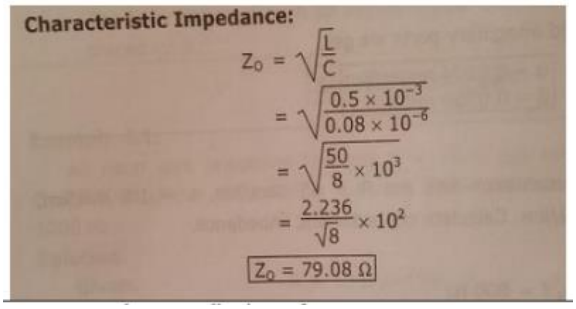
MODEL ANSWER

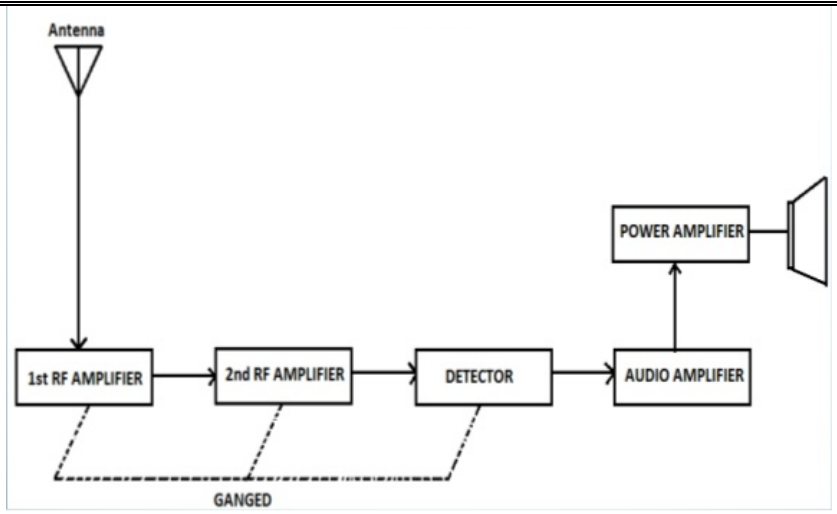
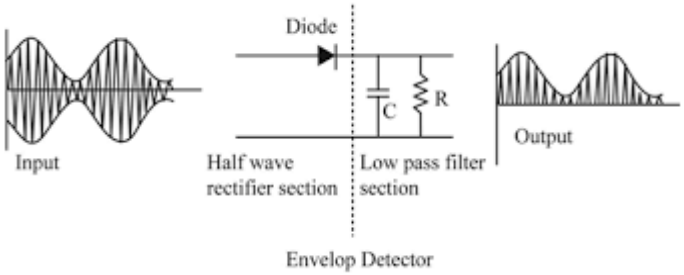
WINTER– 18 EXAMINATION

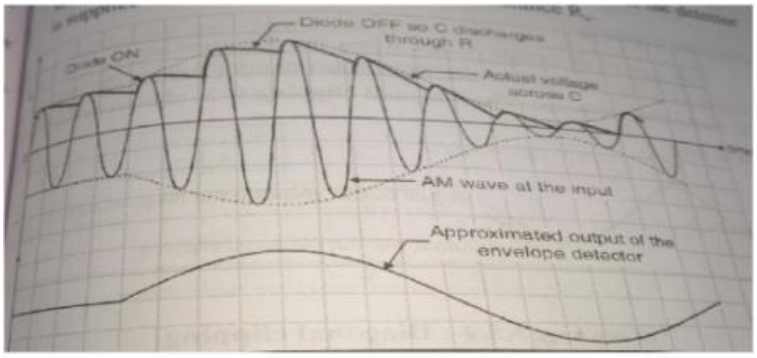
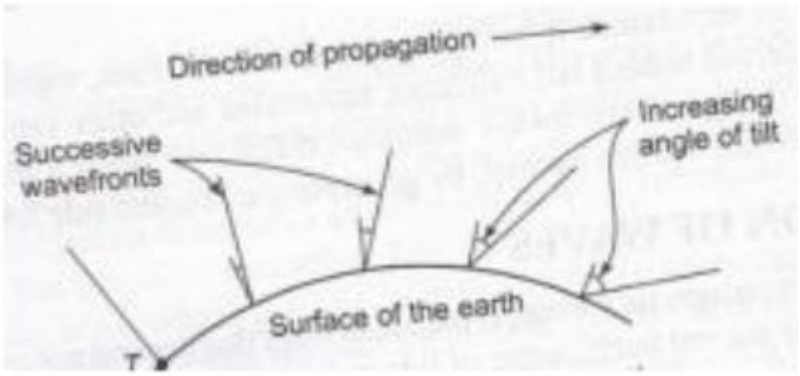
Subject Title: Radio Reception **Subject Code:** 17437

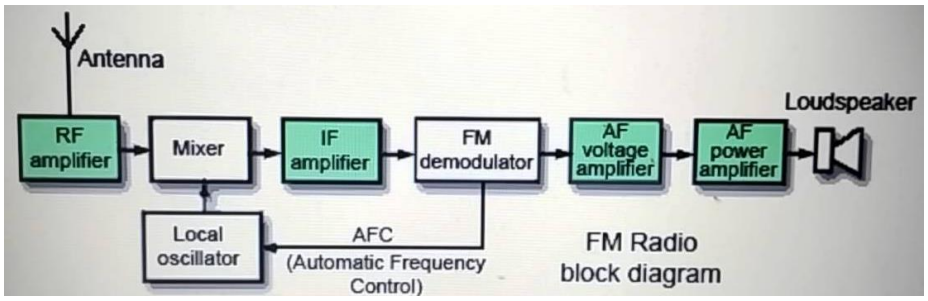
Important Instructions to examiners:

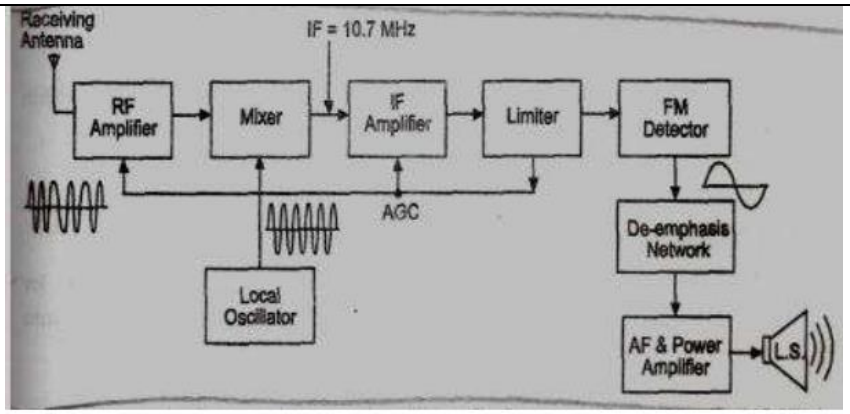
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 anyequivalent 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.

