SUMMER– 19 EXAMINATION

Subject Name: Analog communication **Model Answer** **Subject Code:** 17440

Important Instructions to examiners:

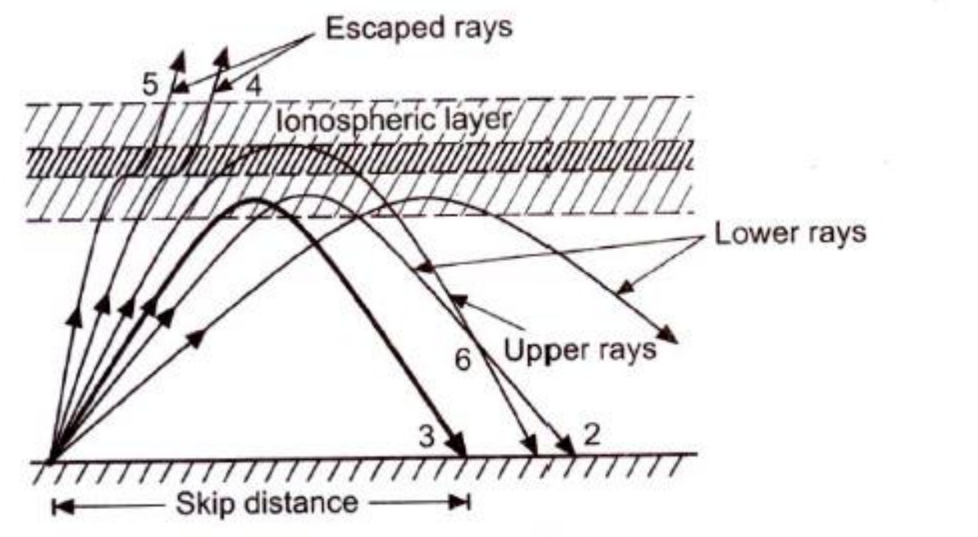
1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. 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 constantvalues 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.	Answers	Marking Scheme
1	**a)**	**Attempt any SIX of the following:**	**12- Total Marks**
	(i)	**Define: Base band signal with one example.**	**2M**
	Ans:	The electrical equivalent of the original information signal is known as the Baseband signal. Example:-The information or the input signal to a communication system can be analog i.e., sound, picture or it can be digital e.g. the computer data.	(Correct definition – 1M, 1 ex.-1M)
	(ii)	**State the need of modulation.**	**2M**
	Ans:	Need of Modulation :- i)Reduction in the height of antenna ii) Avoids mixing of signal iii) Increases range of communication. iv) Multiplexing is possible	Any 4 correct needs - 2M

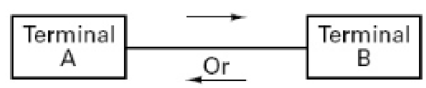
		v) Improve quality of reception.	
	(iii)	**Define modulation index in AM and give its formula.**	**2M**
	Ans:	In AM wave, the modulation index (m) is defined as the ratio of the amplitude of the modulating signal (Vm) to the amplitude of carrier signal (Vc). m = Vm / Vc	Correct definition 1 marks, formula 1mark
	(iv)	**State the super heterodyne principle.**	**2M**
	Ans:	The process of mixing two signals having different frequencies to produce a new frequency i.e., to convert all the incoming frequencies to a lower frequency known as intermediate frequency (IF) . The super heterodyne principle is based on frequency conversion or frequency down conversion.	**2M**
	(v)	**State the need of AGC.**	**2M**
	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	**2M**
	(vi)	**Define standing wave ratio.**	**2M**
	Ans:	Standing wave ratio is defined as the ratio of maximum voltage (Vmax) to minimum voltage **(Vmin).** Standing wave ratio is also defined as the ratio of maximum current (Imax) to minimum current **(Imin).**	(Correct definition – 2 marks)
	(vii)	**Define the terms:** **1) Maximum usable frequency** **2) Fading**	**2M**

SUMMER– 19 EXAMINATION

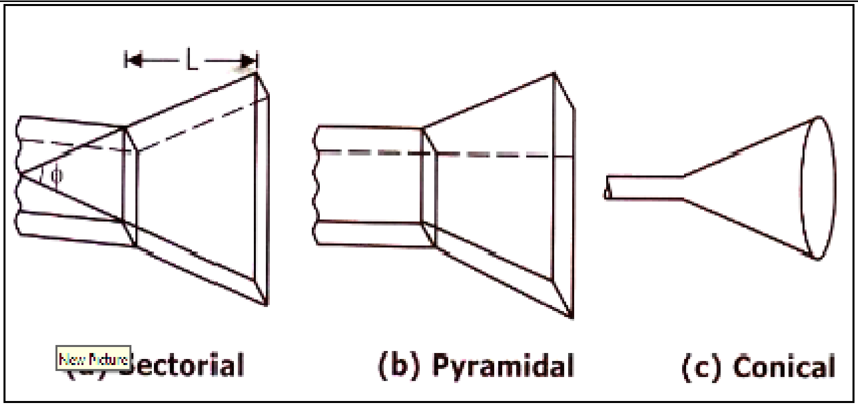
Subject Name: Analog communication **Model Answer** **Subject Code:** 17440

	Ans:	**1) Maximum usable frequency:-** Maximum usable frequency is defined as the limiting frequency ,when the angle of incidence is other than the normal . OR The highest frequency that can be used for sky wave communication between two given points on earth is known as maximum usable frequency. **2) Fading:-** The fluctuation in signal strength at a receiver, which is mainly due to the interference of two waves which left the same source but arrived at the destination by different paths is known as fading.	1-M for each definition
	(viii)	**What is skip distance?**	**2M**
	Ans:	ii) **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 f_c .  **Effects of Ionosphere on Rays of Varying Distance**	**(**Correct definition – 2M)
	b)	**Attempt any TWO of the following:**	**08- Total Marks**
	(i)	**Compare between simplex and duplex communication (four points)**	**4M**

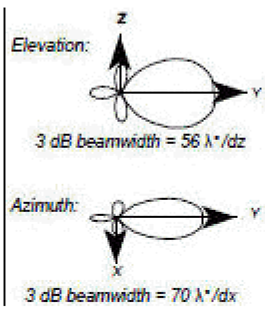
	Ans:	*(table below)*	Each correct point - 1M

Sr. No.	**Simplex**	**Duplex**
1.	It is one way communication	It is a two way communication
2.	Information is communicated in only one direction.	**Information** can transmit as well as receives simultaneously or not simultaneously.
3.	**Examples-** TV broadcasting, radio broadcasting, telemetry, remote control	**Examples-** Walky talky, telephone, mobile, Radar, FAX, Pager
4.	 Transmission in only one direction (a)	 Transmission in either direction, but not simultaneously (b)  Transmission in both directions simultaneously (c)

	(ii)	**Draw the structure of horn antenna and its radiation pattern. List its any two applications.**	**4M**
	Ans:	**The structure of horn antenna**	(diagram – 2 M, Radiation pattern 1M,2 apllications 1M)

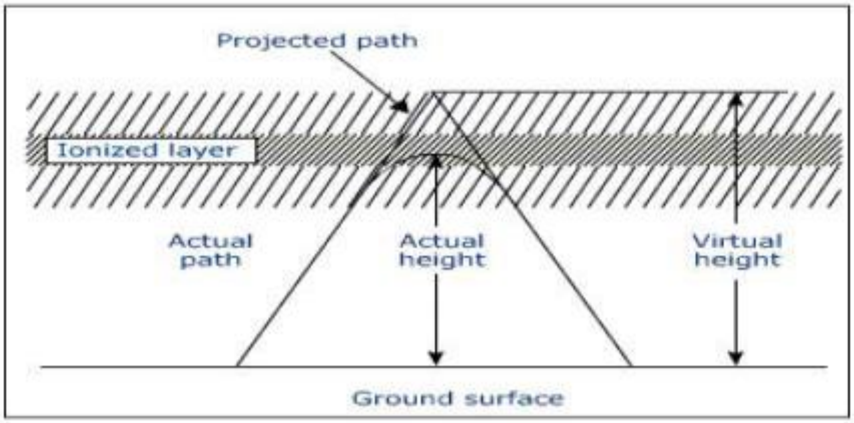
<table>
<tr><td></td><td></td><td>


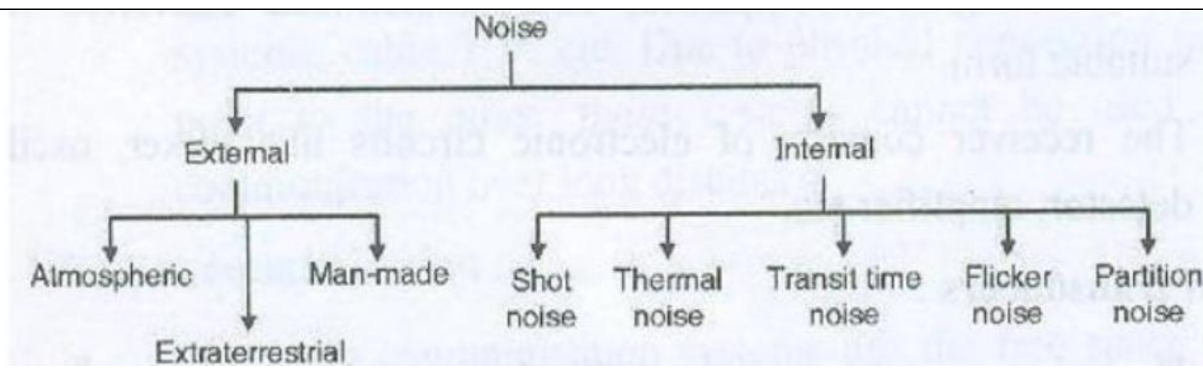
Radiation pattern of Horn Antenna



Application:-
i) Used at microwave frequency.
ii) Used in satellite tracking
</td><td></td></tr>
<tr><td></td><td>(iii)</td><td>Explain the following in wave propagation:
1) Actual height
2) Virtual height</td><td>4M</td></tr>
<tr><td></td><td>Ans:</td><td>1) Actual height:- The height attained by the wave during propagation through the ionosphere is known as Actual height.

