MODEL ANSWER

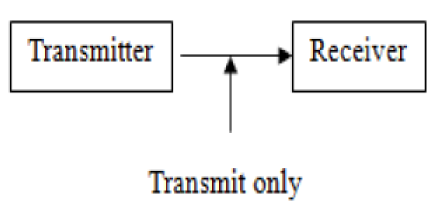
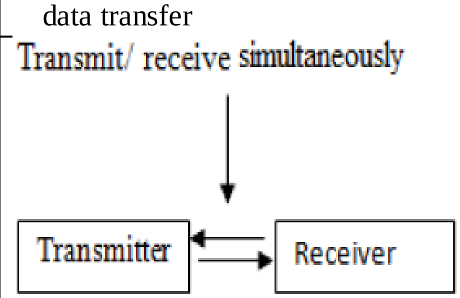
SUMMER– 17 EXAMINATION

Subject Title: Analog Communication Code: **17440**

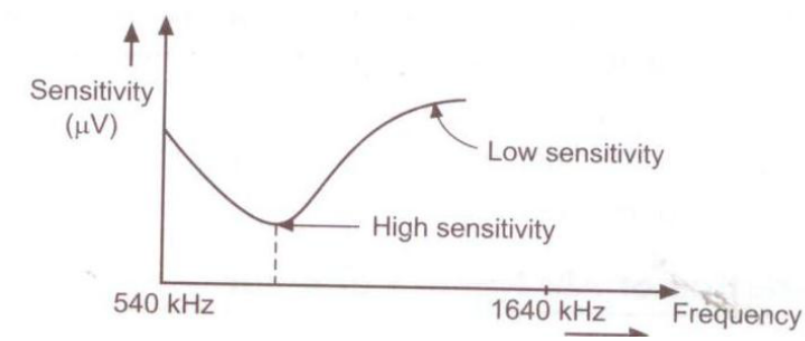
Important Instructions to examiners:

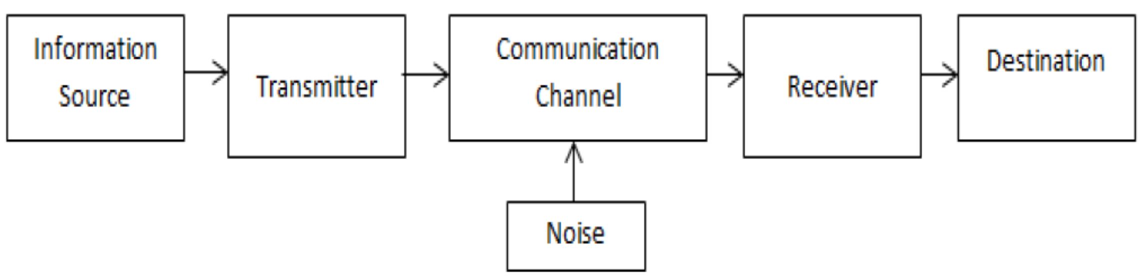
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling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

Q. No.	Sub Q.N.	Answer	
Q.1	**a)**	**Attempt any <u>SIX</u> of the following:**	**12-Total Marks**
	i)	**Compare between simplex and full duplex communication on the basis of:** **1) Definition** **2) Sketch**	**2M**
	Ans:	(see comparison table below)	**(Two points – 2 M)**

SR.NO	SIMPLX COMMUNICATION	FULL DUPLEX COMMUNICATION
Definition	It's a one way communication (unidirectional)	It's a two way Communication (bidirectional) with simultaneous data transfer
Sketch		

	ii)	**State the significance of modulation index in AM transmission.**	**2M**
	Ans:	**i)** m< 1 • If m < 1 or if the percentage of modulation is less than 100% the this type of modulation is known as under modulation • The amplitude of modulating signal less than carrier amplitude, no distortion will occur.	