Q. No.	Sub Q.N.	Answer	Marking Scheme
Q.1	a)	**Attempt any SIX of the following :**	**12-Total Marks**
	a	**With Respect to Space Wave, What is radio horizon?**	**2M**
	Ans:	The radio horizon is the locus of points at which direct rays from an antenna are tangential to the surface of the Earth. If the Earth were a perfect sphere without an atmosphere, the radio horizon would be a circle	**2M**
	b	**What is transverse electromagnetic wave?**	**2M**
	Ans:	A wave that oscillates perpendicular to the axis along which the wave travels. Electromagnetic waves are transverse waves, since the electric and magnetic fields oscillate at a right angle to the direction of motion.	**2M**
	c	**Calculate the characteristics impedance of a transmission line having L = 0.5 mH/Km, C = 0.08 µf and negligible R and G**	**2M**
	Ans:		**2M**

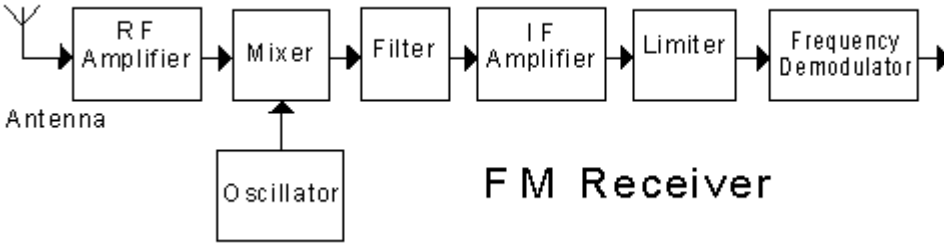
d	**Define the terms directivity and beam width related to antennas.**	**2M**
Ans:	**Beamwidth:-** The beam width of an antenna is described as the angles created by comparing the half power point (3dB) on the main radiation lobe to its maximum power point. As an example the beam width angle is 300 which is the sum of the two angles created at the point where the field strength drops to 0.707 of max voltage at center of lobe (these point are known as half power points.) **Directivity:-** The directive gain can be defined in any direction. However directivity means the maximum directive gain which is obtained in only one direction in which the radiation is maximum. Therefore Directivity = Maximum Directive gain	**1M each**
e	**Draw the block diagram of tuned radio receiver.**	**2M**
Ans:-		**2M**
f	**State the value of IF frequency in AM receiver and FM receiver.**	**2M**
Ans:-	The value of IF frequency in AM receiver is 455KHz and for FM receiver it is 10.7MHz	**1M each**
g	**Draw the I/P and 0/P waveforms of diode detector.**	**2M**
Ans:-	 **OR**	**1M each**

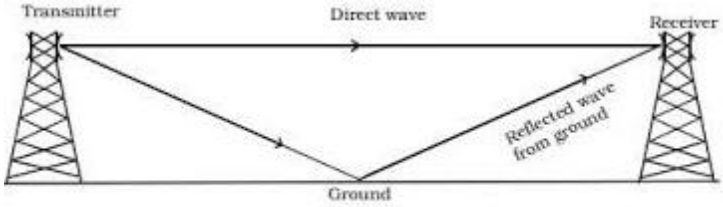
		
h	**Justify how to increase the sensitivity of FM receiver.**	**2M**
Ans:	• Receiver sensitivity or RF sensitivity is one of the key specifications of any radio receiver. • The ability of the radio receiver to pick up the required level of radio signals will enable it to operate more effectively within its application. • The sensitivity of radio receiver can be incresed by increasing the gain of the votlage amplifier so that signals should be amplified and it can be brought to a sufficient level to be heard.	**2M**
b)	**Attempt any <u>TWO</u> of the following :**	**8**
a	**Draw and explain ground wave propagation. State its advantages.**	**4M**
Ans:	Ground wave propagation is used for transmitting low frequency signals. In this propagation the signal wave is parallel to ground. While this transmission there is oscillation of wave, so they induce another wave in the surface of the earth as in figure.  The induced wave in the ground attenuate electromagnetic wave at a short range, hence ground wave propagation is only used for short range communication. The attenuation of surface waves increases very rapidly with increase in frequency, hence ground wave propagation is used for low frequency and large wavelength i.e. AM waves. The range of frequency is from a few KHz to few MHz (5 MHz).	**Diagram 1 M, Explanation 2M, Advantages 1M**

		Advantages:- As the ground wave propagation support large wavelength, the wave can bend round the corners/obstructions more efficiently.	
	b	**Derive the relation between reflection coefficient (K) and VSWR(S).**	**4M**
	Ans:	$V_{max} = \lvert V_i \rvert + \lvert V_r \rvert$ $V_{min} = \lvert V_i \rvert - \lvert V_r \rvert$ Where- Vi = r.m.s. value of incident voltage Vr = r.m.s. value of reflected voltage By definition: $VSWR = \left\lvert \frac{V_{max}}{V_{min}} \right\rvert = \frac{\lvert V_i \rvert + \lvert V_r \rvert}{\lvert V_i \rvert - \lvert V_r \rvert} = \frac{V_i\left(1+\frac{V_r}{V_i}\right)}{V_i\left(1-\frac{V_r}{V_i}\right)} = \frac{1+\lvert k \rvert}{1-\lvert k \rvert}$ Applying Componendo and Dividendo, $\frac{VSWR-1}{VSWR+1} = \frac{1+\lvert k \rvert-1-\lvert k \rvert}{1+\lvert k \rvert+1-\lvert k \rvert} = \frac{2\lvert k \rvert}{2} = \lvert k \rvert$ Therefore, $\lvert k \rvert = \frac{VSWR-1}{VSWR+1} = \frac{S-1}{S+1}$	**2M Reflection Coefficient** **2M VSWR**
	c	**Draw neat block diagram of FM radio receiver.**	**4M**
	Ans:	 **OR**	**4M**

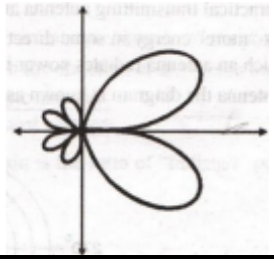
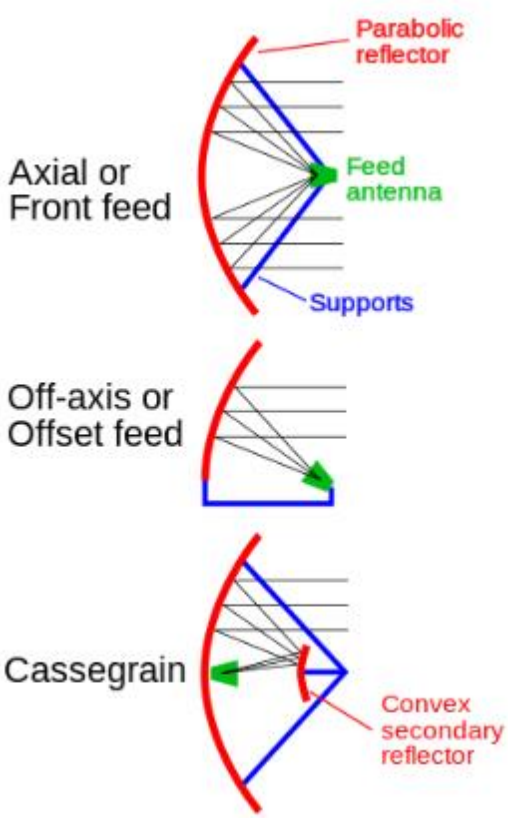