2)Virtual height: -The incident wave returns back to the earth due to refraction. In this process it bends down gradually and not sharply .But the incident and reflected rays follow exactly the same paths as those if the signal have been reflected from a surface located at greater height. It is the height above the earth's surface from which a refracted wave appears to have been reflected. It is also defined as the maximum height that the hypothetical reflected wave would have reached.</td><td>(Each definition-1M,diagram-2M)</td></tr>
</table>



Q. No.	Sub Q. N.	Answers	Marking Scheme
2		**Attempt any FOUR of the following::**	**16- Total Marks**
	a)	**List the types of noise in communication system. Explain any one of them.**	**4M**
	Ans:	 **Explanation of External Noise:-** **Atmospheric Noise:-** Atmospheric noise or static is caused by lighting discharges in thunderstorms and other natural electrical disturbances occurring in the atmosphere. These electrical impulses are random in nature. Hence the energy is spread over the complete frequency spectrum used for radio communication. **Extraterrestrial Noise:-** There are numerous types of extraterrestrial noise or space noises depending on their	(Any 4 types list 2 M, any 1 type explanation 2 M)

sources. However, these may be put into following two subgroups.

1. Solar noise

2. Cosmic noise

Solar Noise:-

This is the electrical noise emanating from the sun. Under quite conditions, there is a steady radiation of noise from the sun. This results because sun is a large body at a very high temperature and radiates electrical energy in the form of noise over a very wide frequency spectrum including the spectrum used for radio communication.

Cosmic noise:-

Distant stars are also suns and have high temperatures. These stars, therefore, radiate noise in the same way as sun. The noise received from these distant stars is thermal noise (or black body noise) and is distributing almost uniformly over the entire sky. We also receive noise from the center of our own galaxy from other distant galaxies.

Man-Made Noise (Industrial Noise):-

Man-made noise or industrial- noise is meant the electrical noise produced by such sources as automobiles and aircraft ignition, electrical motors and switch gears, leakage from high voltage lines, fluorescent lights, and numerous other heavy electrical machines.

Explanation of Internal Noise:-

Thermal Noise:-

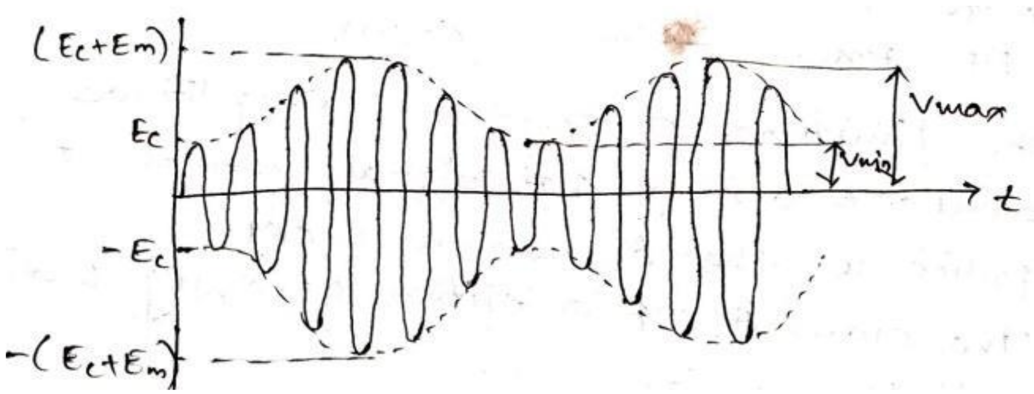
Conductors contain a large number of 'free" electrons and "ions" strongly bound by molecular forces. The ions vibrate randomly about their normal positions, however, this vibration being a function of the temperature. Continuous collisions between the electrons and the vibrating ions take place. Thus there is a continuous transfer of energy between the ions and electrons. This is the source of resistance in a conductor. There is a random motion of the electrons which give rise to noise voltage called thermal noise.

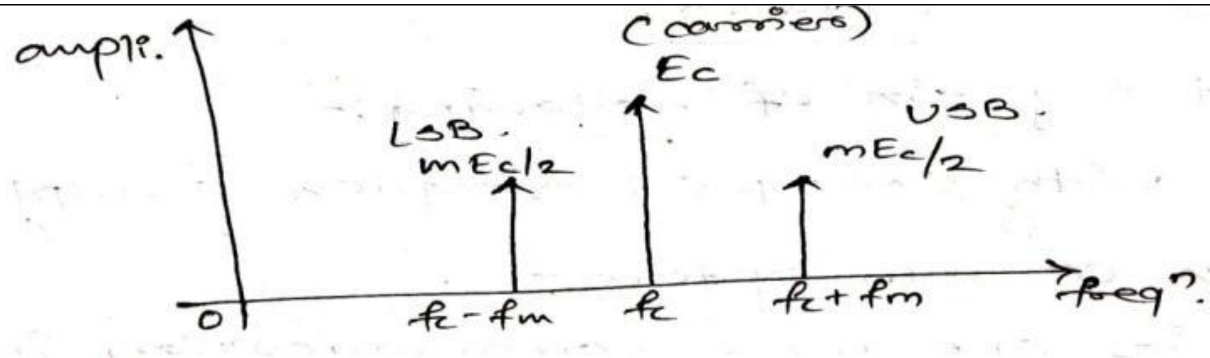
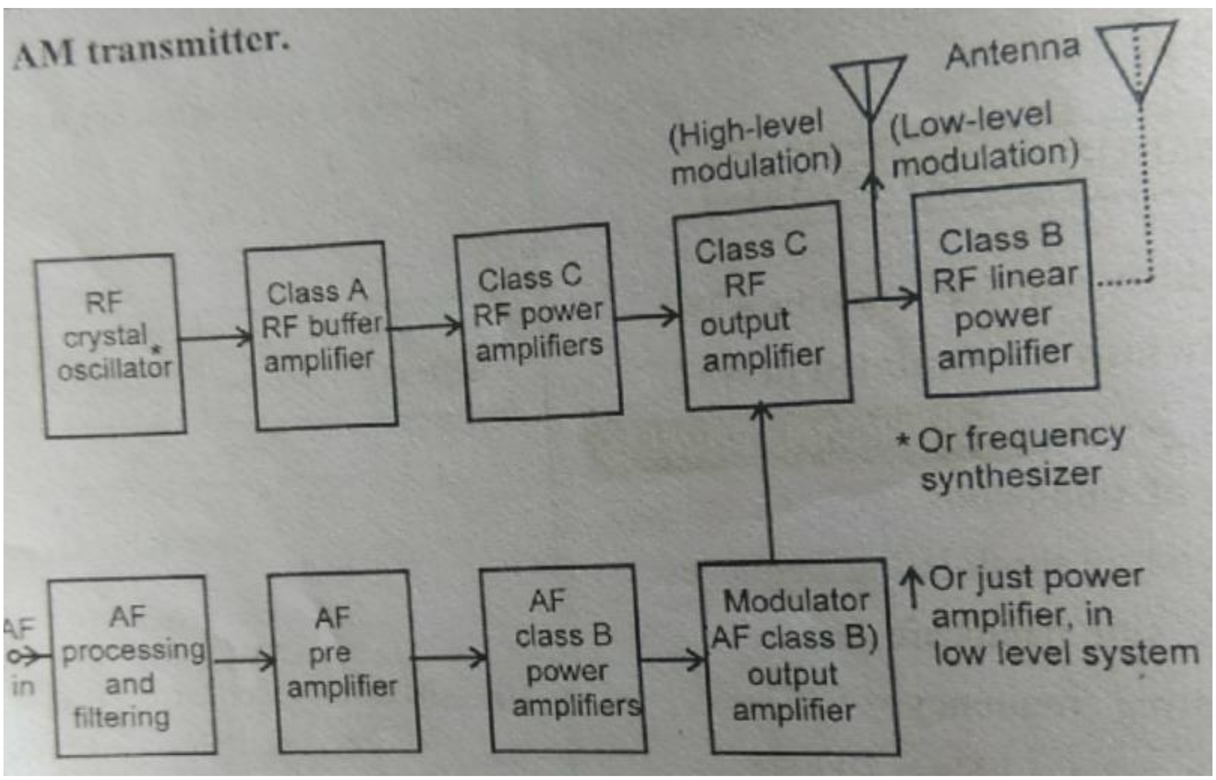
Shot Noise:-

The most common type of noise is referred to as shot noise which is produced by the random arrival of 'electrons or holes at the output element of PN junction.

