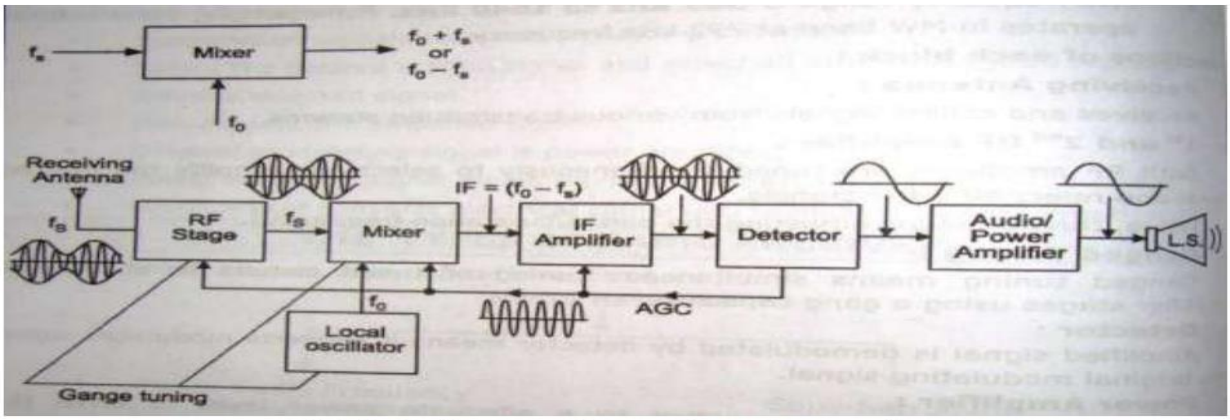


Fig.Block diagram of super-hetrodyne receiver

Function:

- The received signal is in the form of electromagnetic waves, it induces very small voltage into the receiving antenna.
- **RF stages:** The RF stage is an amplifier which is used to select the wanted signal and reject other out of many, and reduces the effect of noise.
- **Mixer:** The mixer receives signals from the RF amplifier at frequency (f_s) and from local oscillator at frequency (f_o) such that $f_o > fs$, and produces f_s, f_o, f_o+f_s and f_o-f_s.
- **Intermediate Frequency (IF):** Out of these the difference of frequency component i.e (fo-fs) is selected and all others are rejected. This is called IF frequency.
- Therefore **IF =fo - fs.** The Intermediate Frequency is then amplified by one or more IF amplifier stages. IF amplifier provides most of the gain and bandwidth of the receiver.

- **Detector:** The amplified IF signal is detected by the detector to recover the original modulating signal. This is then amplified and applied to the loudspeaker.

(e) Describe the operation of amplitude limiter with the help of circuit diagram.

Ans: **(Diagram 2 Marks, Operation 2 Marks)**

Diagram:

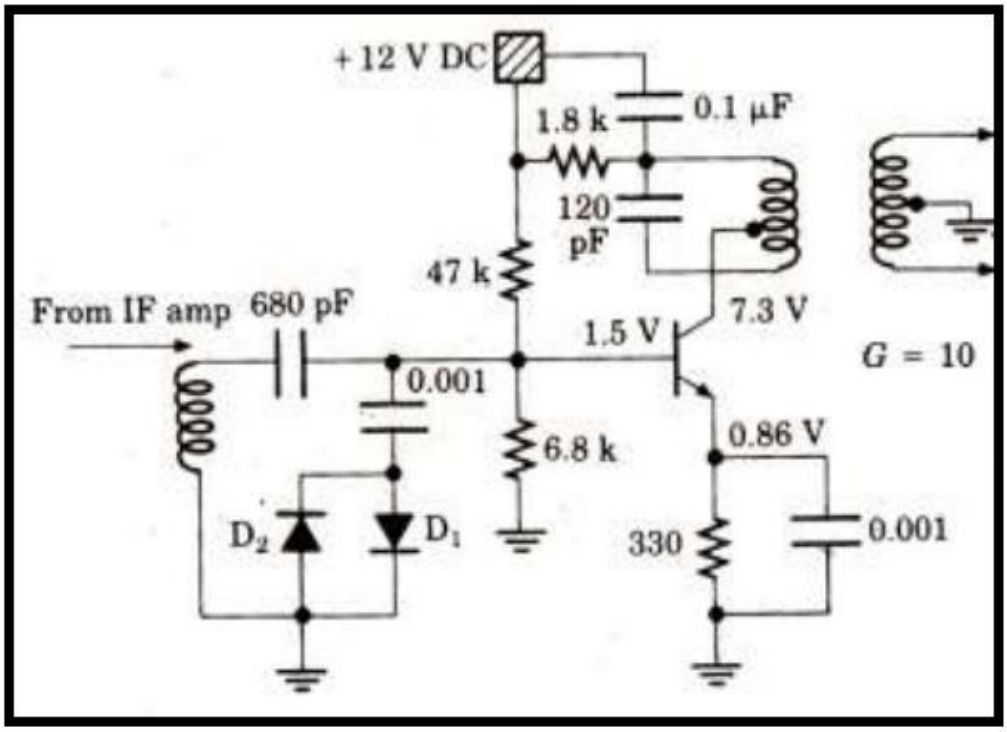


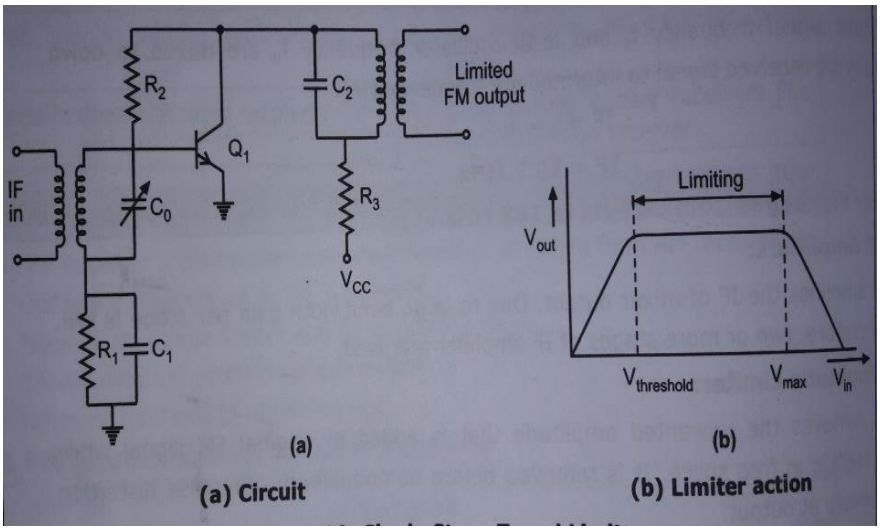
Figure:- Amplitude limiter

Operation:-

- In frequency modulation, the signal amplitude is held constant while the carrier frequency is varied.
- Any noise that contaminates the signal will manifest itself as a change in amplitude.
- The first limiter is a pair of back-to-back diodes D1 and D2.
- Diode D1 will conduct when the input signal is greater than 0.7V on the positive peak, and diode D2 will conduct on the portion of the negative half-cycle that exceeds -0.7VpK of the input signal.
- The second form of limiting in the figure is the transistor amplifier itself, which has a gain of 10.
- When the base signal reaches 1.4V p-p, the collector voltage becomes ten times larger.
- The collector and emitter currents increase, raising the emitter voltage at the same time that the collector is going lower.

- The total collector change is 9.4 V, limiting the output signal to 9.4 V p-p, instead of the alternately driven into saturation and cutoff, it limits the signal amplitude.

OR



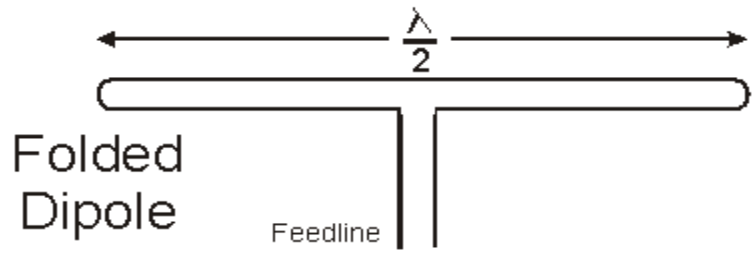
Operation:-

- The limiters remove any amplitude variations on the FM signal, before it being applied to demodulator.
- The limiter is a conventional class A IF amplifier. It is a band pass limiter which is used to remove any amplitude variations on the FM signal before it is applied to demodulator.
- To occur amplitude limiting its requires an IF input signal sufficient enough to drive the transistor into both saturation & cutoff.
- The output tank circuit is tuned to the IF center frequency.
- By driving the transistor between saturation cutoff, the positive & negative peaks of input signal is clipped off& thus any amplitude variation are removed.
- As shown in figure the output of the collector is a square wave, which is made up of many undesirable harmonics, is filtered back into sine wave by the tuned circuit at the collector.
- As shown in the wave form when V_{in} reaches $V_{threshold}$ limiting action begins & for input amplitudes above V_{max} , There decreasing V_{out} with increasing V_{in}.

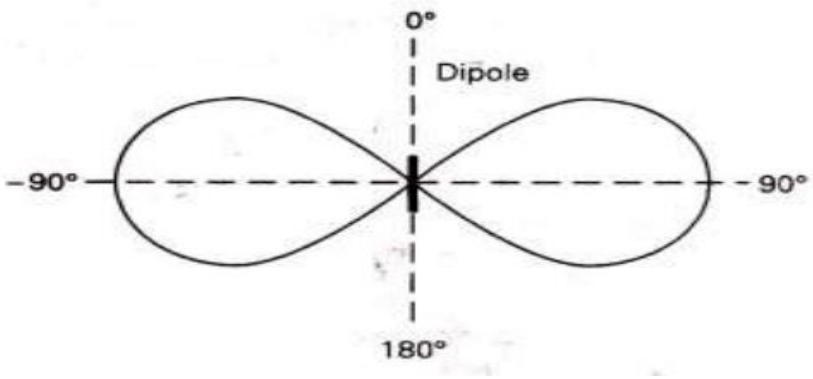
(f) Draw the constructional diagram of dipole antenna and draw its radiation pattern.

Ans: (Construction diagram-2M, radiation pattern-2M)

Construction Diagram:



Radiation Pattern:



Q3) Attempt any FOUR: 16M

(a) Describe effects of images signal on Radio Receiver, Describe the method of rejecting the images signal.

Ans: (Explanation 2M, Methods 2M)

Explanation:-

- It is possible that the unwanted RF signal is pass through RF amplifier & mix with local oscillator signal & appear along with desired signal at the intermediate frequency to be amplified.
- An image is signal which is at the same distance from local oscillator frequency but in opposite direction.
- When oscillator operates at frequency higher than RF the image frequency is = RF+2IF.
- When oscillator operates at frequency below the RF the image frequency is = RF-2IF.
- The effect of image signal on radio receiver is called double spotting, which is the biggest problem for receiver with a low value of IF.
- When image frequency is near to signal frequency, the image rejection is not as good as it could be.

Method of rejecting the images signal:

- The image frequency must be rejected by the receiver. The images rejection depends on the front end selectivity of the receiver i.e the selectivity of the RF circuit.

- The image rejection must be achieved before the IF stage because one it reaches the IF stage it cannot be removed.
- The rejection of an image signal is dependent on the ratio of the wanted to unwanted signal frequencies & on the Q of resonant circuit before mixer amplifier.

b) Describe the radiation and dielectric losses in transmission line.
Ans: **(Each losses 2M)**

Radiation losses:
- It occurs because a transmission line may act as an antenna if the separation of the conductor is an appreciable fraction of the wavelength. It occurs more in parallel lines than to coaxial lines.
- It is difficult to estimate, being normally measured than calculated.
- It increase with frequency for any given transmission line

Dielectric losses:
- Dielectric heating is proportional to the voltage across the dielectric and hence inversely proportional Characteristic impedance.
- It increases with frequency.

(c) Explain the need of AGC and Delayed AGC.