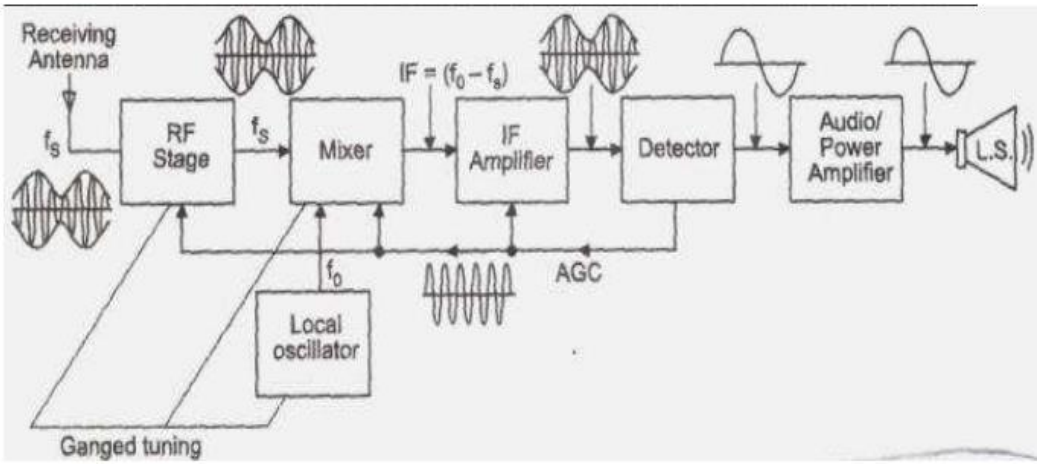
OR

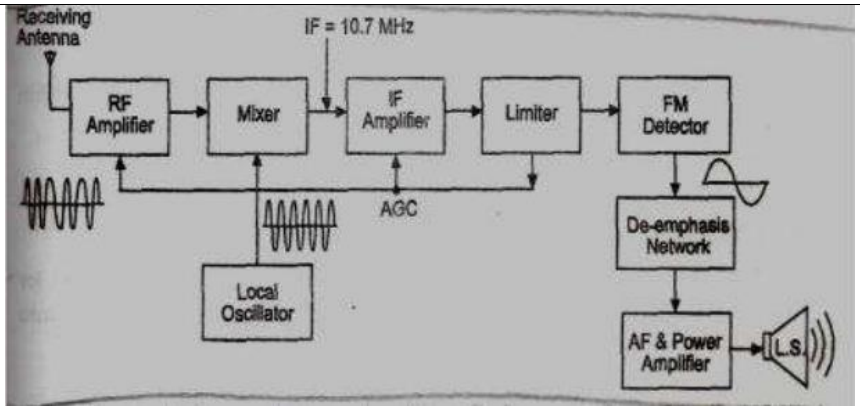


Q 2		Attempt any FOUR of the following:	16-Total Marks
	a)	**Describe space wave propagation with neat sketch.**	4M
	Ans:	**Space wave propagation concept :-**  *Space wave propagation* 1. The process of sending, receiving and processing of information through space without any special communication channel is called space communication. 2. The information to be transmitted is superimposed on a high-frequency electromagnetic wave called the carrier wave. 3. After superimposition, the resultant wave called the modulated wave is transmitted from one place to another by using an antenna. **Explanation:** 1. The electromagnetic waves which travel directly from the transmitting antenna to the receiving antenna are called space waves and this type of propagation is called space wave propagation. 2. High-frequency electromagnetic waves cannot be transmitted as ground waves due to high energy losses. Moreover, these waves are absorbed by the ionosphere hence they cannot be transmitted via sky wave propagation. 3. Therefore, such high-frequency electromagnetic waves are directly transmitted throng Earth atmosphere using a transmitting antenna As these waves travel in a straight line, the receiving antenna must be in line of sight of the transmitting antenna.	2M Diagram 2M Explanation

b)	**Explain different types of losses in transmission lines.**	**4M**
Ans:	**Losses in Transmission Line:-** There are three ways in which energy, applied to a transmission may desperate before reaching the load. They are **(1) Radiation Losses:-** • Its occurs when a transmission line may act as an antenna when the separation of the conductor is an appreciable fraction of a wave length . • This loss increase with frequency for any given transmission line eventually ending that lines usefulness at some high frequency. • This loss is more in parallel wire lines than to coaxial lines. **(2) Conductor Or I2 R loss:-** • This loss is proportional to the current and their fore inversely proportional to characteristics impedance • It also increases with frequency, this time because of the skin effect. **(3) Dielectric loss:-** • This loss is proportional to the voltage across the dielectric and hence inversely proportional to the characteristic impedance for any power transmitted. • It again increases with frequency because a gradually worsening properties with increasing frequency for any given dielectric medium. **(4) Corona Effect:-** • Corona is a luminance discharge that occurs between the two conductors of a transmission line when the difference of proportional between them exceeds the break down voltage of the dielectric insulator. • Generally when corona occurs, the transmission line is destroyed.	**1M each**
c)	**Explain the operation of non resonant antenna and draw its radiation pattern.**	**4M**
Ans:	**Non resonant antenna:-** • Non-resonant antennas are the antennas in which the source is matched to the load (i.e. they don't have open circuit). • A non-resonant antenna is like a properly terminated transmission line, produces no standing waves. • They are suppressed by the use of a correct termination resistor and no power is reflected, ensuring that only forward travelling waves will present. • In a correctly matched transmission line, all the transmitted power is dissipated in the terminating resistance. • When an antenna is terminated as shown in Figure about two-third of the forward power is radiated and remaining is dissipated in the antenna.	**2M**

	Radiation pattern:- 	**2M**
d)	**Draw and explain the constructional sketch of Cassegrain feed parabolic reflector antenna.**	**4M**
Ans:	 • A Cassegrain antenna is a parabolic antenna in which the feed antenna is mounted at or behind the surface of the concave main parabolic reflector dish and is aimed at a smaller convex secondary reflector suspended in front of the primary reflector. • The beam of radio waves from the feed illuminates the secondary reflector, which reflects it back to the main reflector dish, which reflects it forward again to form the desired beam. • The Cassegrain design is widely used in parabolic antennas, particularly in large antennas such as those in satellite ground stations, radio telescopes, and communication satellites.	**Diagram 2M & Explanation 2M**
e)	**With the help of block diagram describe the function of superheterodyne**	**4M**

		radio receiver.	
	Ans:	***(Note:- In the question only Superheterodyne radio receiver is asked. But it is not mentioned either it is AM or FM radio receiver. So student write any one marks should be given)*** **Block diagram AM superheterodyne radio receiver:-**  • AM super heterodyne receiver works on the principle of super heterodyning. • In the super heterodyne receiver, the incoming signal voltage is combined with a signal generated in the receiver. • The local oscillator voltage is normally converted into a signal of a low fixed frequency with the help of mixer. • The signal at this intermediate frequency contains the same modulation as the original carrier and it is now amplified and detected to reproduce the original modulating signal. **OR** **Block diagram FM superheterodyne radio receiver:-** **Explanation:-** **RF amplifier:** There are two important functions of RF amplifier: 1) To increase the strength of weak RF signal. 2) To reject image frequency signal. In FM broadcast the channel bandwidth is large as compared to AM broadcast. Hence the RF amplifier must be design to handle large bandwidth.	**Diagram 2& Explanation 2M**



Frequency Mixer:

The function of frequency mixer is to heterodyne signal frequency fs and local oscillator frequency fo. At the output, it produces the difference frequency known as intermediate frequency fi. The intermediate frequency used in FM receiver is higher than that in AM receiver. Its value is 12MHz (practical value of IF is 10.7MHz).

Local oscillator:

Since FM broadcast operates in VHF and UHF band, a separate local oscillator is used in FM receiver The local oscillator frequency fo is kept smaller than the signal frequency fs by an amount equal to the intermediate frequency fi
(fi = fs-fo).

IF amplifier:

Two or more stages of IF amplifier are used to provide large gain to the receiver. This increases the sensitivity of a receiver. If amplifier should be designed to handle large bandwidth.

Amplitude limiter:

The function of amplitude limiter is to remove all amplitude variation of FM carrier voltage that may occur due to
atmospheric disturbances. Use of amplitude limiter makes the system less noisy.