Transit Time Noise:-

Another kind of noise that occurs in transistors is called transit time noise. Transit time is the duration of time that it takes for a current carrier such as a hole or current to move from the

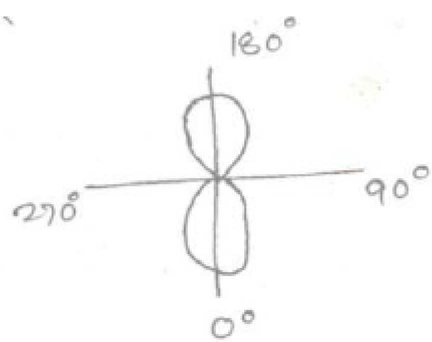
		input to the output. **Flicker Noise:-** Flicker noise or modulation noise is the one appearing in transistors operating at low audio frequencies. **Transistor Thermal Noise:-** Within the transistor, thermal noise is caused by the emitter, base and collector internal resistances **Partition Noise:-** Partition noise occurs whenever current has to divide between two or more paths, and results from the random fluctuations in the division.	
	b)	**Draw amplitude modulated waveform in time domain and frequency domain with proper labeling.**	4M
		AM in Time domain  **AM in frequency domain**	2 M 2M

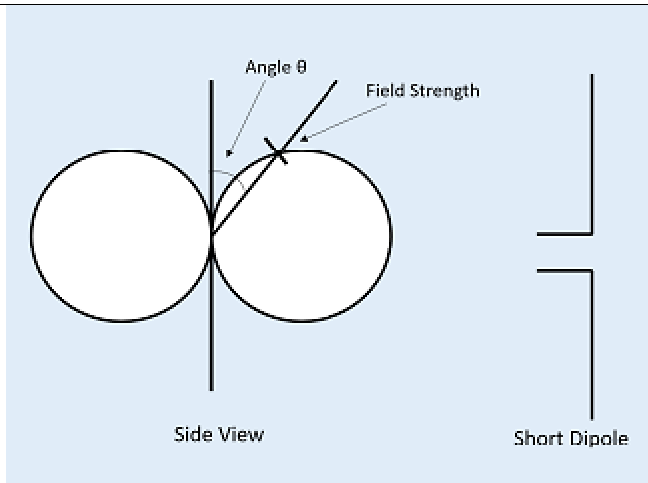
			
	c)	**Draw the block diagram of AM transmitter, explain its operation.**	**4M**
	Ans:	AM transmitter is of two types i)High Level AM Transmitter ii)Low Level AM Transmitter  **i) RF crystal oscillator**: It is a source of carrier signal of desired frequency. The circuit is designed such that the frequency, amplitude and phase of carrier signal is constant. RF crystal oscillator generates pure unmodulated carrier signal. **ii)RF buffer amplifier:** It is a unity gain amplifier having a very high input impedance and very low output impedance . It is used to avoid loading effect or in other words it is used for impedance matching. If RF crystal oscillator is directly connected to the RF power amplifier,	Diagram-2M, Explaination-2M. Marks can also be given to these two types(High Level, Low Level AM Transmitter)

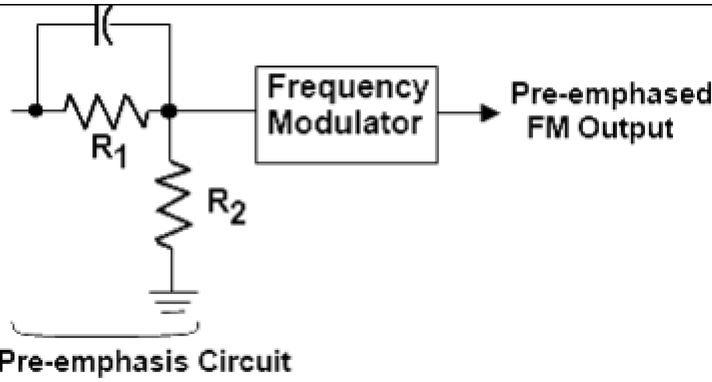
		then due to loading effect, frequency of carrier signal may change. **iii) Class C power amplifier:** It is a high power frequency class C amplifier. It is used to increase the power level of carrier signal. Class C amplifier is used because it has very high efficiency is greater than 70%. **iv) Modulator:** Modulator is also a class C amplifier in which modulating signal of sufficient amplitude is added with the carrier signal to obtain amplitude modulated carrier signal. This high power high frequency AM signal is then applied to the transmitting antenna which radiates this AM signal into air or space.	
	d)	**Define:** **(i) Image frequency and** **(ii) Double spotting**	**4M**
	Ans:	**i)Image frequency:-** Image Frequency is defined as the signal frequency plus twice the intermediate frequency. It is denoted as $f_{si} = f_s + 2f_i$ Where, f_s = Signal Frequency f_i =intermediate frequency. **ii)Double spotting:-** Double spotting means the same stations get picked up at two different nearby points,on the receiver dial. It is due to the poor front end selectivity i.e., inadequate image frequency rejection.	Each definition-2M
	e)	**State and explain the losses in transmission line.**	**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 .	**Note:-** If only list of losses is written give 1M Types- with

SUMMER– 19 EXAMINATION

Subject Name: Analog communication **Model Answer** **Subject Code:** 17440

		• 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 I^2R 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.	explaination-4M
	f)	**Draw the radiation pattern for Dipole antenna:** **(i) Half wave dipole** **(ii) Folded dipole.**	**4M**
	Ans:	**The radiation pattern for Half wave dipole antenna** 	**2 marks for each**

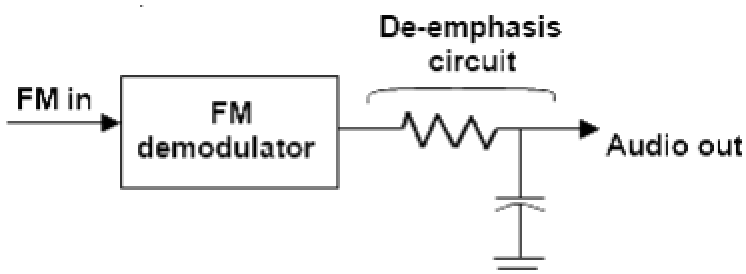
		 **The radiation pattern for Folded dipole antenna.**	
Q. No.	**Sub Q. N.**	**Answers**	**Marking Scheme**
3		**Attempt any FOUR of the following:**	**16- Total Marks**
	a)	**Explain pre-emphasis and de-emphasis concept in FM.**	**4M**
	Ans:	**Pre-emphasis:-** In an FM system the higher frequencies contribute more to the noise than the lower frequencies. Because of this all FM systems adopt a system of pre-emphasis where the higher frequencies are increased in amplitude before being used to modulate the carrier. Pre-emphasis is a process which is used in transmitter side to boosting the amplitude of higher modulating signal before modulator. IF we used it after the modulator than carrier &modulator signal will mixed and it is difficult to verify which one is the modulating signal.	**Diagram 2M & Explanation 2M**



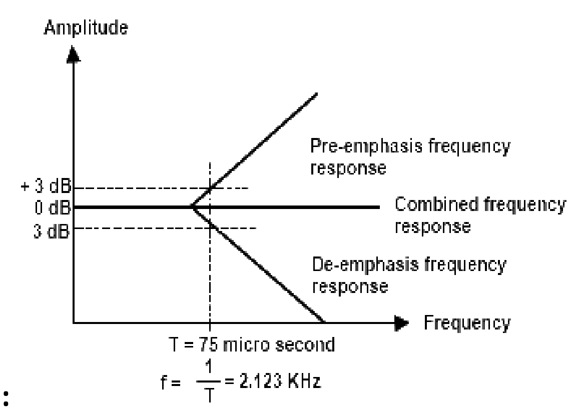
(a) Pre-emphasis Circuit

De-emphasis:

De-emphasis is process which is used in receiver side to reduce the signal & get their original signal. But it is used after demodulator circuit. Thus Pre-emphasis is used at transmitter and de-emphasis at receiver to improve the noise immunity



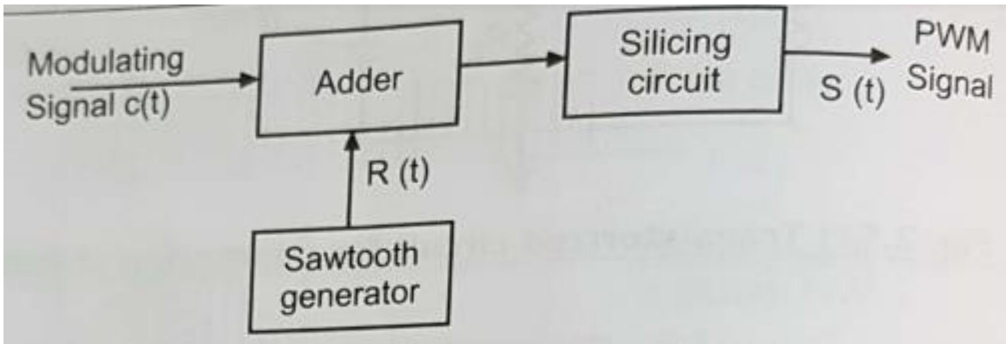
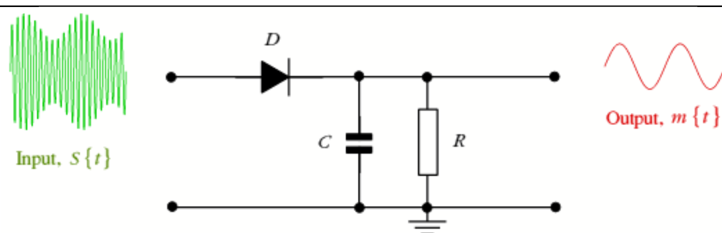
(c) De-emphasis circuit



Pre-emphasis/ De-emphasis graph:

SUMMER– 19 EXAMINATION

Subject Name: Analog communication **Model Answer** Subject Code: 17440

	b)	**Draw the block diagram of PWM. List its advantages**	**4M**
	Ans:	**Block diagram of PWM:-**  **Advantages of PWM:-** 1. More immune to noise. 2. Synchronization between transmitter and receiver is not required. 3. Possible to separate out signal from noise.	**2M** **2M** **(any 2)**
	c)	**Explain the demodulation of AM signal using diode detector.**	**4M**
	Ans:	 **Simple diode detector:-** **Explanation:-** This is essentially just a half wave rectifier which charges a capacitor to a voltage nearly to the peak voltage of the incoming AM waveform s(t). When the input wave's amplitude increases, the capacitor voltage is increased via the rectifying diode. When the input's amplitude falls, the capacitor voltage is reduced by being discharged by a 'bleed' resistor, *R*. The main advantage of this form of AM *Demodulator* is that it is very simple and cheap! Just one diode, one capacitor, and one resistor. That's why it is used so often. **OR**	**Diagram 2M & Explanation 2M**