		ii) m = 1 If m = 1 or percentage of modulation is 100 this type modulation is 100% modulation The ideal condition for AM is m =1, since this will produce the greatest output at the receiver with no distortion **iii)m>1** If m > 1 or if the percentage of modulation is greater than 100% the this type of modulation is known as over modulation the modulating signal being of greater amplitude part of its information is lost in the process of modulation which is undesirable.	
	iii)	**Define modulation index in FM.**	**2M**
	Ans:	**Modulation Index of FM:** It is defined as the ratio of Frequency Deviation (δ) to the modulating signal frequency (fm). **OR** Modulation Index of FM is defined as mf = δ /fm=Frequency Deviation/modulating frequency	**(Correct Definition – 2 M)**
	iv)	**Define sensitivity with graph.**	**2M**
	Ans:	**Sensitivity:** The ability to amplify weak signals is called sensitivity. The sensitivity is expressed in millivolt. It is often defined in terms of the input voltage that must be applied at the input of the receiver to obtain a standard output power. The sensitivity curve indicates that the receiver input required to obtain the same standard output changes with carrier frequency. **Graph:**  	**1M** **1M**
	v)	**State two disadvantages of TRF receiver over superheterodyne receiver.**	**2M**
	Ans:	**Disadvantages of TRF Receiver:** 1. Instability due to oscillatory nature of RF amplifier. 2. Variation in bandwidth over tuning range. 3. Insufficient selectivity at high frequencies 4. Poor adjacent channel rejection capability	**(Any Two correct drawbacks – 1 M each)**
	vi)	**Define VSWR with refernce to standing waves.**	**2M**
	Ans:	**Voltage Standing Wave Ratio:** The voltage standing wave ratio (VSWR) is the ratio of max voltage to min voltage. VSWR= V_{MAX} / V_{MIN}	**(Definition- 2M)**

	vii)	**Define critical frequency w.r. to wave propagation.**	**2M**
	Ans:	**i) 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 90^0 (normal) to it. The critical frequency for F_2 layer is between 5 to 12 MHz	**(Definition- 2M)**
	viii)	**Define fading w.r. to wave propagation.**	**2M**
	Ans:	**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.	**(Definition- 2M)**
	B)	**Attempt any <u>TWO</u> of following:**	**8M**
	i)	**Draw the block diagram of a basic communication system. State the function of each block.**	**4M**
	Ans:	 **Transducer:** A transducer is usually required to convert the output of a source into an electrical signal that is suitable for transmission. For example, a microphone serves as the transducer that converts an acoustic speech signal into an electrical signal. **Transmitter:** The transmitter converts the electrical signal into a form that is suitable for transmission through the physical channel or transmission medium. For example, in radio and TV broadcast, the transmitter must translate the information signal to be transmitted into the appropriate frequency range that matches the frequency allocation assigned to the transmitter. There is some internal noise available inside the transmitter section due to the electronic circuits used which is called thermal noise due to heat dissipation and other noises etc. **Channel:** The communications channel is the physical medium that is used to send the signal from the transmitter to the receiver. In wireless transmission, the channel is usually the atmosphere (free space). **Receiver:** The function of the receiver is to recover the message signal contained in the received signal. if the message signal is transmitted by carrier modulation, the receiver performs carrier demodulation in order to extract the message from the sinusoidal carrier. There is some internal noise available inside the receiver section due to the electronic circuits used which is called thermal noise due to heat dissipation and other noises etc. **Output Transducer:** The output transducer converts electrical signal into original form, e.g. Loudspeaker etc.	**(Block diagram – 2 M, working principle – 2 M)**
	ii)	**Compare sky wave propagation and space wave propagation w.r. to following points:**	**4M**

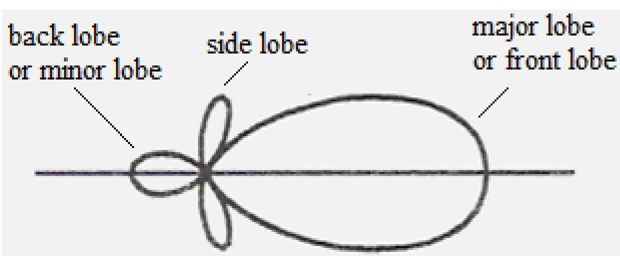
1) **Applications**
2) **Polarization**
3) **Frequency range**
4) **Effect of fading**