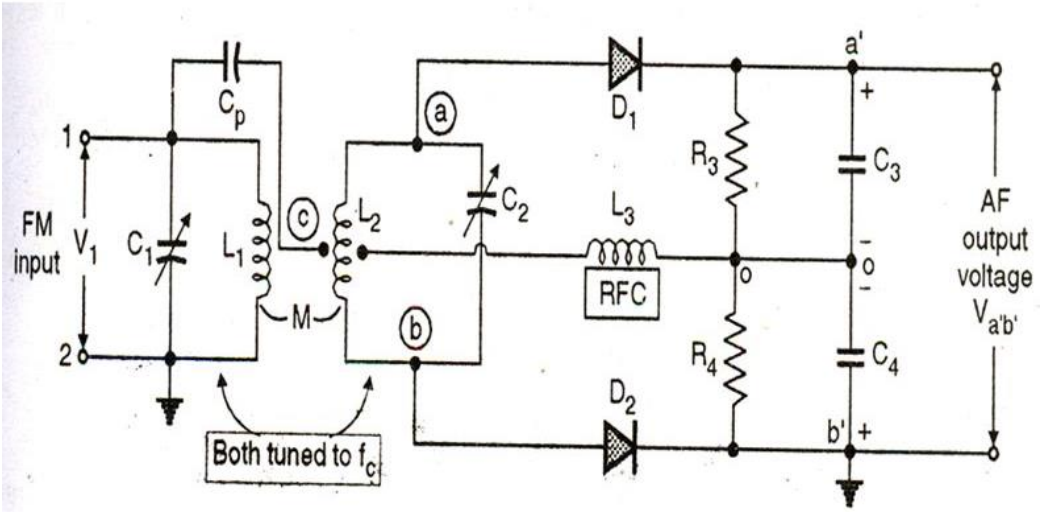
FM Discriminator or detector:

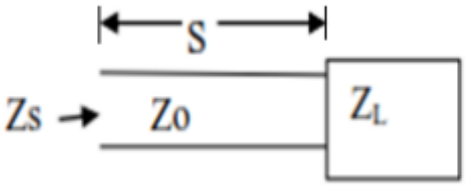
It separates modulating signal from frequency modulated carrier signal. Thus it produces audio signal at its output.

Audio frequency voltage and power amplifier:

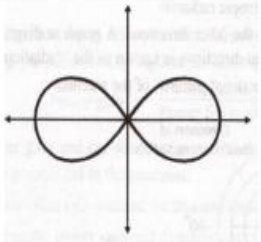
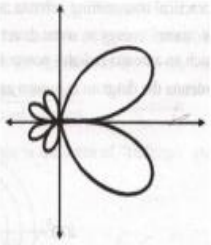
Audio amplifier increases voltage and power level of audio signal to a suitable level.in FM broadcast, the maximum modulating frequency is 15 kHz. Hence the audio amplifier must have large bandwidth.

f)	**Draw the circuit diagram of foster Seelay detector and write its working principle.**	**4M**

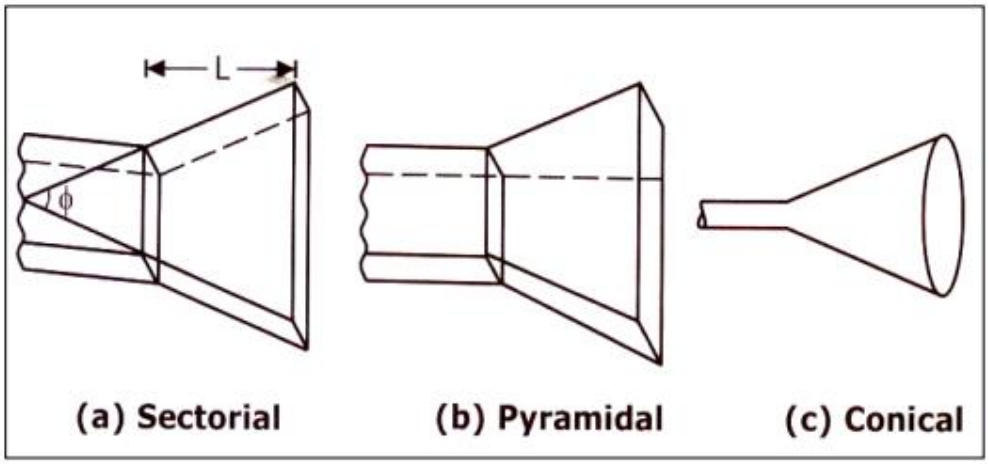
	Ans:	**Circuit diagram of Foster Seelay detector:-**  **Working principle:-** • It uses a double-tuned RF transformer to convert frequency variations in the received fm signal to amplitude variations. • These amplitude variations are then rectified and filtered to provide a dc output voltage. This voltage varies in both amplitude and polarity as the input signal varies in frequency. • The output voltage is 0 when the input frequency is equal to the carrier frequency (F_R). • When the input frequency rises above the center frequency, the output increases in the positive direction. When the input frequency drops below the center frequency, the output increases in the negative direction. • The output of the Foster-Seeley discriminator is affected not only by the input frequency, but also to a certain extent by the input amplitude. Therefore, using limiter stages before the detector is necessary. • Figure shows a typical Foster-Seeley discriminator. The primary tank circuit consists of C_1 and L_1. C_2 and L_2 form the secondary tank circuit. Both tank circuits are tuned to the center frequency of the incoming fm signal. • Choke L_3 is the dc return path for diode rectifiers D_1 and D_2. Resistors R_3 and R_4 are the load resistors and are bypassed by C_3 and C_4 to remove radio frequency.	**2M** **2M**
Q. 3		**Attempt any <u>FOUR</u> of the following:**	**16-Total Marks**
	a)	**Define the following w.r.t. wave propagation :** **i) Virtual height** **ii) Critical frequency** **iii) Maximum usable frequency** **iv) Skip distance.**	**4M**
	Ans:	**Virtual height:-** The apparent height of a layer in the ionosphere, determined from the time required for a radio pulse to travel to the layer and return, assuming that the	**1M each**

		pulse propagates at speed of light. **Critical frequency:-** The critical frequency of a layer is defined as the maximum frequency that is returned back to the earth by that layer, when the wave is incident at an angle 900 (normal) to it. The critical frequency for F2 layer is between 5 to 12 MHz **Maximum usable frequency:-** It is the highest radio frequency that can be used for transmission between two points via reflection from the ionosphere at a specified time independent of transmitter power. **OR** The limiting frequency when the angle of incidence is other than the normal is known as maximum unstable frequency. MUF= fc* Sec θ **Skip distance:-** The skip distance is defined as the shortest distance from a transmitter, measured along the surface of earth at which a sky wave of fixed frequency returns back to the earth.The frequency should be greater than critical frequency fc .	
b)	**How can a quarter wave transformers be used for impedance matching?**		**4M**
Ans:	**Quarter wave transformer:-**  $Zs = \frac{Zo^2}{Z_L}$ • In all applications of transmission line, it is required that the load be matched to line, which requires tuning out the unwanted load reactance and the transformation of resulting impedance to the required value especially at high frequencies. • The impedance of the quarter line depends on load impedance and characteristics impedance as shown in figure • When the length S is exactly quarter wavelength line then the line is lossless. If the Zo is varied, the impedance seen at the input to the λ/4 transformer will also vary accordingly, so that load may be matched to characteristic impedance of the main line. This is similar to varying turns ration of a transformer to obtain the required value of input impedance to match the load impedance. • Quarter wave transformer works as filter to prevent unwanted frequencies from reaching the load such as antenna. • The name transformer is given to quarter wavelength transmission line since it behaves as a transformer depending upon the value of Z_L. If $Z_L = Z_o$ then it acts as 1:1 transformer. If $Z_L > Z_o$ then it acts as a Step down transformer If $Z_L < Z_o$ then it acts as a Step up transformer	**Diagram 1M & Explanation 3M**

c)	**Compare resonant and non-resonant antenna? (any 4 point)**	**4M**
Ans:		**Any 4 points 1M each**