Practical diode detector:

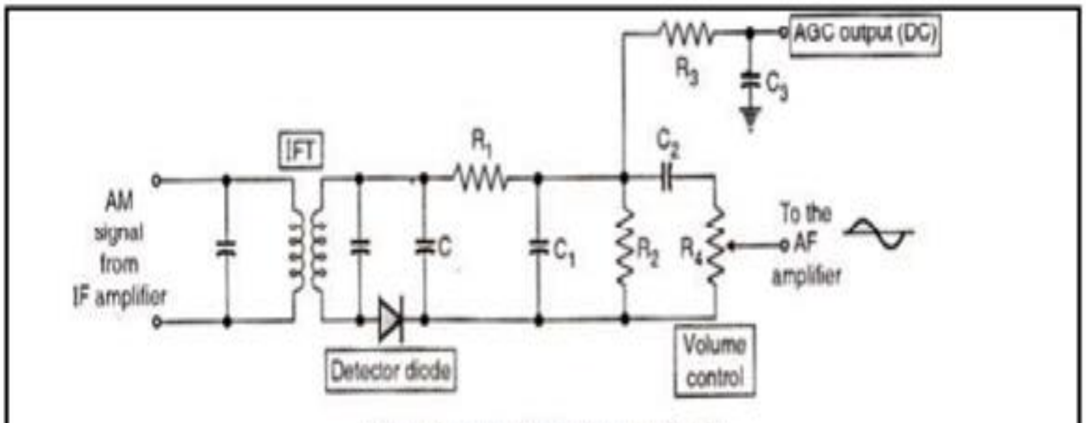


Fig. Practical diode detector circuit

[Note: Any other relevant diagram should be considered]

Explanation:-

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. R_1 and R_2 provide a series dc path. R_1 - C_2 is the low pass filter which is used to remove the RF ripple that is still present in the detected output.

The capacitor C_2 is a coupling capacitor which prevents the diode dc output from reaching the volume control potentiometer R_4.

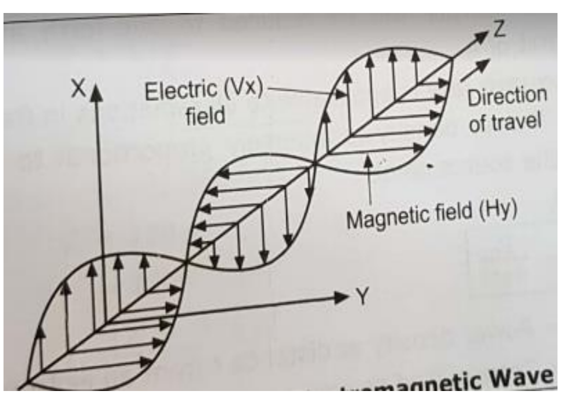
Hence across R_4 we get the demodulated signal with a zero dc shift. This signal is then applied to the AF amplifier.

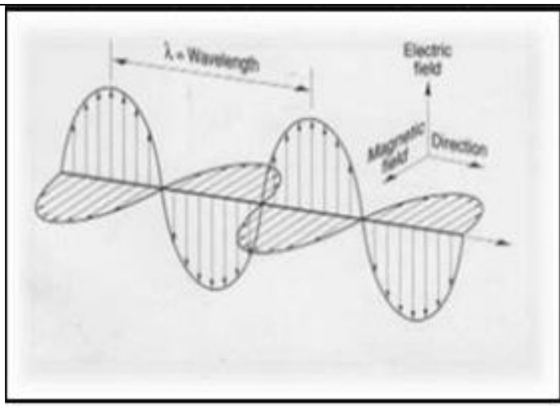
The R_3-C_3 combination forms a low pass filter. It is designed to remove the AF component from the demodulator output.

This filter will allow only dc part to pass 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 detector output is proportional to the signal strength. Stronger Am signal higher is the dc AGC voltage.

d) **For a transmission line, the incident voltage. Ei = 6V and Er =2V ,Calculate:** **4M**

(i) Reflection Coefficient

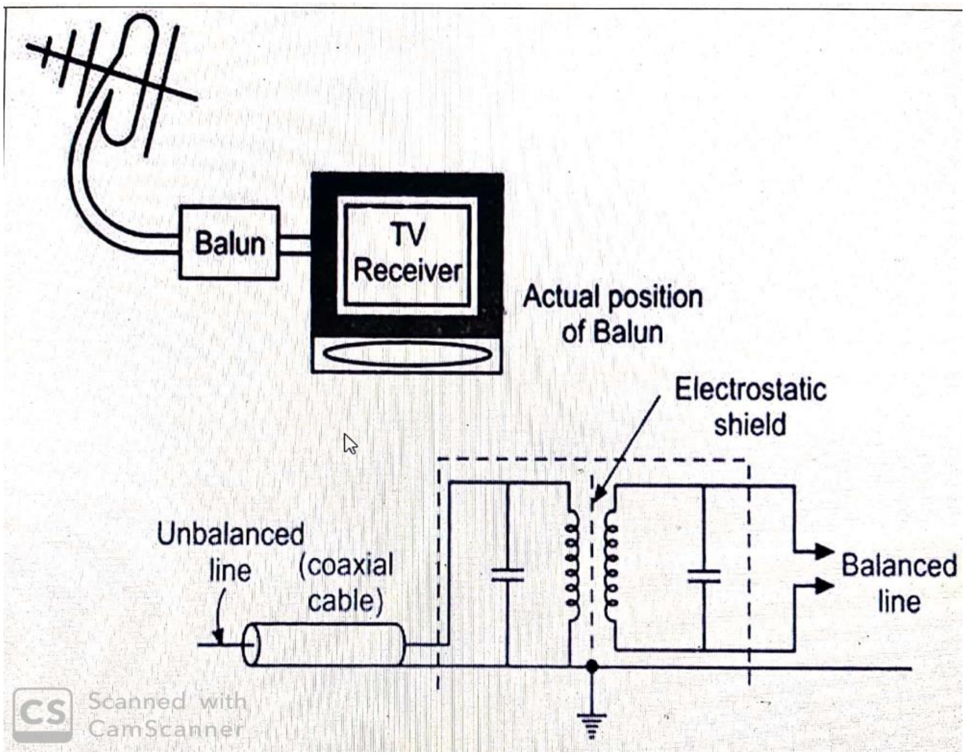
		(ii) SWR	
	Ans:	**Reflection Coefficient(K) = Er / Ei** = 2V / 6V **K = 0.333** **SWR = 1+K / 1- K** = 1+0.333 / 1-0.333 = 1.333 / 0.667 **SWR= 1.998**	**Each 2M…..** **(formula 1M & correct answer 1M each)**
	e)	**Explain the transverse electromagnetic waves in wave propagation.**	**4M**
	Ans:	1. The electromagnetic waves are oscillations, which propagate through free space. 2. Em wave travel in free space at the speed of light. 3. Figure shows the simple EM wave, in which the direction of electric field , magnetic field and propagation are mutually perpendicular to each other. 4. The EM waves are transverse in nature i.e. oscillations are perpendicular to the direction of waves so the name transverse electromagnetic waves (TEM). **Diagram:-** **Transverse electromagnetic wave(TEM)**  **OR**	**2M** **2M**

			
	f)	**An antenna has a radiation resistance of 72 Ω a loss resistance of 8 Ω and a power gain of 16. Find efficiency and directivity.**	**4M**
	Ans:	**...tion: Given:** $R_d = 72\ \Omega$ $R_{loss} = 8\ \Omega,\quad R_{rad} = 72 - 8 = 64\ \Omega$ $A_p = 16$ **Efficiency:** $\eta = \frac{R_{rad}}{R_{rad} + R_d} = \frac{64}{64 + 72} \times 100 = 0.47 \times 100$ $\boxed{\eta = 47\%}$ **Directivity:** $A_p = \eta \cdot D$ $\therefore\ D = \frac{A_p}{\eta} = \frac{16}{0.47} = 34.04$ $\boxed{D = 34.04}$	**Each 2M** **(formula 1M & correct answer 1M)**
Q. No.	Sub Q. N.	Answers	Marking Scheme
4		**Attempt any FOUR of the following::**	**16- Total Marks**
	(a)	**For AM, f_c =500kHz , f_m = 5 kHz Determine:** **(i) Upper and lower sideband frequencies** **(ii) Bandwidth**	**4M**
	Ans:	**Given data** **fc = 500KHz , fm = 5KHz**	**1.5 MARKS FOR**