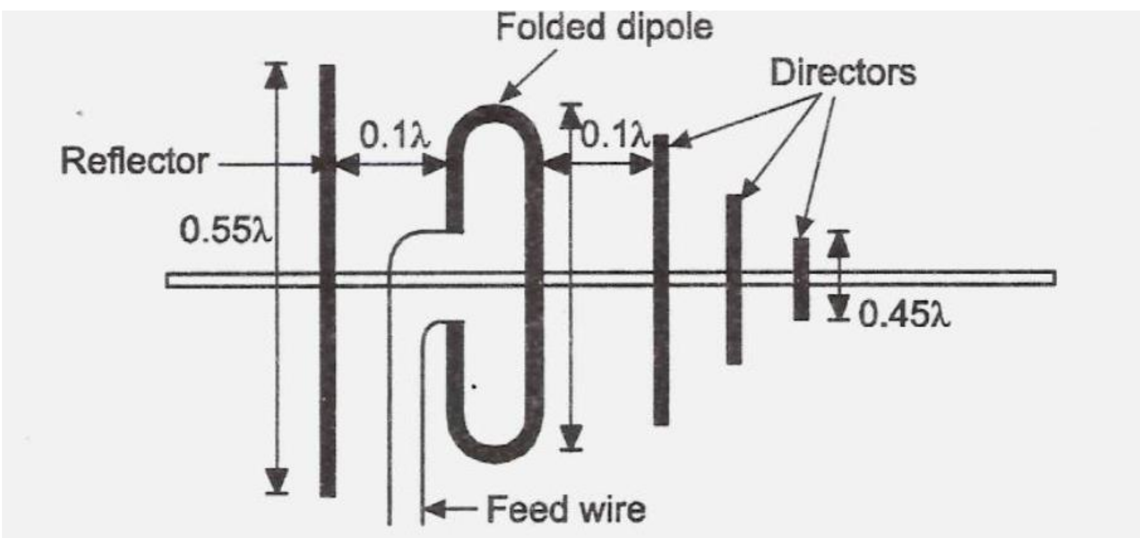
Ans: (1M-Each comparison)

Sr.No	Parameters	Sky wave propagation	Space wave propagation
1	Applications	Radio Broadcasting (SW Range)	Satellite communication, TV , frequency modulation broadcast, RADAR system etc
2	Polarization	Vertical	Horizontal
3	Frequency range	3 MHz to 30 MHz	frequencies above 30 MHz
4	Effect of fading	Severe	Less

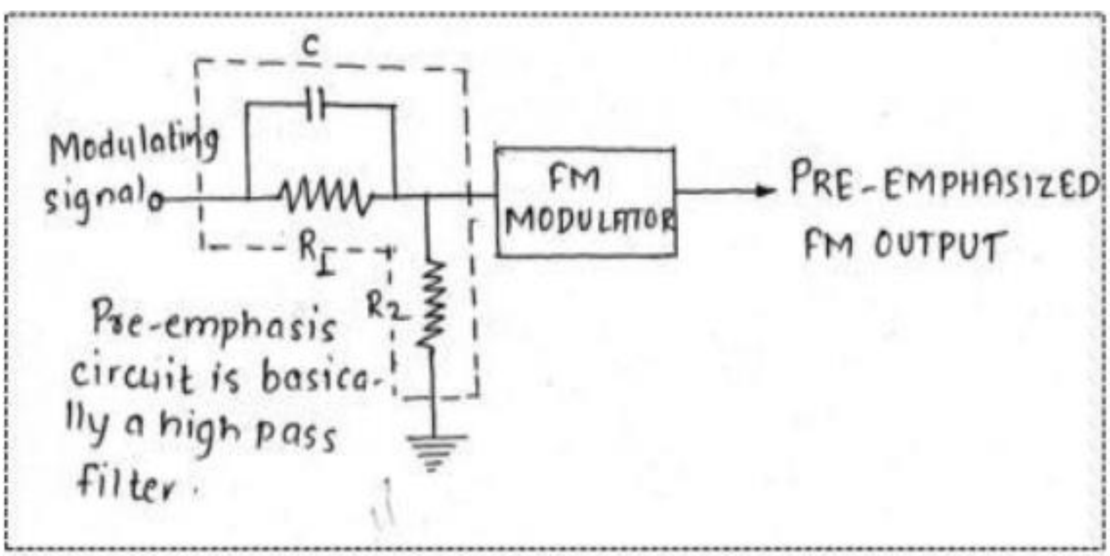
iii) **Draw radiation pattern of yagi-uda antenna. Explain its working principle.** 4M