Ans : **(Need of AGC 2M, Delayed AGC 2M)**

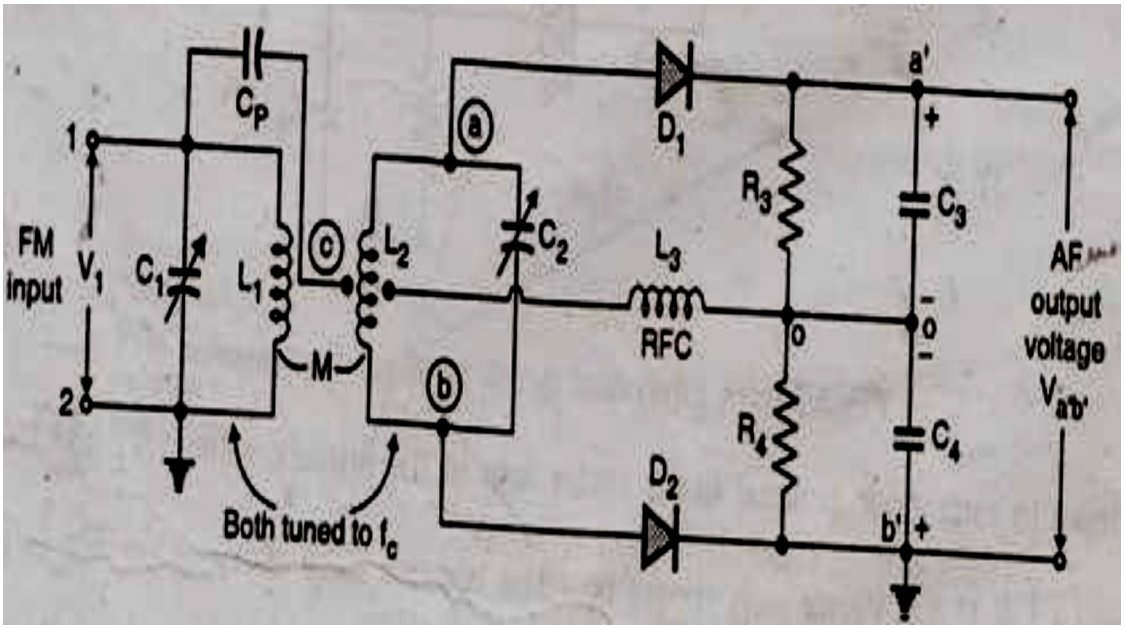
Automatic Gain Control (AGC):
- The signals from various radios reaching at the receiver inputs are not of same strength.
- The signals from the strong stations are strong and those from the weak stations are weak.
- If the receiver gain is constant then the receiver output will fluctuate proportional to the input signal and this is not desirable.
- Hence the automatic gain control (AGC) is used to adjust the receiver gain automatically so as to keep the receiver output constant irrespective of the strength of input signal.

Delayed AGC:
- In this, the AGC bias is not applied until the input signal strength reaches a predetermined level, after this level, AGC bias is applied just like simple AGC but more strongly.
- The problem of reducing the receiver gain for the weak signals is thus avoided.
- The delayed AGC is not used in the low cost radio receiver. It is used in the high quality receivers like communication receivers.
- Thus the delayed AGC does not reduce the gain for weak signals and reduces the gain only for strong signals

(d) Draw the circuit diagram of foster seeley detector and write its working principle.

Ans : **(Diagram 2M, Working 2M)**

Diagram:



Working:

(i) Output voltage at $f_{in}=f_c$:

- When the input frequency is equal to the center frequency fc, the phase shift between the primary and secondary voltages is exactly 90^0.
- Therefore the input voltages to the both diodes will be equal. Therefore the outputs of both the diodes will be equal. Hence the net output voltage will be zero.

(ii) Output voltage for $f_{in} > f_c$:

- At input frequencies above the center frequency fc, secondary voltage V_{ab} leads the primary voltage V_1 by less than 90^0.
- Hence input voltage to D_1 V_{ao} is higher than input to D_2 i.e V_{bo}. The output voltage therefore be positive for $f_{in}>f_c$.

(iii) Output voltage for $f_{in} < f_c$:

- For input frequencies below the center frequency fc, the secondary voltage V_{ab} leads the primary voltage V_1 by more than 90^0.
- Hence input voltage to D_1 is less than input voltage to D_2. Therefore the output voltage will be negative for $f_{in} < f_c$.

(e) Draw the equivalent circuit of transmission line at low frequency and radio frequency.

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

Diagram:-

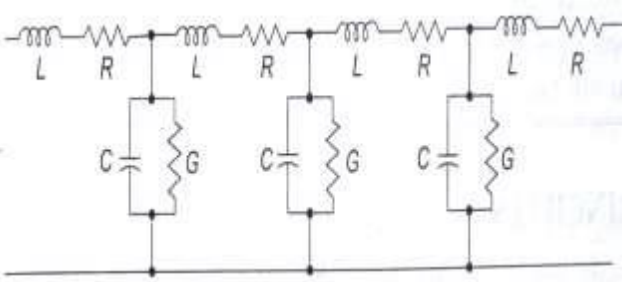


Figure:-Equivalent circuit of Transmission line for low frequency

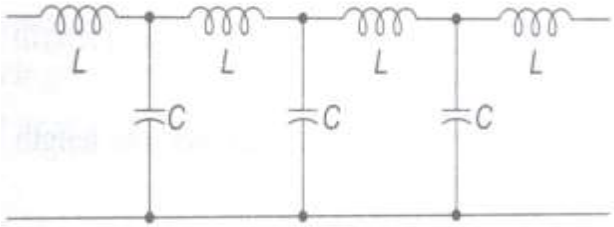


Figure:- Equivalent circuit of Transmission line for radio frequency

(f) With the help of diagram write principle of horn type antenna.

Ans: **(diagram 2M, Working 2M)**

Diagram:

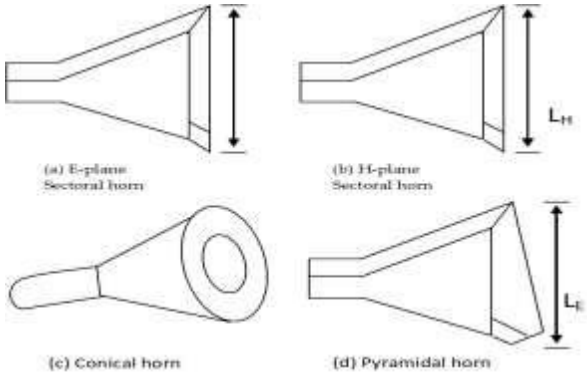


Fig. Horn antenna

Working:

- With a horn feed mechanism, the primary antenna is a small horn antenna rather than a simple dipole or dipole array.
- The horn is simply a flared piece of waveguide material that is placed at the focus and radiates a Somewhat directional towards the parabolic reflector.
- When the propagating electromagnetic field reaches the mouth of the horn, it continues to propagate in the same general direction.