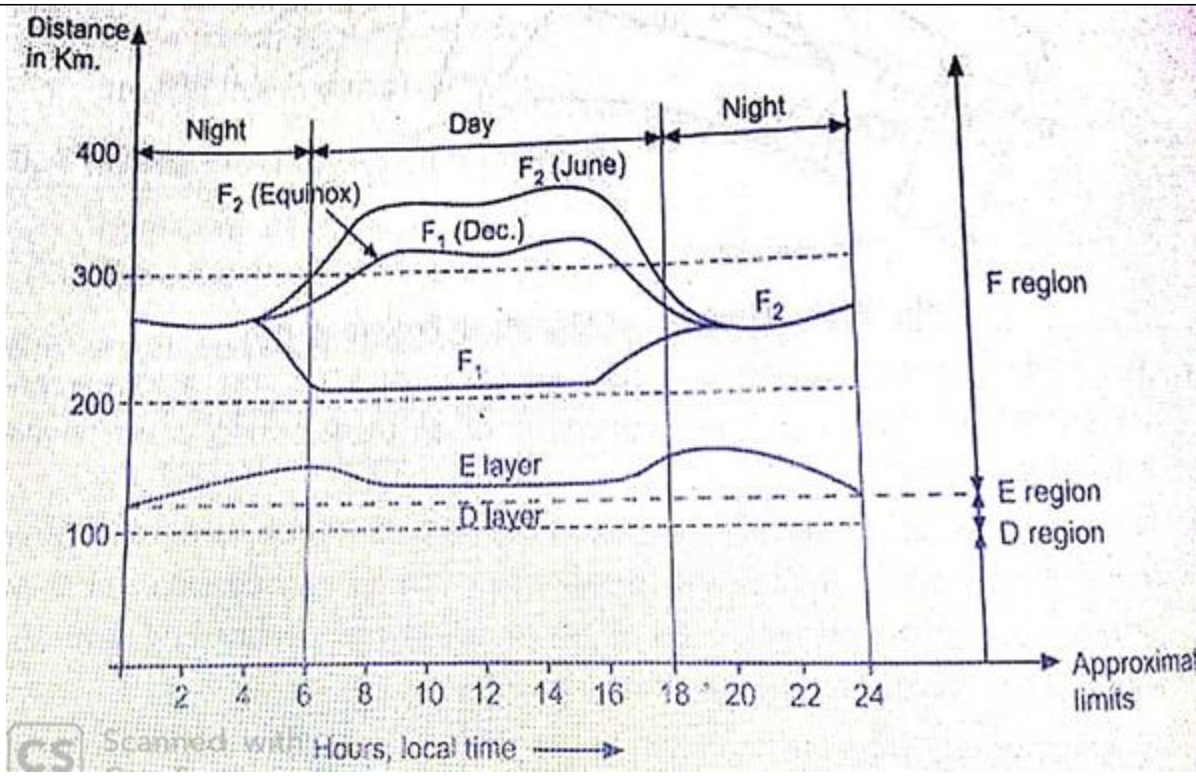
		USB =fc+fm USB = 500+5 =505 KHz. LSB =fc – fm LSB = 500 – 5 =495 KHz Bandwidth = 2fm . = 2* 5 =10 KHz	USB,1.5 MARKS FOR LSB &1 MARK FOR BW
	(b)	Compare between FM and PM	4M
	Ans:	(see table below)	Any 4 points 4marks

PARAMETERS	FM	PM
1. Variable parameter of carrier.	Frequency	Phase
2. Variable parameter proportional to modulating voltage.	Frequency deviation	Phase deviation.
3. Amplitude of modulated signal.	Constant	Constant.
4. Noise immunity	Best of all schemes	Better than AM
5. Coverage area for transmitted power	More	Moderate
6. Signal to noise ratio	Best	Better

	(c)	Explain the use of baluns for impedance matching.	4M
	Ans:	. • Balun stands for Balance to unbalance. • It can also be used to connect the unbalanced transmission line to a balance load	Diagram 2 marks Explaina tion 2

		such as antenna. • It consist of special type of transformer with an unbalanced primary and centre tapped secondary winding. • Baluns is used for matching two wires line to co-axial cable. • It is used in Tv receiver for impedance matching. • Its input is 300-75ohm. • It consist of two quarter wave length. 	marks
	(d)	List and explain the properties of quarter wave transformer.	4M
	Ans:	Properties of quarter wave transformer: 1. Impedance transfomation: it provides impedance transformation upto the highest frequencies and is compatible with transmission line. 2. Impedance inversion: if Z_L is inductive then Z_S iwill be capacitive and if Z_L is capacitive then Z_S will be inductive it is known as impedance inversion. 3. Frequency dependent: quarter wave transformer has a length of λ/4 at only one frequency and hence it is highly frequency dependent.	List any 3 properties 1mark& Explaination 3 marks

		4. quarter wave transformer act as step down or step up transformer,depending on whether Z_L IS greater than or less than Z_O.	
	(e)	Describe the effect of ionosphere on sky wave propagation.	4M
	Ans:	The Ionosphere is the upper portion of the atmosphere. The ultra violet radiation from the sun will ionize the upper layer of the atmosphere. In this layer free electrons and positive and negative ions are present and hence this layer of ions is known as ionosphere. There are four layers: D, E, F1 and F2. 1. D Layer: It is lowest layer at an height of 70 kms with thickness 10 km. The ionization density is maximum at noon and disappears at night. 2. E Layer: It is the next layer at an height of 100 kms with thickness 25 km. The layer disappears at night due to recombination of ions and molecules. 3. F1Layer: It is the next layer at an height of 180 kms with thickness 20 km. It provides more absorption for HF waves. 4. F2Layer: It is the next layer at an height of 250-400 kms with thickness 200 km. It is having highest electron density of all layers, due to this F2 layer remains present at night time. Ionosphere Propagation: In this propagation, the transmitted signal transmits into the upper atmosphere where it is bent i.e reflected back to earth. This bending of the signal takes place due to the presence of the ionosphere layer. Its Frequency Range is from 3 MHz to 30 MHz Polarization: Vertical.	Diagram 2 marks and Explaination 2 Marks



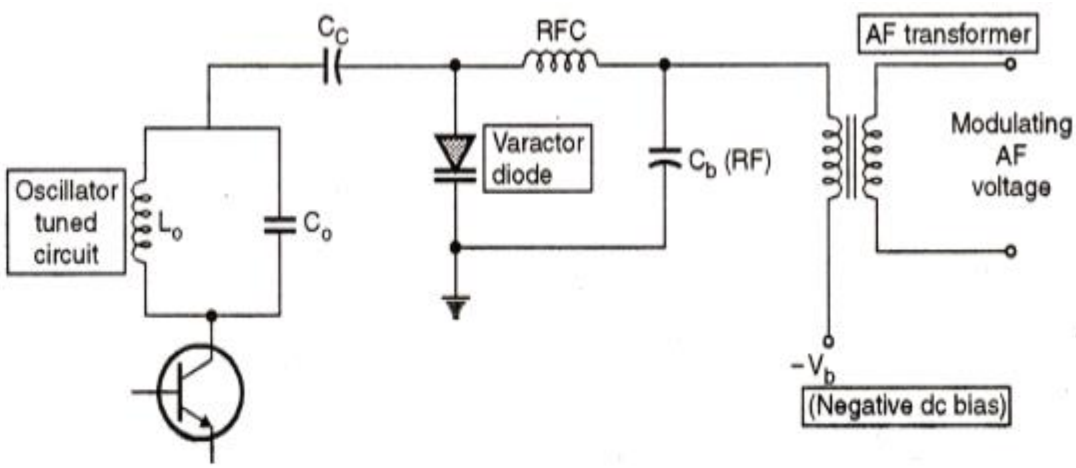
Ionospheric layers and their regular variations

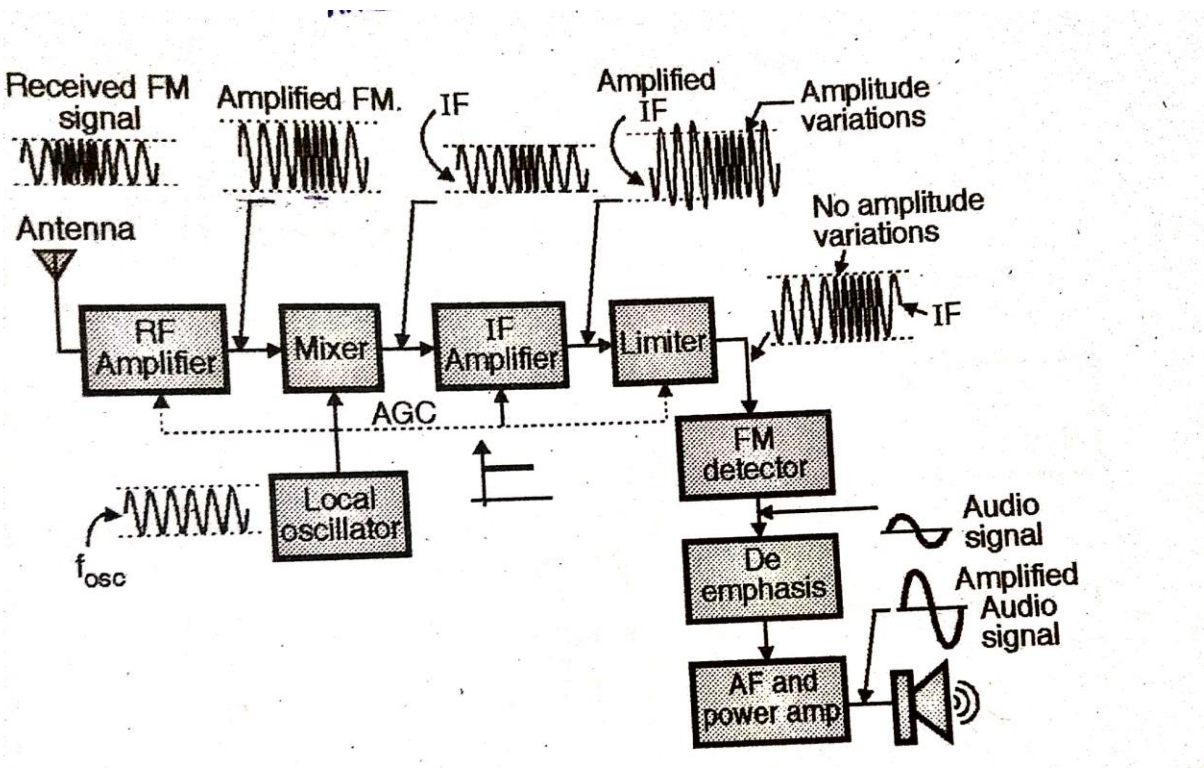
	f)	**Compare resonant and non-resonant antennas.**	**4M**

Ans | **Any 4 points 4 marks**

Parameters	**Resonant antenna**	**Non-resonant antenna**
1.Defination	**It is as transmission line of length equal to multiples of λ/2 and open at both ends.**	**It is a transmission line whose length is not a multiple of λ/2.**
2. Termination	**These are open at both ends.**	**These are terminated properly.**
3. Standing waves	**Standing waves are present.**	**Standing waves are absent.**
4. Radiation pttern	**In all direction**	**Uni-directional.**
5. Example	**Loop Antenna ,Half Wave**	**Yagi –Uda Antenna ,Rohmbic Antenna ,Ground**

			dipole Antenna	Antenna.