Parameter	Resonant antenna	Non resonant antenna
i) Definition	It is transmission Line of length equal to multiples of λ2 and open at both and.	It is transmission line whose length is not a multiple of λ2
ii) Reflection Pattern	Standing wave present	Standing wave not present
iii) Radiation Pattern		
iv) Applications	i) Portable receiver ii) Direction finding equipment	i) TV broadcasting ii) wave propagation

d)	**With the help of diagram write working principle of horn antenna.**	**4M**
Ans:	**Diagram :-**	**2M**

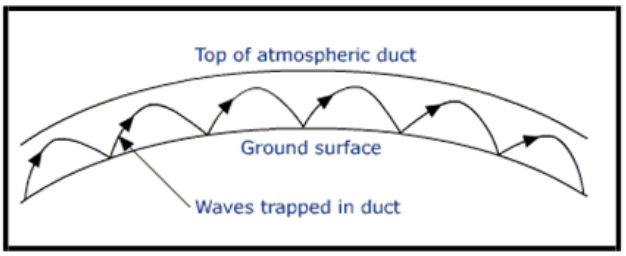


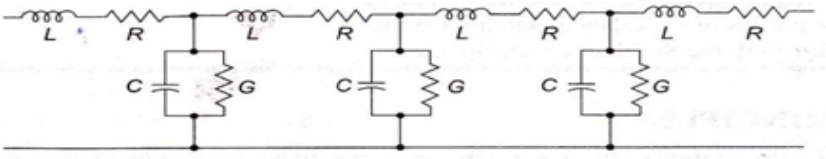
Working principle:-

- It is basically a waveguide terminated by horn.
- Waveguide is a hollow metallic pipe used to carry electromagnetic waves at microwave frequencies.
- All the energy travelling forward in the waveguide is radiated very effectively with the addition of the horn.
- There are three configuration s of most commonly used Horn antennas,

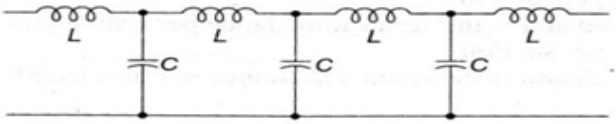
i) Sectorial
ii) Pyramidal
iii) Conical
As shown in figure

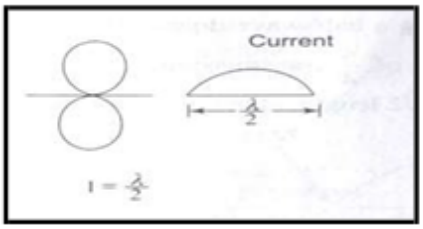
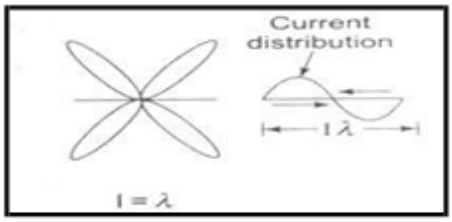
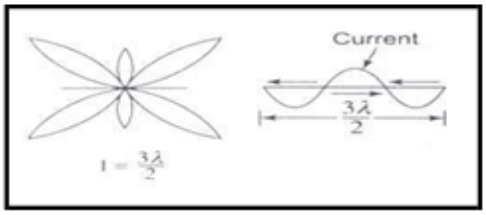
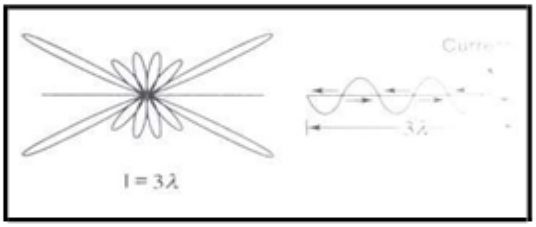
		i) The Sectorial horn flares out only in one direction. ii) Pyramidal horn flares out in both directions and has the shape of truncated pyramid. iii) The Conical horn is the termination of a circular waveguide. □ The ratio of L/λ decides the beam width and the gain of the antenna. □ There are two types of Horn antenna a) Cass- horn antenna b) Hog Horn antenna	
e)	**Explain the need of AGC and delayed AGC.**		**4M**
Ans:-	**Need of AGC:-** • The need or purpose of AGC circuit is to maintain the output voltage level (volume) of radio receiver constant over a wide range of RF input signal level. • AGC also helps to smooth out the rapid fading which may occur with long distance short wave reception & prevents overloading of the last IF amplifier which might otherwise have occurred **Need of delayed AGC:-** • The problem of reducing the receiver gain for weak signal is avoided . the delayed AGC is not used in low cost radio receiver. • It is used in high quality receiver like communication receiver.		**2M each**
f)	**Describe the AFC and its necessity for FM receiver.**		**4M**
Ans:	**Automatic frequency control:-** AFC is the automatic control of the intermediate frequency in radio, television, or radar receivers, to correct for variations of the frequency of the transmitted carrier or the local oscillator in the receiver. **Need of AFC:-** • It is also called as automatic Fine Tuning (AFT), is a method or circuit to automatically keep a resonant circuit tuned to the frequency of an incoming radio signal. It is primarily used in radio receivers to keep the receiver tuned to the frequency of the desired station. • In radio communication, AFC is needed because, after the band pass frequency of a receiver is tuned to the frequency of a transmitter, the two frequencies may drift apart, interrupting the reception.		**2M** **2M**

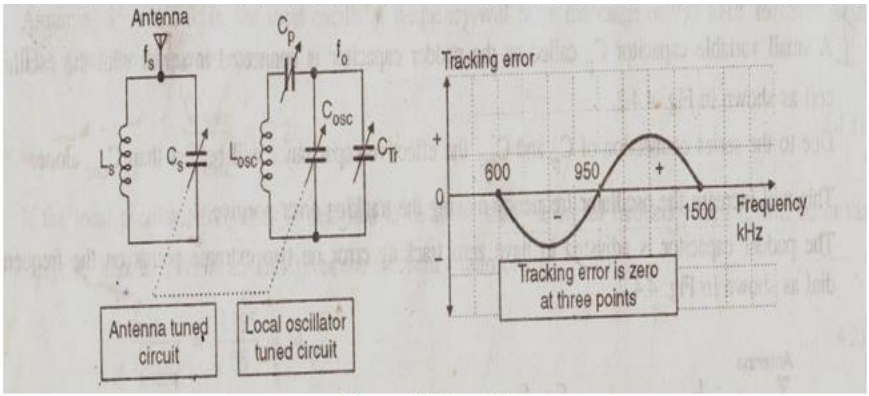
Q. 4	**A)**	**Attempt any FOUR of the following :**	**16-Total Marks**
	a)	**Draw and explain duct propagation.**	**4M**
	Ans:	**Diagram:**  **Figure:- Duct propagation** **Explanation**: • At such short wavelengths everything tends to happen very rapidly. Refraction and absorption tend to be accentuated. • One new phenomenon which occurs is super refraction, also known as ducting. • As air density decreases and refractive index increases with increasing height above ground. The change in refractive index is normally linear and gradual. • But under certain atmospheric conditions a layer of warm air may be trapped above cooler, often over the surface of water. • The result is that the refractive index will decrease far more rapidly with height than is usual. • The rapid in refractive index will do to microwave what the slower reduction of these quantities, in an ionized layer, does to HF waves; Complete bending down takes place. • Microwaves are thus continuously refracted in the duct and reflected by the ground, so that they are propagated around the curvature of the earth.	**(Diagram 2Marks, Explanation 2 Marks)**
	b)	**Draw the equivalent ckt. of transmission line at RF frequency ? List its types.**	**4M**
	Ans:	**Transmission line at low frequency**	**2M each diagram**