- The horn structure can have several shapes, such as pyramidal, conical, sectoral etc.
- As with the Centre feed, a horn feed presents somewhat of an obstruction to waves reflected from the Parabolic dish.
- In horn feed impedance matching is very properly.
- All energy travelling forward is radiated.
- Directivity is improved.
- Diffraction is reduced.

Q4) Attempt any Four: 16M

(a) Derive the equation of characteristics impedance of transmission line at low frequencies and high frequencies.

Ans: 4M

- The expression for Z_0 of a line series elements (R and L) as well as shunt elements (C and G) by,

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

where, $Z = R + j\omega L\ (\Omega/m) \rightarrow$ series impedance per unit length.
$Y = G + j\omega C\ (s/m) \rightarrow$ shunt admittance per unit length.

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

- At low frequencies, $R >> \omega L$ and $G >> \omega C$

$$\therefore \quad Z_0 = \sqrt{\frac{R}{G}}\ \Omega$$

- Similarly at high frequencies $R << \omega L \propto G << \omega C$

$$Z_0 = \sqrt{\frac{L}{C}}\ \Omega$$

b) Define beam width, polarization and attenuation in wave propagation.

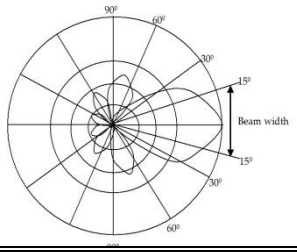
Ans: (Beam width with diagram 2M, polarization 1M, attenuation 1M)

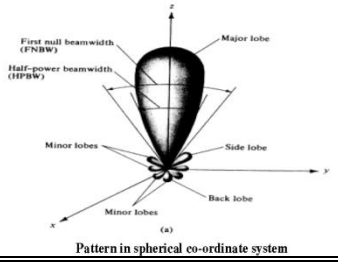
Beam width:

- It is defined as the angular separation between the two half power points on the power density radiation pattern.

OR

- It can be defined as the angular separation between two 3 dB down points on the field strength of radiation pattern of antenna.
- Beam width is expressed in degrees.





Pattern in spherical co-ordinate system

Polarization:

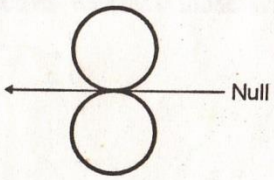
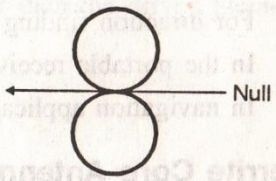
- The polarization of plane EM wave is simply the orientation of the electric field vector with respect to the earth surface.
- If the polarization remains constant then it is called as the linear polarization.
- The types of polarization can be of : Vertical , Horizontal, Circular & Elliptical Polarization.

Attenuation:

- It is defined as the reduction in power density with increase in distance. The reduction in power density is equivalent to power loss hence it is called as attenuation.

(d) Write difference between loop antenna and ferrite rod antenna. ***(4 point)***

Ans: **(Each point 1M)**

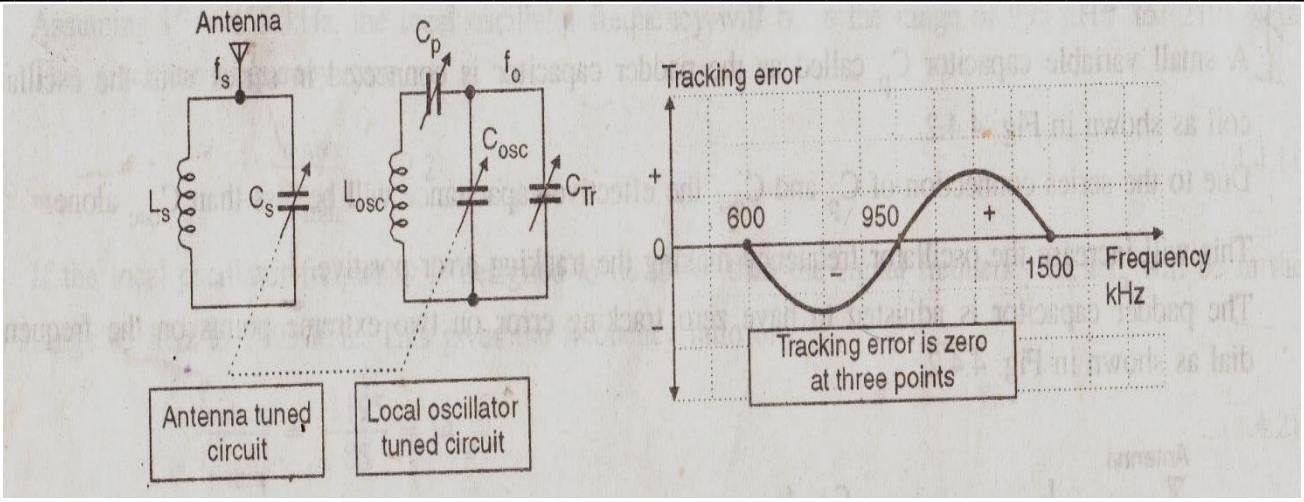
Sr. No.	Parameter	Loop antenna	Ferrite rod antenna
1.	Working principle	When EM waves pass over a conductor, an emf is induced into it.	Same as that of loop antenna.
2.	Construction	A single turn coil.	It is a multiple turn coil wound on a ferrite rod.
3	Radiation pattern		
4.	Applications	1. Direction finding 2. Portable radio.	As a receiving antenna in radio receiver.

(d) Describe the role of Padder (capacitor) in three point tracking.

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

Three point tracking:

- It is the combination of Padder and trimmer tracking.
- The three frequencies of correct tracking that is at which zero tracking error exists are normally 600 KHz, 1500 KHz and the geometric mean of two frequencies i.e 950 KHz.
- It is possible to keep the tracking error below 3 KHz.
- A small variable capacitor C_p called as padder capacitor is connected with series oscillator coil as shown in figure.
- 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.