Q. No.	Sub Q. N.	Answers	Marking Scheme
5.		**Attempt any FOUR of the following:**	**16- Total Marks**
	a)	**Draw the circuit diagram of varactor diode FM modulator and explain its working.**	**4M**
	Ans:	• Varactor diode modulator is the direct method of FM generation wherein the carrier frequency is directly varied by the modulating signal. • A varactor diode is a semiconductor diode whose junction capacitance varies linearly with applied voltage when the diode is reverse biased. • Varactor diodes are used along with reactance modulator to provide automatic frequency correction for an FM transmitter. The varactor diode modulator circuit is shown in diagram for generation of FM wave.  . Varactor diode modulator • Varactor diode is arranged in reverse bias to offer junction capacitance effect. The modulating voltage which is in series with the varactor diode will vary the bias and hence the junction capacitance, resulting the oscillator frequency to change accordingly. • The external modulating AF voltage adds to and subtracts from the dc bias, which changes the capacitance of the diode and thus the frequency of oscillation.	**Diagram 2 marks and Explaination 2 Marks**

		• Positive alternations of the modulating signal increase the reverse bias on the varactor diode, which decreases its capacitance and increases the frequency of oscillation. • Conversely, negative alternations of the modulating signal decrease the frequency of oscillation. • The RFC and capacitor C b act as a filter which transmits only the AF variations to the varactor diode and blocks high frequency RF voltage from reaching the AF stage. • This method of FM generation is direct because the oscillator frequency is varied directly by the modulating signal, and the magnitude of frequency change is proportional to the amplitude of the modulating signal voltage.	
	b)	**Draw the block diagram of FM super heterodyne radio receiver with waveforms.**	**4M**
	Ans:	 **FM super heterodyne radio receiver with waveforms..**	Block diagram 2marks. Waveforms 2marks.
	c)	**Compare TRF and super heterodyne receivers.**	**4M**

	Ans:	Sr no	TRF radio receiver	Super heterodyne radio receiver	Each point 1 mark
		1.	Simple radio receiver.	It has complex operation because of frequency conversion	
		2.	Not a practical version	Practical version with some logical modification.	
		3.	It has problems like instability, insufficient adjacent frequency rejection and bandwidth variation.	Instability ,insufficient adjacent frequency rejection and bandwidth variation are not present because of additional components are present.	
		4.	Its selectivity and sensitivity is not uniform throughout its tuning range.	Its selectivity and sensitivity is uniform throughout its tuning range.	
	d)	The parameters of Transmission line are R = 50 Ω/ km, L= 1mH/km ,C = 0.1µf/km, G = 2µV/km. calculate characteristic impedance.			4M

Ans:

Assume $f = 800\ Hz$

$\omega = 2\pi f$

$= 2 \times \pi \times 800$

$= 5024$ rad/sec.

* Series Impedance

$Z = R + j\omega L$

$= 50 + j5024 \times 1 \times 10^{-3}$

$= 50 + j5024 \times 10^{-3}$

$= (50 + j5024)$

$\boxed{Z = 50.25 \angle 5.73^\circ}$

Shunt admittance

$Y = G + j\omega C$

$= (2 \times 10^{-6} + j5024 \times 0.1 \times 10^{-6})$

$= (2 + j5024 \times 0.1) \times 10^{-6}$

$\boxed{Y = 0.5024 \angle 89.77^\circ}$

Characteristics Impedance Z_0

$$Z_0 = \sqrt{\frac{Z}{Y}} = \sqrt{\frac{50.25 \angle 5.73^\circ}{0.5024 \angle 89.77^\circ}}$$

$\boxed{\therefore Z_0 = 10 \angle -84^\circ}$

Or

For Z 1.5 marks,for Y 1.5 marks ,for Zo 1 mark

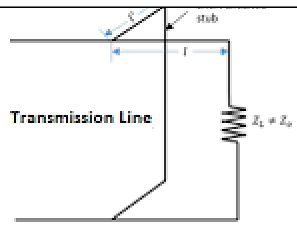
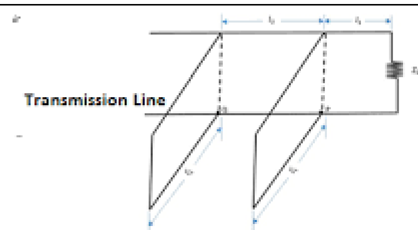
SUMMER– 19 EXAMINATION

Subject Name: Analog communication **Model Answer** **Subject Code:** 17440

		Given data :- $R = 50\,\Omega/km$ $L = 1\,mH/km = 1\times10^{-3}/km$ $C = 0.1\,\mu F/km = 0.1\times10^{-6}/km$ $G = 2\,\mu\mho/km = 2\times10^{-6}\,\mho/km$ Case 1 at Low frequency $Z_0 = \sqrt{\frac{R}{G}}$ $= \sqrt{\frac{50}{2\times10^{-6}}}$ $= 5\times10^{+3}$ Case 2 at high frequency. $Z_0 = \sqrt{\frac{L}{G}}$ $= \sqrt{\frac{1\times10^{-3}}{0.1\times10^{-6}}}$ $= 100$	**For case1 2marks,for case2 2 marks**

e) **Differentiate between single stub and double stub (four points).** **4M**

Ans: (Each point 1 mark)

SINGLE STUB	DOUBLE STUB
1.single stub ,one short ckted stub at one fixed points.	In double stub ckted stub at two short fixed points.
2.Single stub is used as single frequency.	Double stub is used as different frequencies.
3.It is used as low frequency range.	.It is used as high frequency range.
4.  Single Stub Matching	 Double Stub Matching

f) **List the types of micro-strip antennas. Explain any one of them.** **4M**

Ans: List the types of micro-strip antennas are as fallows.

(List 1 marks. Diagram 2 marks. Explaination 1marks.)

1) RECTANGULER
2) CIRCULER.
3) SQUARE .
4) ELIPTICAL.
5) TRINGULAR.

Rectangular Micro-strip Antenna:

Micro-strip Antennas are also called as patch antennas.it usually consist of a metal patch on top of a grounded dielectric substrate .The patch may be in a variety of shapes, but Rectangular and Circular are common.

Micro-strip or patch antennas are becoming increasingly useful because they can be printed directly onto a circuit board. Micro-strip antennas are becoming very widespread within the mobile phone market. Patch antennas are low cost, have a low profile and are easily fabricated.

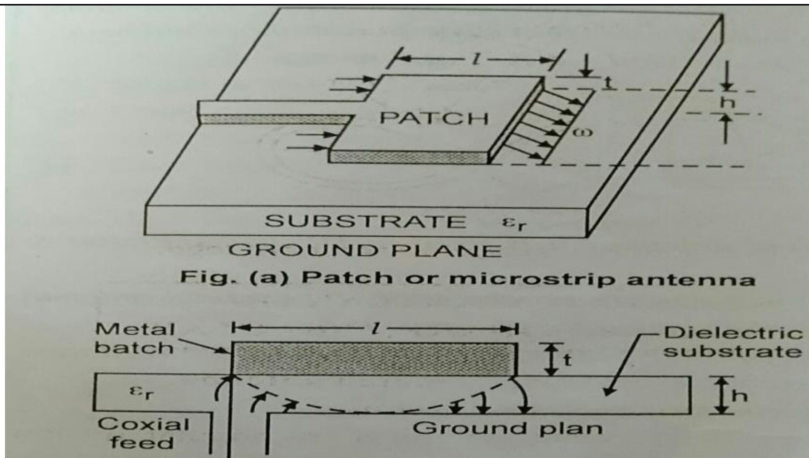
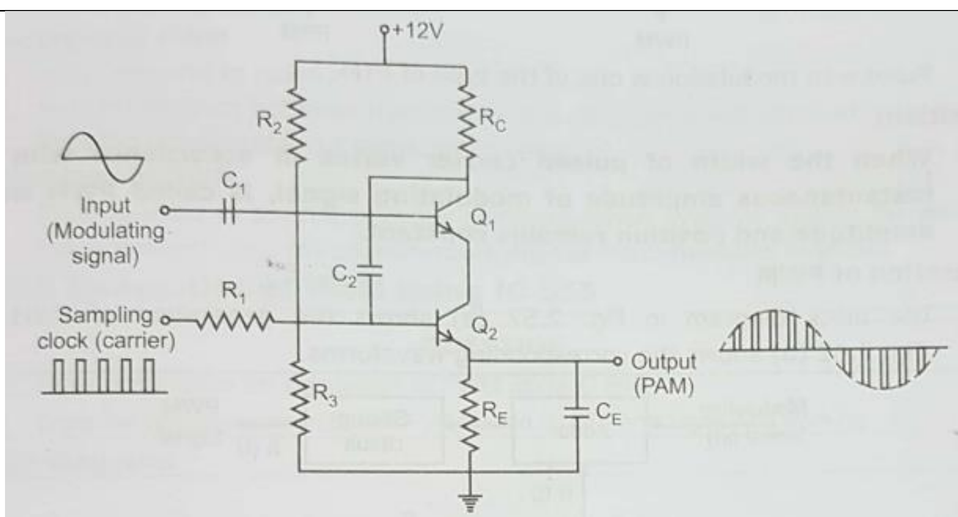
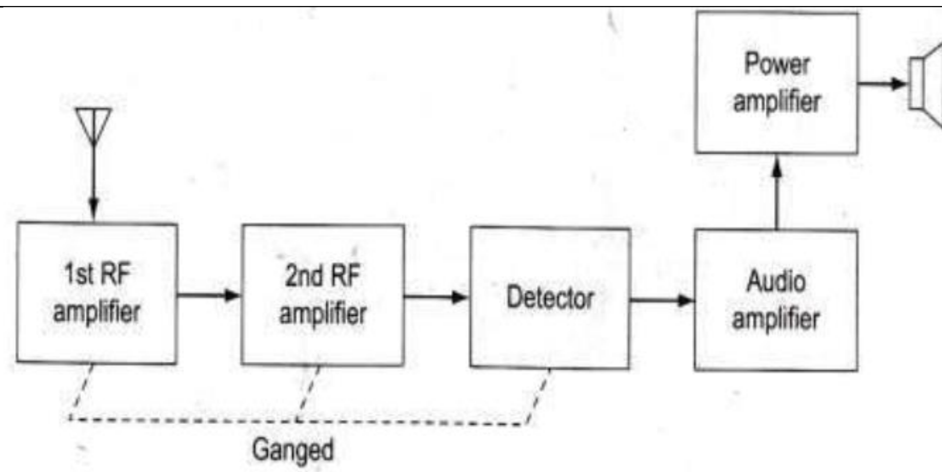
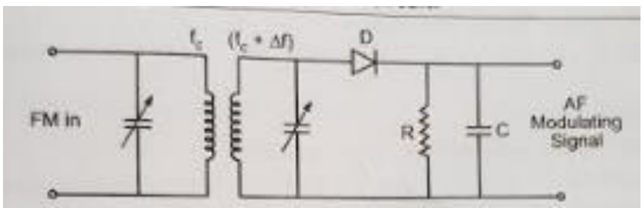