Transmission line at RF frequency



c)	**Draw the radiation pattern for the resonant dipole with following lengths :** **i) L = $\frac{\lambda}{2}$** **ii) L = λ** **iii) L = $\frac{3\lambda}{2}$** **iv) L = 3λ**	**4M**
Ans:	a) Radiation pattern of length L=λ/2  b) Radiation pattern of length L=λ  c) Radiation pattern of length L=3λ/2  d) Radiation pattern of length L=3λ 	(1 Mark each)

	d)	**Describe the role of Padder (capacitor) in three point tracking.**	**4M**
	Ans:	**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	**Explanation 2M** **Diagram 2M,**
	e)	**State the need of alignment and write down the procedure for IF alignment in AM radio receiver.**	**4M**
	Ans:	**RF alignment of AM Radio Receiver:-** • 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:-** • To obtain the maximum output signal at the center frequency of AM radio receiver.	**2 M** 2M 2M **2 M**
	f)	**Describe the operation of amplitude limiter with the help of circuit diagram.**	**4M**
	Ans:	**Operation**:- • In frequency modulation, the signal amplitude is held constant	**Operation 2 Marks**

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 D_1 and D_2.
- Diode D_1 will conduct when the input signal is grater than 0.7V on the positive peak, and diode D_2 will conduct on the portion of the negative half-cycle that exceeds $-0.7V_{pK}$ 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.

Diagram:-

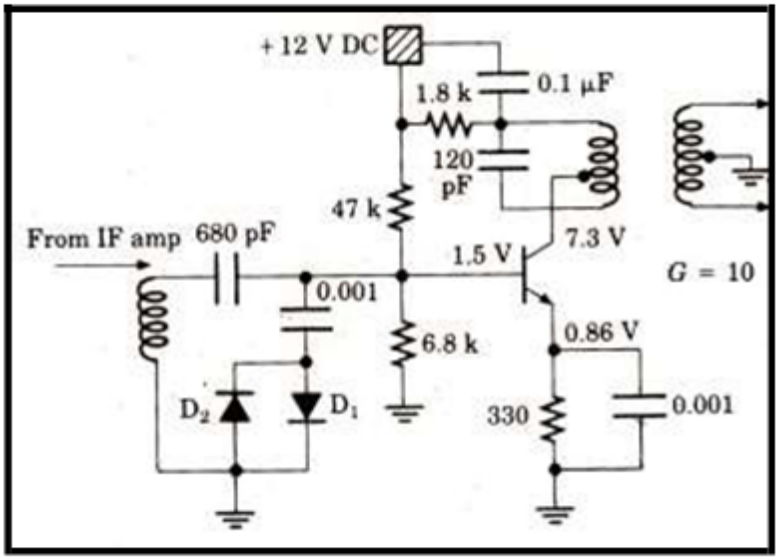
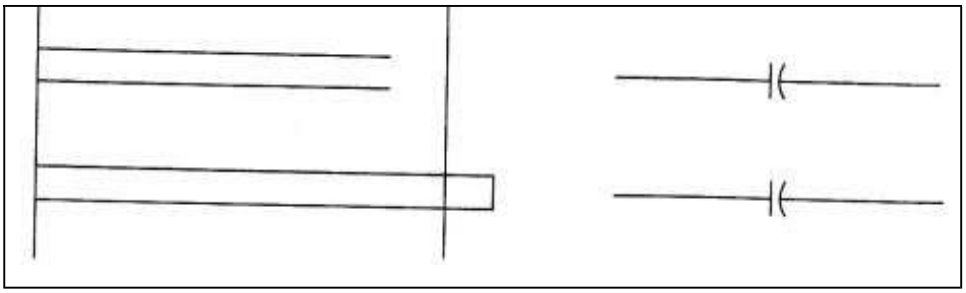
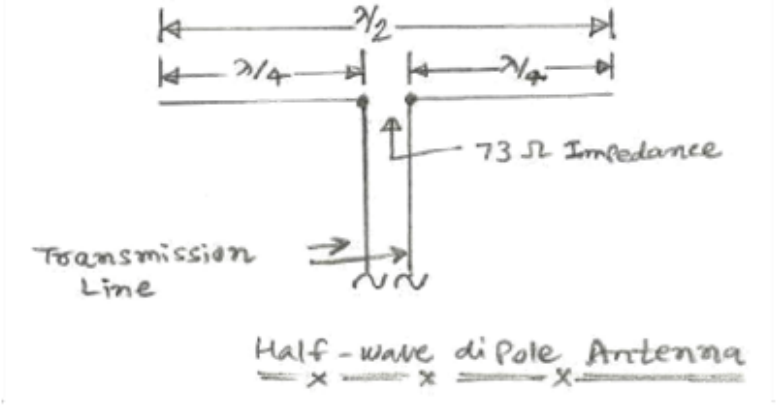


Figure:- Amplitude limiter

Diagram 2 Marks,

Q.5		**Attempt any FOUR of the following :**	**Total Marks 12**
	a)	**Explain the term fading? List its major causes.**	**4M**
	Ans:	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**	**fading 2M** **cause 2M**

		• **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)	**Describe the need of short length transmission line for open and short circuit.**	**4M**
	Ans:	• 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 λ/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 λ/4 long behave as a pure inductance. • An open-circuited line less than λ/4 long appear as a pure capacitance. 	**Explaination-2 marks** **Diagram-2 marks,**
	c)	**Describe the working principle of folded dipole antenna and yagi uda antenna with radiation pattern.**	**4M**
	Ans:	**<u>Construction Diagram</u>**	**Antenna 1M, Radiation pattern 1M, Operation 2M**



Folded Dipole:

- It is a widely used antenna that uses a folded dipole as the driven element.
- It is exactly $(\frac{\lambda}{2})$ long and open circuited at one end.
- It has 2 elements, one is directly converted and 2nd coupled inductively at the ends.

Radiation Pattern:

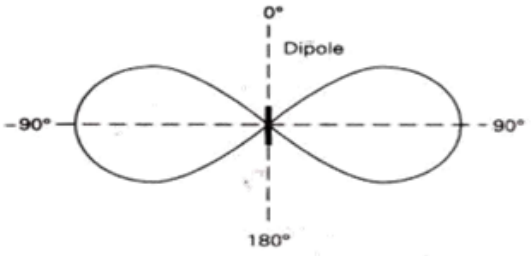


Diagram:

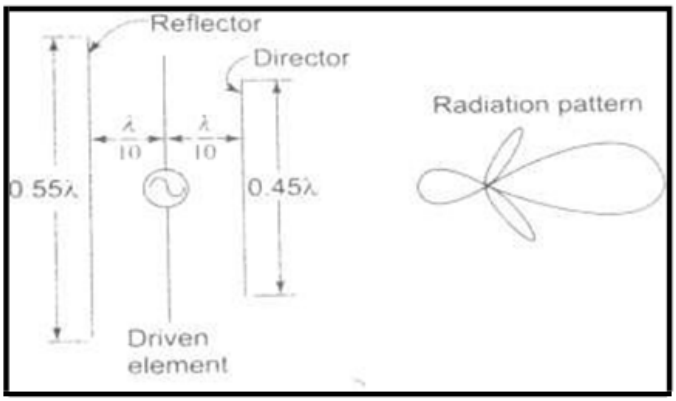


Figure:-Yagi-uda antenna

Operation:-

- It is a linear array that consisting of a dipole and two or more parasitic elements: one reflector and one or more directors.