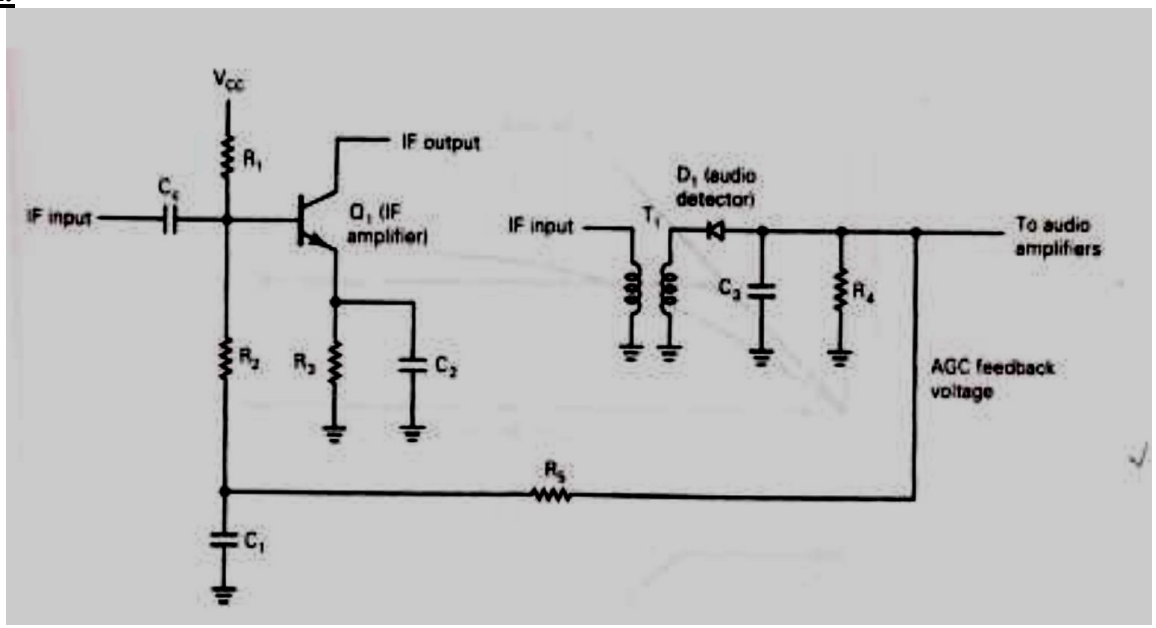


Three point tracking

(e) Explain simple AGC circuit for radio receiver.

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

Diagram:



Working:

- Simple AGC is a system which will change the overall gain of a receiver automatically.
- This is done in order to keep the receiver output constant even when the single strength at the input of the receiver is changing.
- In the AGC system a dc voltage (AGC bias) is derived from the detector. This AGC base is this proportional to the strength of the received signal.
- The AGC bias is applied to a selected number of RF and IF amplifiers and mixer stage.
- The Trans conductance and hence the devices connected in these stages is dependent on the applied AGC bias.
- The receiver gain is automatically reduced as the input signal becomes more and more strong.

(f) Draw diagram of Ratio detector and describe its working.

Ans: **(Diagram 2M, working 2M)**

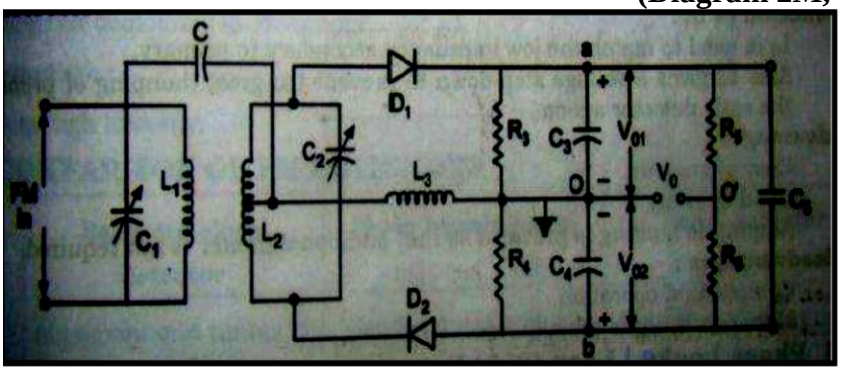


Fig. Ratio detector

Working:

- 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

$$V_o = \frac{(V_{o1} - V_{o2})}{2}$$

- Thus output voltage is proportional to the difference between the individual output voltages.
- L3 matches the low impedance secondary to primary and also it provides voltage step down to prevent too great damping of primary by the ratio detector action.

Q 5. Attempt any FOUR: **16M**

(a) Concept of actual height and virtual height:

Ans:

(Diagram 2M, each Definition 2M)

- **Actual Height:-**
  In sky wave propagation, the incident wave returns back to each due to refraction. In this process it bends down gradually & not sharply. The maximum height attained by the wave is called as `Actual Height'.

- **Virtual Height:-**
  When the incident wave bends ground gradually in sky wave propagation, the incident & reflected rays follow exactly the same path as those if the signal would have been reflected from a surface located at greater height. This height is called as `Virtual Height'.

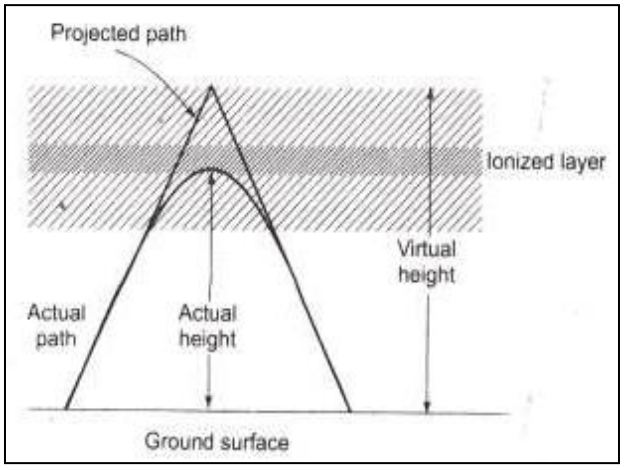


Figure: Actual and Virtual height

(b) Define the term standing wave ratio. Why the high value of SWR is often undesirable?