Fig. (a) Patch or microstrip antenna
Fig. (b) Side view of patch antenna

Q. No.	Sub Q. N.	Answers	Marking Scheme
6.		**Attempt any FOUR of the following::**	**16- Total Marks**
	a)	**Draw the diagram for PAM generation using transistors. Explain its working.**	**4M**
	Ans:		**2M**
		Explanation:-	**2M**

		1. Transistor Q1 is used in the active region so it has been provided with DC biasing to its base. 2. Modulating signal is applied to the base of transistor Q1 3. In the emitter of Q1, the other switch transistor Q2 is used with load resistor in its emitter. 4. Sampling clock as a carrier signal is given to drive its base and transistor Q2 is driven into saturation. 5. PAM output is taken from emitter of this switching transistor Q2. 6. When sampling pulse given to the transistor Q2 it becomes ON and we get pulse with amplitude same as modulating signal at that time. 7. In the time interval between sampling pulses output is zero. Thus we get the output as PAM.	
	b)	**Draw the TRF receiver block diagram and explain its working.**	**4M**
	Ans:	 **Explanation:-** 1. TRF receivers are simple and having high sensitivity. The AM transmission takes place in MW band and SW band. MW frequency range is 540KHz to 1640KHz. 2. The receiving antenna receives and collect signals from various transmitting stations. 3. 1st and 2nd RF amplifiers are tuned simultaneously to select and amplify the desired signal and reject all other signals. 4. Ganged tuning means simultaneous tuning of tuned circuits in all the RF amplifier stages	**Diagram 2M** **2M**

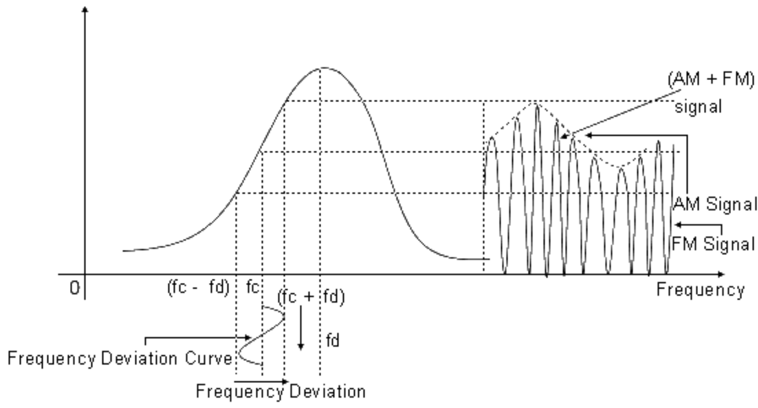
		using gang capacitor. 5. The detector is used to demodulate the amplified signal that means it converts modulated signal into original modulating signal. 6. The detected signal is amplified to a adequate power level to drive the loudspeaker. 7. The loudspeaker converts electrical signal into original sound information.	
	c)	**List the types of FM detector. Explain any one of them.**	**4M**
	Ans:	**Types of FM detector:-** **1.** Simple slope detector **2.** Balanced slope detector **3.** Phase discriminator(Foster seely discriminator) **4.** Ratio detector 5. PLL detector ***(NOTE: Explanation of any one type is to be considered for awarding the Mark to student)*** **Simple slope detector:-**  **Explanation:-** Consider a frequency modulated signal fed to a tuned circuit at primary and is tuned to frequency fc. The resonant frequency of secondary side tuned circuit is adjusted to (fc +Δf). The output pf this tuned circuit will have an amplitude that depends on the frequency deviation of the input signal. The circuit is detuned by an amount of Δf, to bring the carrier centre frequency to required point on the selectivity curve.	**Any two types** **1M** **Diagram 2M & Explanat ion(1M)** **Graphical represent ation is optional**

SUMMER– 19 EXAMINATION

Subject Name: Analog communication **Model Answer** Subject Code: 17440

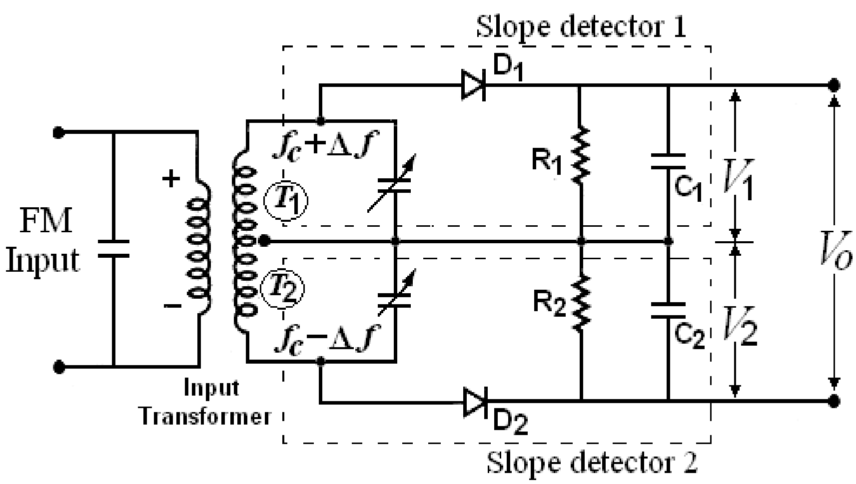
Frequency variations produces an output voltage proportional to the frequency deviations of the carrier.

This output voltage is applied to a diode detector with RC load of suitable time constant which gives original modulating signal at output.



Slope Detector Waveform

Balanced slope detector:-



Explanation:-

The circuit uses two slope detectors, connected back to back to the opposite ends of centre tapped transformer and hence fed 180 degree out of phase.

The circuit is divided into three tuned circuits. Primary side tuned circuit is tuned to centre frequency fc and secondary side top of tuned circuit is tuned above IF i .e. (fc + Δf) and bottom of tuned circuit is below IF i. e. (fc -Δf).

Each tuned circuit is connected to diode detector and RC load.

R_1C_1 and R_2C_2 are filters to remove RF ripple.

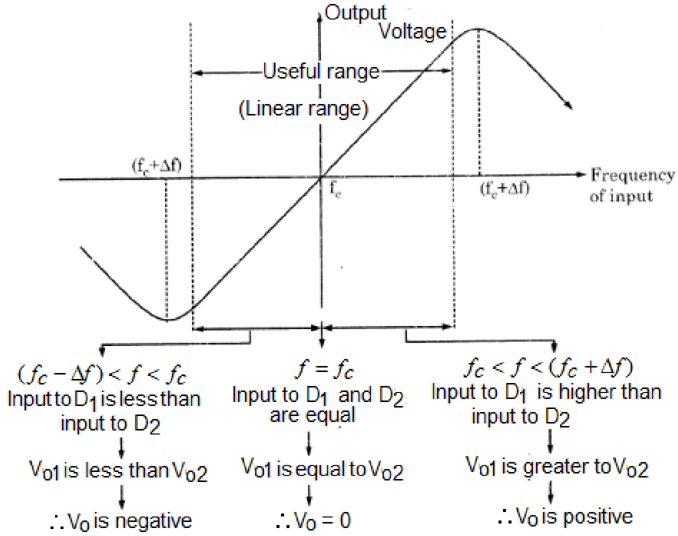
The final output voltage Vo is

$V_o = V_{o1} - V_{o2}$

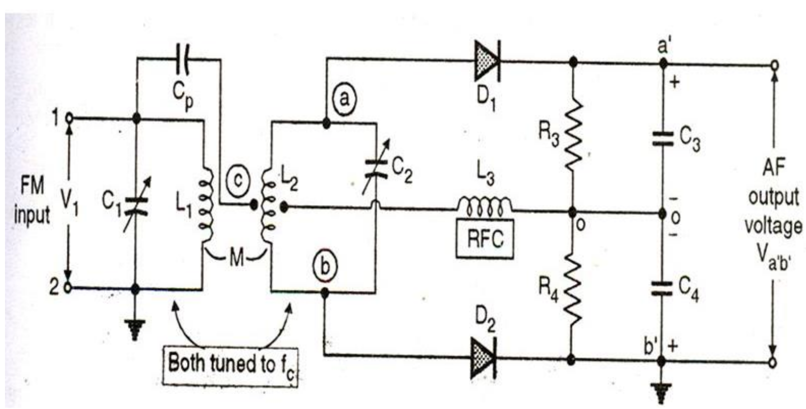
When fin = fc; $V_{o1} = V_{o2}$, hence $V_o = 0v$

When $f_c < f_{in} < (f_c + f)$; $V_{o1} > V_{o2}$;that is V_o is positive

When $(f_c - f) < f_{in} < fc$; $V_{o2} > V_{o1}$; that is V_o is negative



Circuit diagram of Foster Seely discriminator / 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-Seely 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-Seely 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.