		• A simple 3 element yagi uda antenna is shown above • The driven element is half wave folded dipole. • The reflector is a straight aluminum rod approximately 5% longer than the dipole. • The director is approximately 5% shorter than the dipole or driven element. • The spacing between the elements is generally $1/10^{th}$ of wavelength. • The typical directivity is between 7dB to 9dB. • The bandwidth of this antenna can be increased by using more than one folded dipole, each cut at slightly different lengths. • This antenna is commonly used for VHF television reception because of its wide bandwidth.	
	d)	**Draw the constructional sketch of phased array antenna and describe its working with radiation pattern.**	**4M**
	Ans:	**Phased array:** • A phased array is a group of antenna arrays or a group of arrays that, when they are connected together, functions as a single antenna. • The beam width and direction can be changed electronically without physically moving any antenna within the array. • They eliminate the need for mechanically rotating antenna elements. • The radiation pattern can be also adjusted and changed electronically. • When electromagnetic energies from different sources occupy the same space at the same time, they combine, sometimes constructively and sometimes destructively. • There are two basic kinds of phased array. • In the first type, a single high power output device supplies power to large number of antennas through a set of power splitters and phase shifters. • The second type, phased antenna array uses approximately as many low power variable output devices as there are radiating elements. • In both the types the radiation pattern is selected by changing the phase delay introduced by the phase shifters.	**Diagram-2 marks, Explaination-2 marks**

Diagram:

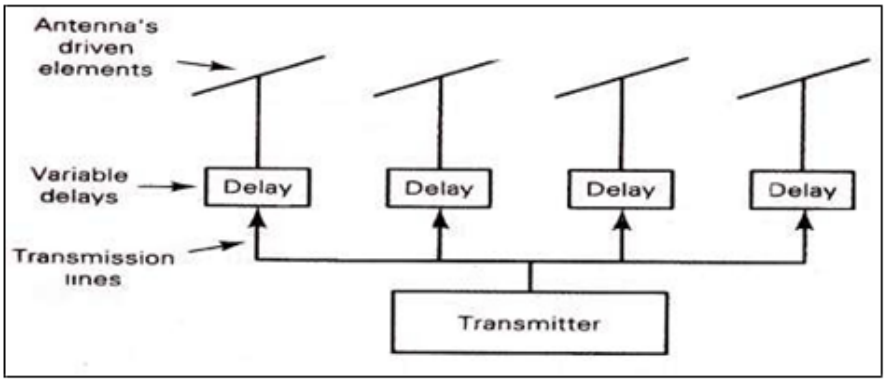
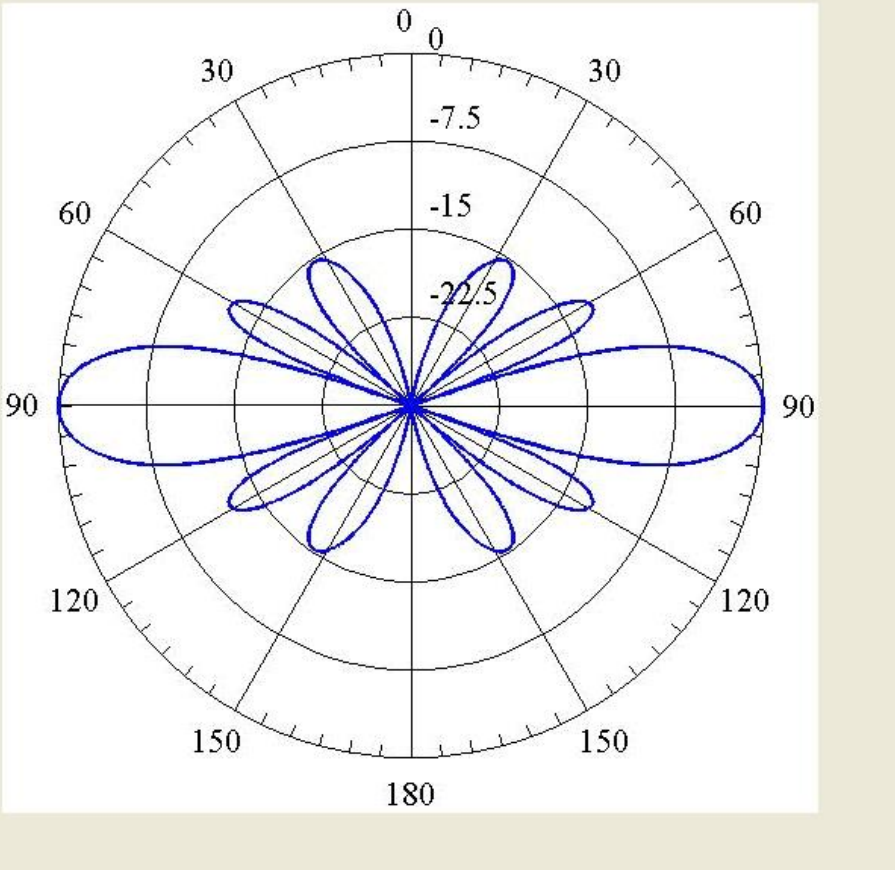
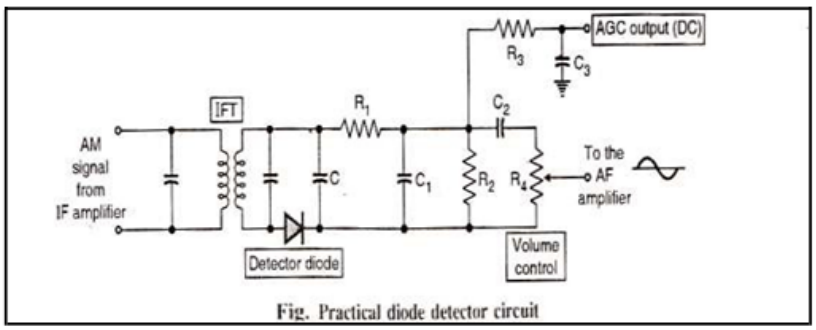


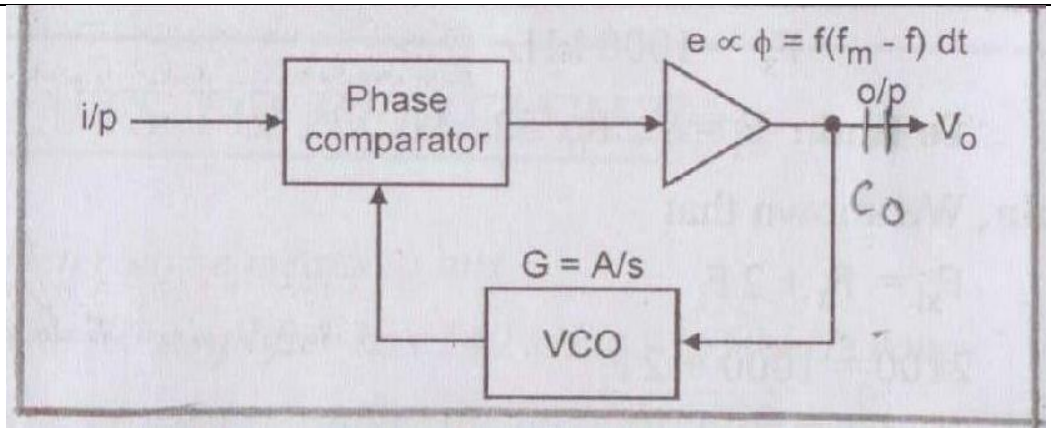
Fig. Phased Array.