Ans: (Definition of SWR-2 Marks, Reason -2 Marks)

- **Definition of SWR:-**
  It is defined as the ratio of the maximum voltage to the minimum voltage or the maximum current to the minimum current of a standing wave on a transmission line.

$$SWR = \frac{V_{max}}{V_{min}} \ (unitless)$$

When incident and reflected waves are equal in amplitude (a total mismatch), SWR is infinity. This is the worst case condition. This means that complete transmitted wave is reflected back to the source which is not desirable.

(c) Define the following terms related to antenna:-

Ans: (Each definition 1M)

- **Directivity:-**
  It is the maximum directive gain which is obtained in only one direction in which the radiation is maximum.
  That is directivity = Max. Directive gain

- **Isotropic radiator:-**
  It is theoretical point source of electromagnetic or sound waves which radiates the same intensity of radiation in all direction. It radiates uniformly in all direction over a sphere center on this earth.

- **Power gain:-**
  It is the ratio of power fed to an isotropic antenna to the power fed to a directional antenna, to develop the same field strength at the same distance, in the direction of maximum radiation.

$$\text{Power gain} = \frac{power\,fed\ to\ the\ isotropic\ antenna}{power\ fed\ to\ the\ directional\ antenna}$$

- **Antenna Gain:-**
  Antenna gain is defined as the ratio of the power density radiated in a particular direction to the power density radiated to the same point by the reference antenna.
  It is mathematically given by,

$$Anteena\ Gain = \frac{P}{P_{ref}}$$

  Where
  P = power density at some point with the given antenna
  Pref = power density at same point with the reference antenna

(d) Describe the frequency tracking in AM radio receiver.

Ans: **(4M)**

The frequency tracking in AM radio receiver:-

- The AM receiver has number of tunable circuits (e.g. antenna, mixer, local oscillator, tuned circuit etc.)
- All these circuits must be tuned correctly if any station is to be tuned. Hence Capacitor in the various tuned circuit are ganged.
- Due to the arrangement it is possible to used only one tuning control to vary the tuning capacitors simultaneously.
- The local oscillator frequency (f0) must be precisely adjusted to a value which is above the signal frequency (fs) by IF.

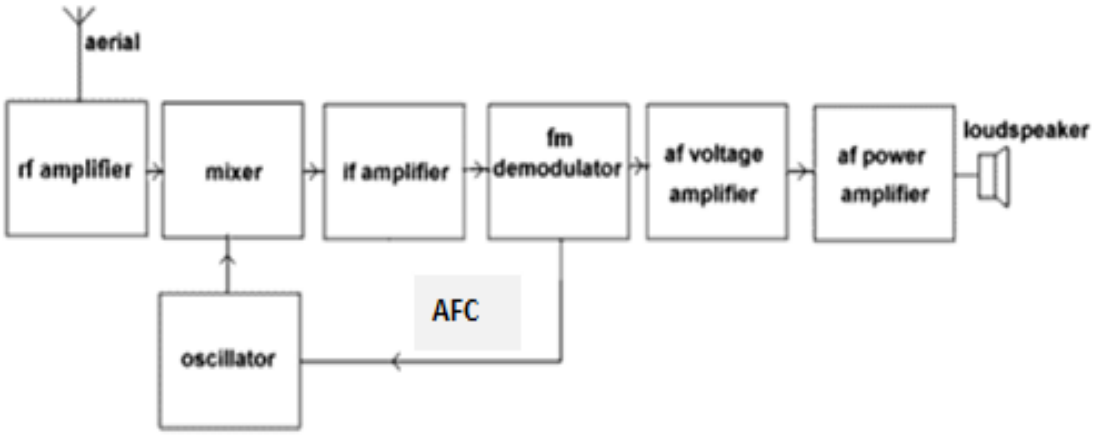
  i.e. f0= fs + I.F.
- If the tuning is not done correctly then

  f0 - fs I.F.
- Stations will appear away from their current position on frequency dial of the receiver.
- The Process in which the local oscillator frequency follows or tracks the signal frequency to have a correct frequency difference is called as frequency tracking.

(e) Draw block diagram of FM receiver with AFC and explain it .

Ans: **Diagram 2M, Explanation 2M**

Block diagram:-



Explanation:-
FM receiver operates on the principle of superhetrodyning

- **RF Amplifier:-**
  In domestic AM Rx, the RF amplifier is not used but in the FM Rx, the RF amplifier is always used. The Rf amplifier improves the S/N ratio and it will match the Rx. Input impedance to the antenna impedance.

- **Mixer:-**
  The mixer stage in FM Rx will down convert the receive signal to RF. Which is done by mixing the input signal frequency fs with local oscillator fo. The fo is higher than fs. The IF produced at the output of mixer is at 10.7MHz

- **IF amplifier:-**
  The IF amplifier using FM Rx is similar to the AM Rx but if an B.W required for FM is higher the AM Rx. Here IF is 10.7MHz and B.W is 200 KHz due to this large bandwidth. The gain per stage will be low. Their fore 2 or more IF amplifiers are required and this amplifier are cascaded together.

- **Amplitude Limiter:-**
  The FM wave transmitted by the transmitter has constant amplitude. But while travelling noise and other unwanted signals get added to it and change its amplitude these unwanted amplitude changes in the receiver FM signal must be removed before it goes for demodulation otherwise distortion appear in the demodulated signal is the demodulators react to amplitude changes as well as frequency changes.Hence amplitude limiter will remove all the unwanted amplitude variations from received signal and hence it is always placed before FM detector.

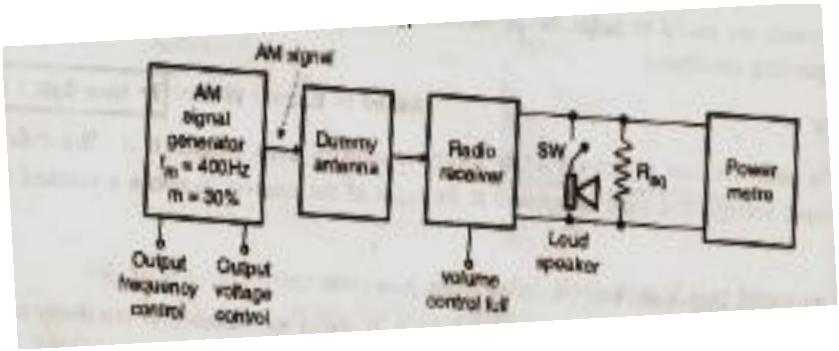
- **FM Detector:-**
  It is a circuit which receives an FM wave at its input & produces the message signal or modulating signal at its output.