Circuit diagram of Ratio detector:-

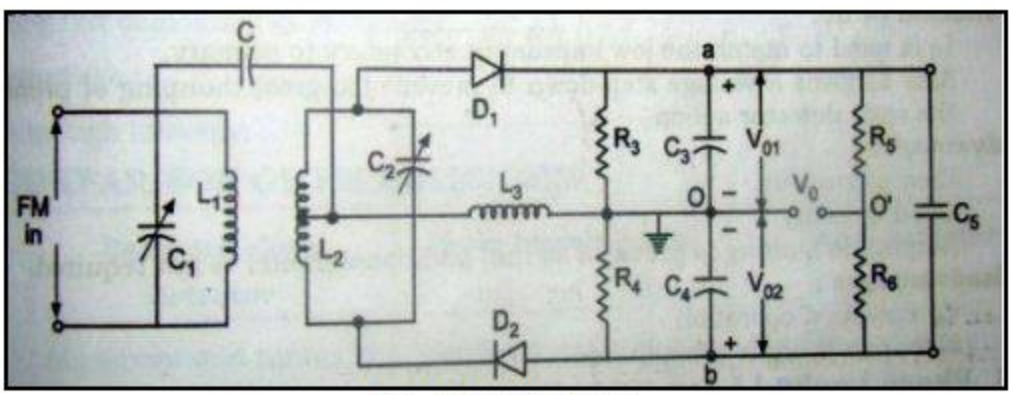


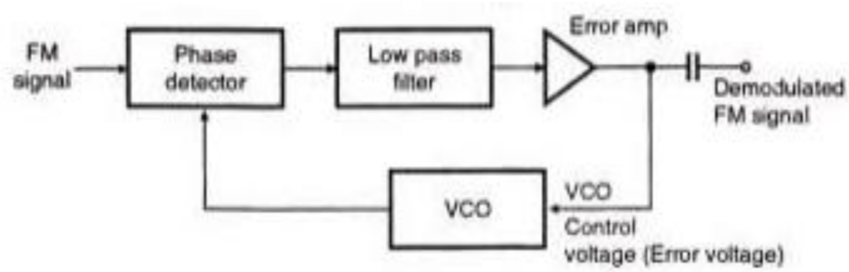
Fig. Ratio detector

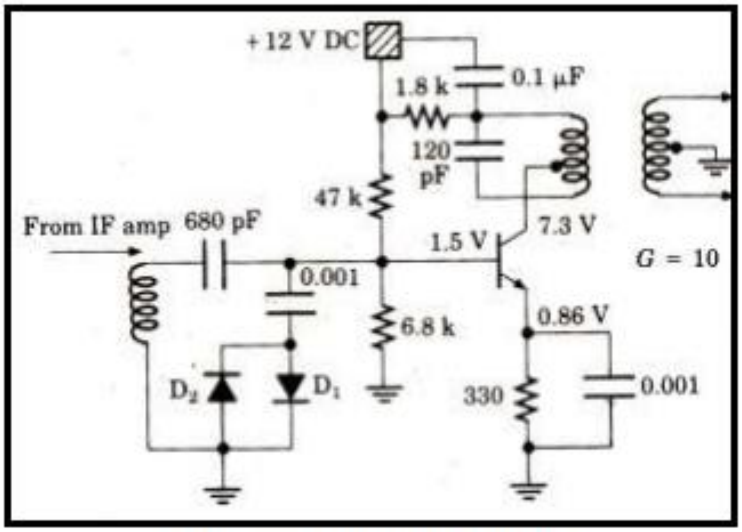
Explanation:- •

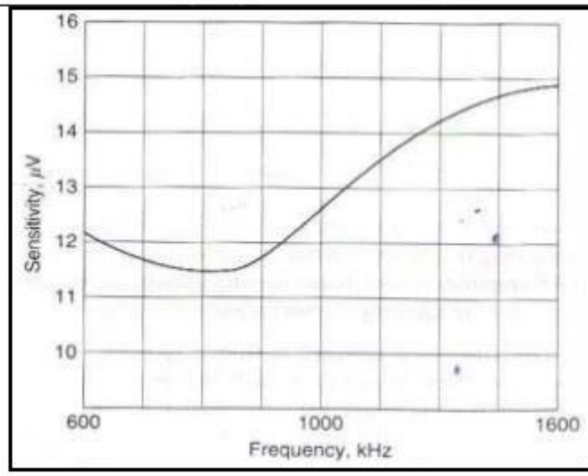
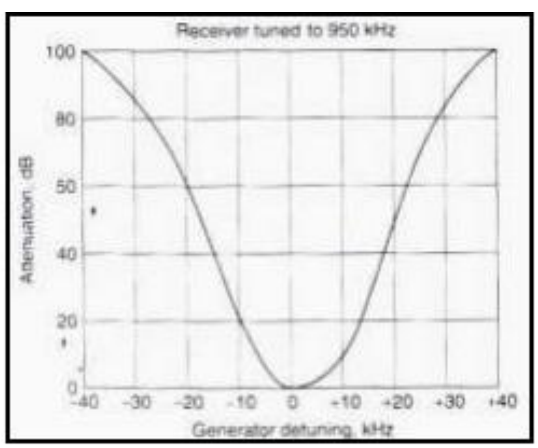
With diode D_2 reversed biased, point O is now positive with respect to b, so that V_{ab} is now sum voltage. •

Large capacitor C_5 is connected to keep the o/p sum voltage constant, even though the load current increases. Thus provides the amplitude limiting. •

Output voltage V_o is equal to half of the difference between the output voltages from the

		individual diodes. • Thus output voltage is proportional to the difference between the individual output voltages. L_3 matches the low impedance secondary to primary and provides voltage step down to prevent too great damping of primary by the ratio detector action. **PLL detector:-**  **Explanation:** 1. A PLL frequency demodulator requires no tuned circuits and automatically compensates for changes in the circuit frequency due to instability in the transmit oscillator. **2.** Therefore, if the PLL input is a deviated FM signal and the VCO natural frequency is equal to the IF center frequency, the correction voltage produced at the output of the phase comparator and fed back to the input of the VCO is proportional to the frequency deviation. If the IF amplitude is sufficiently limited prior to reaching the PLL and the loop is properly compensated	
	d)	**Draw the circuit diagram of limiter and explain its working.**	**4M**
	Ans:	**Circuit diagram of amplitude limiter:-**	**2M**

		 **Figure:- Amplitude limiter** **Explanation:-** 1. In frequency modulation, the signal amplitude is held constant while the carrier frequency is varied. 2. Any noise that contaminates the signal will manifest itself as a change in amplitude. 3. The first limiter is a pair of back-to-back diodes D_1 and D_2. 4. 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 -0.7VpK of the input signal. 5. The second form of limiting in the figure is the transistor amplifier itself, which has a gain of 10. 6. When the base signal reaches 1.4V p-p, the collector voltage becomes ten times larger. 7. The collector and emitter currents increase, raising the emitter voltage at the same time that the collector is going lower. **8.** 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	**2M**
	e)	**Explain the following characteristics of AM radio receiver:** **(i) Sensitivity** **(ii) Selectivity.**	**4M**

	Ans:	**Sensitivity:-** The ability to amplify the weak signals is called sensitivity. It is the function of overall receiver gain. Sensitivity of radio receiver is decided by the gain of the RF IF amplifiers. The sensitivity is expressed in microvolt or millivolt.  **Fig. Sensitivity** **Selectivity:-** It is the ability of radio receiver to reject the unwanted signals. Selectivity depends on IF amplifier. Higher the Q of the tuned circuits better is the selectivity. It is used to distinguish between two adjacent carrier frequencies. Selectivity curve shows the how perfectly the receiver is able to select the desired carrier frequency and reject other frequencies.  **Fig. Selectivity:**	**2M each** **Response is optional**
	f)	**Define the following terms:** **(i) Polarization**	**4M**

		(ii) Antenna gain **(iii) Antenna resistance** **(iv) Directivity**	
	Ans	**i) Polarization:-** It is defined as the direction of electric field vector in the EM wave radiated by the transmitting antenna. **ii) 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 P_{ref} = power density at same point with the reference antenna **iii)Antenna Resistance:-** Radiation resistance is the AC 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. It is given by, $$R_r = \frac{P_{rad}}{i^2}$$ Iv) **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	**1M each**