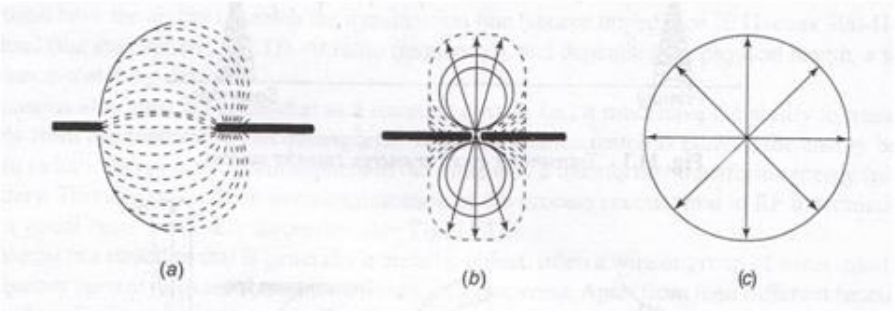
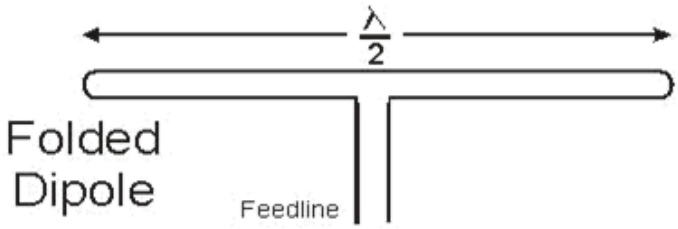
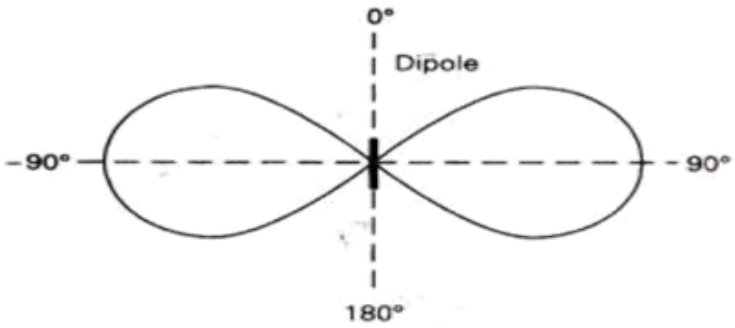
[Note: Any other relevant diagram should be considered]

Radiation pattern:



	e)	**Draw and explain the working of practical diode detector with wave forms.**	**4M**
	Ans:	**Practical diode detector:**  Fig. Practical diode detector circuit • The circuit diagram for a practical diode is as shown in Figure. As the direction of the diode has been reversed. the negative envelope will be demodulated • Due to this a negative AGC voltage will be developed. RI and R.2 provide a series dc path • R1.C1: is the low pass filter which is used to remove the RE ripple that is still present in the detected output • The capacitor C1 is a coupling capacitor which prevents the diode dc output from reading the volume control potentiometer R4 • Hence across R.4 we get the demodulated signal with a zero dc shift. This signal is then applied to the AF amplifier • The R.3-C3 Combination forms a low pass filter. It is designed to remove the AF Component from the demodulator output • This filter will allow only dc part to pan through. Which is used as AGC voltage This AGC voltage is then applied to the RF and IF amplifiers to control their gain automatically. Such a practical diode detector circuit is in the domestic radio receivers The dc AGC voltage produced at the detects output is proportional to the signal strength Stronger Am signal higher is the dc AGC voltage	**Diagram-2 marks, Explaination-2 marks**
	f)	**Draw and explain operation of FM demodulator using PLL.**	**4M**
	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.	**2M diagram** **2M Explanation**

			
Q.6		**Attempt any FOUR of the following:**	**Total Marks 16**
	a)	**Define the following terms: i) Standing Wave Radio (SWR) ii) V SWR iii) Reflection coefficient. State the formula which gives the relation between reflection coefficient and standing wave ratio.**	**4M**
	Ans:	$E = \frac{SWR - 1}{SWR + 1}$ When E is reflection coefficient & SWR is standing wave ratio. SWR definition: It is the ratio of the maximum to the minimum signal voltage on a transmission line. VSWR definition: The voltage standing wave ratio, VSWR is defined as the ratio of the maximum to minimum voltage on a loss-less line. Reflection coefficient: The ratio of the amplitude of the reflected wave and the amplitude of the incident wave.	**1M each Definition** **1 M Equation**
	b)	**Write the concept of Hertzian dipole and draw its radiation pattern.**	**4M**
	Ans:	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	Radiation pattern 2M & Explanation 2M

			
	c)	**Draw constructional sketch of half wave dipole antenna and draw its radiation pattern.**	**4M**
	Ans:	**Construction Diagram:**  **Radiation Pattern:** 	**Construction diagram-2M, radiation pattern-2M**
	d)	**Explain selectivity and sensitivity of radio receiver.**	**4M**
	Ans:	**Sensitivity:** • Sensitivity of a radio receiver is defined as the ability to amplify weak signals. • It is often defined in terms of the input voltage that must be applied at the input receiver to obtain a standard output power. • It is measured in μV or decibels • Sensitivity can be improved by increasing the gains of RF and IF amplifier stages.	**Sensitivity- 2 Marks, Selectivity-2 Mark Graph 1mark, explanation 1 mark**

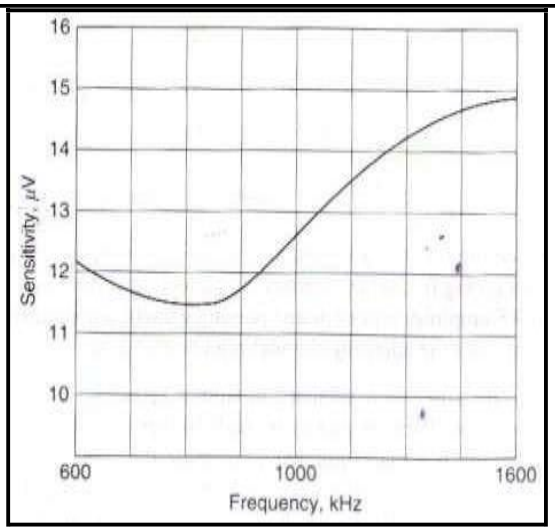


Fig. Sensitivity

Selectivity:

- The selectivity of a radio receiver is its ability to reject unwanted signals.
- The selectivity decides the adjacent channel rejection of a receiver.
- Selectivity depends on the IF amplifier, higher the "Q" of the tuned circuit used in the IF amplifier.

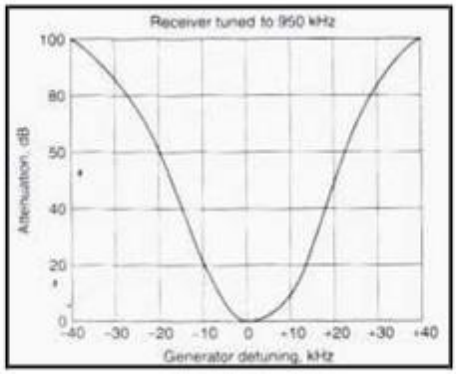


Fig. Selectivity:

e)	**State various factors influencing the choice of Intermediate Frequency (IF) for radio receivers.**	**4M**
Ans:	Explanation:- • The Intermediate frequency of a radio receiver is compromise, as there are reasons why it should be neither low nor high nor in a range between the two. • The choice of the IF depends on the following factors.	**4M(any four points)**

		i) IF should not be too high as it will result selectivity and therefore poor adjacent channel reaction. This is due to difficulty in obtaining high a Q in high frequencies. ii) If the If is too high the tracking problems increases. iii) If the IF is lowered than then the image frequency rejection is poorer. iv) A very low IF can make the selectivity too sharp cutting the sidebands. v) For very low IF, the frequency stability of the local oscillator must be very high. Because small drift in the local oscillator frequency will result in a larger error. vi) The IF must not fall within the tuning range of the receiver. Otherwise instability will occur and heterodyne whistles will be heard. This will make the tuning impossible. vii) In the standard broadcast AM receivers IF is within the range of 438 to 465 KHz being the most popular Frequency.	
f)	**Describe balance slope detector with neat circuit diagram.**		**4M**
Ans:	**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 tunedcircuits 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.		**Diagram 2M, explanation-2M**

Circuit Diagram:-