- **De-Emphasis:-**
  The artificial boosting given to the higher modulating frequencies in the process of pre-emphasis is mollified or compensated at Rx by process called De-emphasis

- **AF & Power amplifier:-**
  It amplifies the voltage & power of audio signal.

- **AFC:-**
  In FM receiver, the local oscillator frequency stability is a great problem, due to drift in frequency may take place because of temperature changes or aging of the components. So in order to correct the frequency of local oscillator automatically the AFC is used.

(f) How are sensitivity, selectivity, fidelity and S/N ratio test are carried out on radio receiver?
Ans: (Diagram- 1M)



Sensitivity measurement:- **1M**

- The AM signal is applied to the receiver through a standard coupling network known as "dummy antenna" and the output power is measured by replacing the loudspeaker by an equal value load resistance.
- A standard input AM signal at 30% modulation and 400 H_z modulating frequency is applied to the receiver through the dummy antenna.
- The input required to obtain a standard output power of 50mW is measured.
- This gives the sensitivity of the receiver. The measurement is carried out with the volume control knob at its full volume position.

Procedure to measure sensitivity:-

- Adjust f_m = 400 H_z, m=30% on the AM signal generator.
- Adjust the carrier frequency of AM input at 530 KHz. Then adjust the output voltage of the signal generator to get a standard too get a standard output of 50mW. Across thr resistances Req. Measure the corresponding input voltage. Frequency is equal to the resistance of loud speaker.

- Repeat step-3 for various values of carrier frequency from 530 KHz to 1650 KHz.
- Plot the graph of carrier frequency on X-axis verus receiver input on Y-axis. This is the sensitivity curve. The observation table sensitivity measurement.

Selectivity measurement:- **1M**

- The conditions for measurement of selectivity are same as those for sensitivity measurement.
- Here the receiver is tuned to 950 KHz and the input is adjusted to get standard output by adjusting the generator output frequency to 950 KHz.
- Now the generator output frequency is deviated above and below 950KHz in suitable steps. Every time the generator output voltage is adjusted and noted down to get a standard 50 mW receiver output power.
- The attenuation is calculated and plotted.

Fidelity:- **1/2M**

- Connect the step as shown fig.
- Adjust m=30% and carrier frequency f_c =1000 KHz. Keep this frequency constant through-out the fidelity measurement.
- Now adjust the modulating frequency f_m =1KHz and adjust the output voltage to get the maximum undistorted output. Keep the input voltage constant through the experiment.

- Vary the modulating frequency f_m from 100 Hz to 10 KHz in suitable steps and measure the receiver output every time.
- Convert the receiver output into dB and plot the fidelity curve.

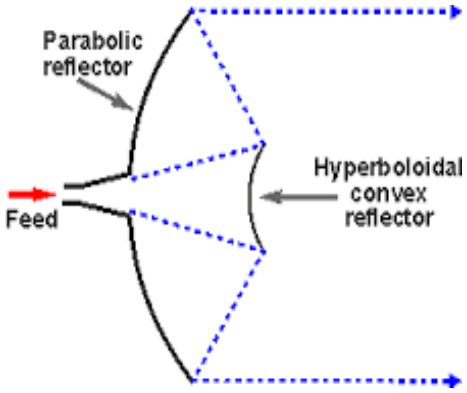
S/N Ratio test:- **1/2M**

- There are number of ways in which the noise performance& hence the sensitivity of radio receiver can be measured.
- The most common method is to compare the signal & noise levels for known signal level. The greater the signal difference between the signal and unwanted noise that is greater S/N ratio , the better radio receiver sensitivity performance

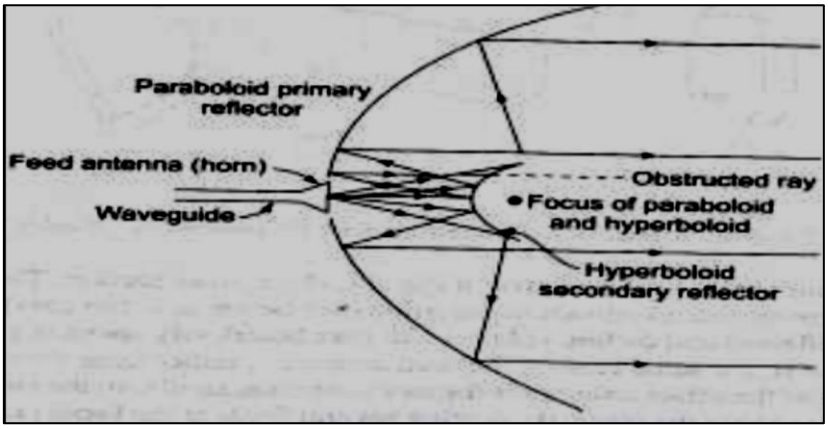
Q6) Attempt any Four: **16M**

(a) Describe the working of parabolic reflector antenna with casegrain feed.

Ans: **(Diagram- 2 Marks, Explanation- 2 Marks)**



OR



- The primary radiating source is located in or just behind a small opening at the vertex of the paraboloid rather than at the focus. The primary antenna is aimed at a small secondary reflector located between the vertex and focus.

- The rays emitted from the primary antenna are reflected from the Casegrain sub-reflector and then illuminate the main parabolic reflector just as if they had originated at the focus.
- The sub-reflector must have a hyper-boloidal curvature to reflect the rays from the primary antenna in such a way as to function as a virtual source at the paraboloid focus.
- The Cassegrain feed is commonly used for receiving extremely weak signals or when extremely long transmission lines or waveguide runs are required and it is necessary to place low-noise preamplifiers as close to the antenna as possible.

(b) Describe the purpose of short length transmission line for open and short circuit.

Ans: (Diagram-2 marks, Explaination-2 marks)

- At the higher frequency, it is not possible to use lumped components for impedance matching, so we use short length transmission line for matching the impedance.
- If the frequency of operation is lowered, the shunt inductive reactance of thus tuned circuit is lower and the shunt capacitive reactance is higher. Inductive current predominates, and therefore the impedance of the circuit is purely inductive.
- This piece at the new frequency is less than $\lambda/4$ long, since the wavelength is now greater than and the length of line is naturally unchanged. We thus have the important property that a short-circuited line less than $\lambda/4$ long behave as a pure inductance.
- An open-circuited line less than $\lambda/4$ long appear as a pure capacitance.

[Note: Any other relevant diagram should be considered]

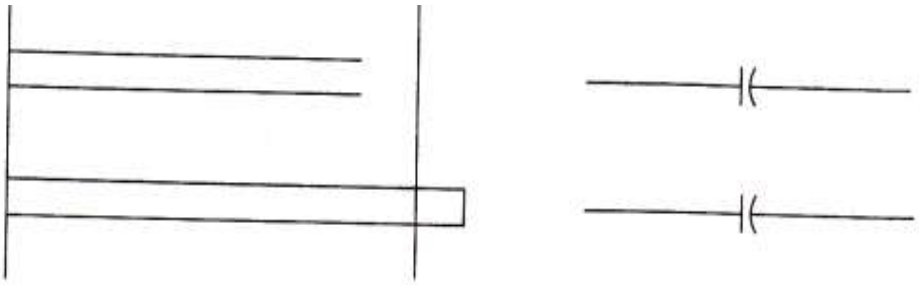
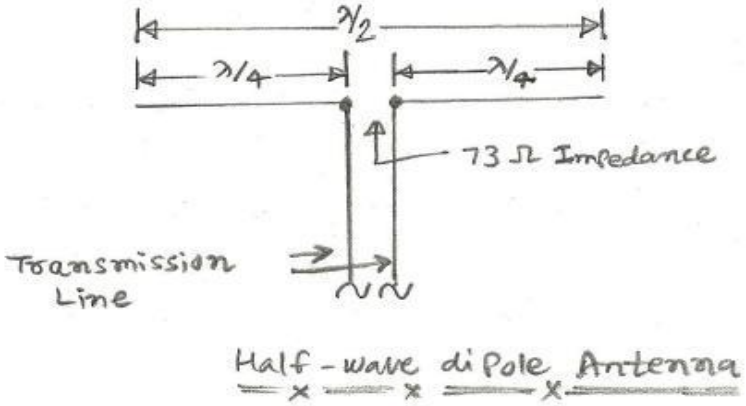


Figure: short length transmission line

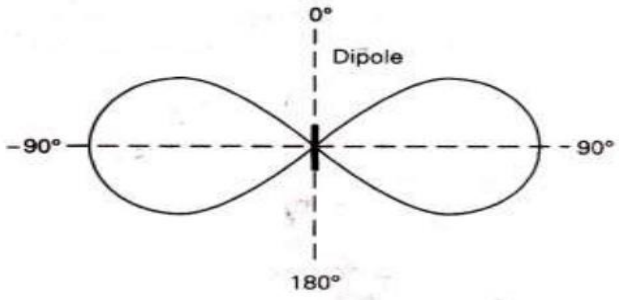
(c) Draw constructional sketch of half-wave dipole antenna and draw its radiation pattern.

Ans: (Construction diagram-2M, radiation pattern-2M)

Construction Diagram:



Radiation Pattern:



(d) What is RF alignment of AM Radio Receiver? What is necessity of alignment?

Ans: RF alignment of AM Radio Receiver:- **2M**

- The marginal adjustment of the local oscillator and RF tuned frequency to get maximum output of a radio receiver is known as Alignment of radio receiver.
- The RF alignment of the radio receiver is also called as RF tracking of the receiver.

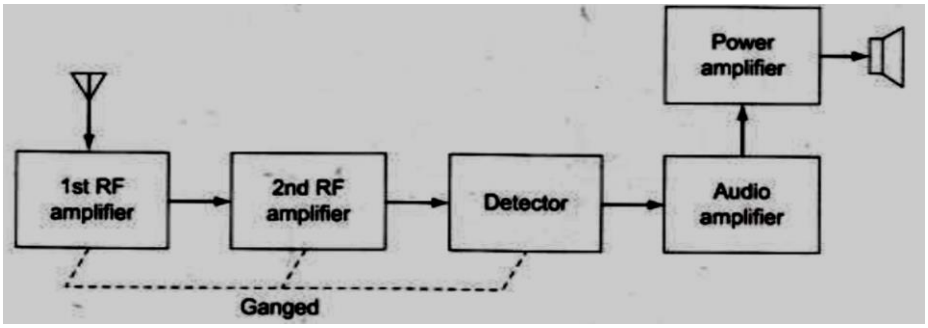
Necessity of alignment:- **2M**

- To obtain the maximum output signal at the center frequency of AM radio receiver.

(e) Draw block diagram of tuned radio receiver and describe function of all blocks.

Ans: **(Diagram 2 Marks, Operation 2 Marks)**

TRF radio receiver:



Operation:

- Due to EM waves passing over the receiving antenna, voltage is induced in it.
- The RF amplifiers are tuned simultaneously to select and amplify the desired signal and reject all the other.
- Ganged tuning means simultaneous tuning of tuned circuits in all the RF amplifier stages.
- The amplified signal is then demodulated by the detector, the carrier signal is then bypassed and only the modulating signal is recovered in this process.
- The detected signal is amplified to the adequate power level using the audio amplifier and power amplifier and given to the loudspeaker.

(f) Write difference between tuned radio receiver and superheterodye receiver (4point).

Ans: **(Any 4 points 1M Each)**

SR.NO.	TUNED RADIO RECEIVER	SUPERHETERODYE RECEIVER
1.	It consists of two or three tunable RF amplifier.	It has only RF amplifier.
2.	The TRF receiver suffered from variation in B.W over the tuning range	Here B.W is constant by maintaining constant frequency difference between local oscillator and RF amplifier
3.	Its selectively is less at high frequencies	Greater selectivity
4.	Poor adjacent frequency rejection	Better adjacent frequency rejection