Ans: (Radiation pattern-2M, Working principle-2M)





Explanation- A Yagi–Uda antenna, commonly known as a Yagi antenna, is a directional antenna consisting of multiple parallel elements in a line, usually half-wave dipoles made of metal rods.
A Yagi–Uda antenna, commonly known as a Yagi antenna, is a directional antenna consisting of multiple parallel elements in a line, usually half-wave dipoles made of metal rods. Yagi–Uda antennas

		consist of a single driven element connected to the transmitter or receiver with a transmission line, and additional parasitic elements: a so-called reflector and one or more directors.	
Q 2		**Attempt any <u>FOUR</u> of the following:**	**16M**
	a)	**State and explain the concept of transmission bandwidth.**	**4M**
	Ans:	• Bandwidth is defined as the portion of the electromagnetic spectrum occupied by a signal • We may also define the bandwidth as the frequency range over which as information signal is transmitted. • Bandwidth is the difference between the upper and lower frequency limits of the signal. • We already know different types of baseband signals such as voice signal, music signal, t.v signal etc. Each of these signals will have it's own frequency range. This frequency range of a signal is knows as it's bandwidth. • For example the range of music signal is 20 H_Z to 15 $KH_{Z.}$ Therefore the bandwidth is(f2-f1) • BW= f2 - f1= 15000-20=14980H_z	**(Any relevant examples gives mark) (State - 2M, Explanation - 2M)**
	b)	**Explain pre-emphasis and de-emphasis networks used in FM transmission and reception.**	**4M**
	Ans:	**<u>Pre-emphasis:</u>** 	**(Pre-emphasis-2 M)** .

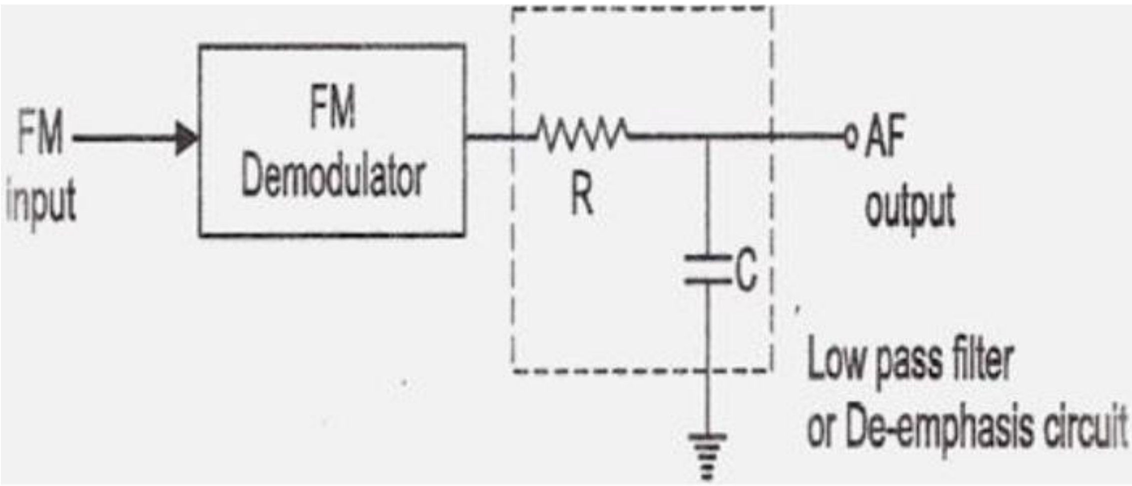
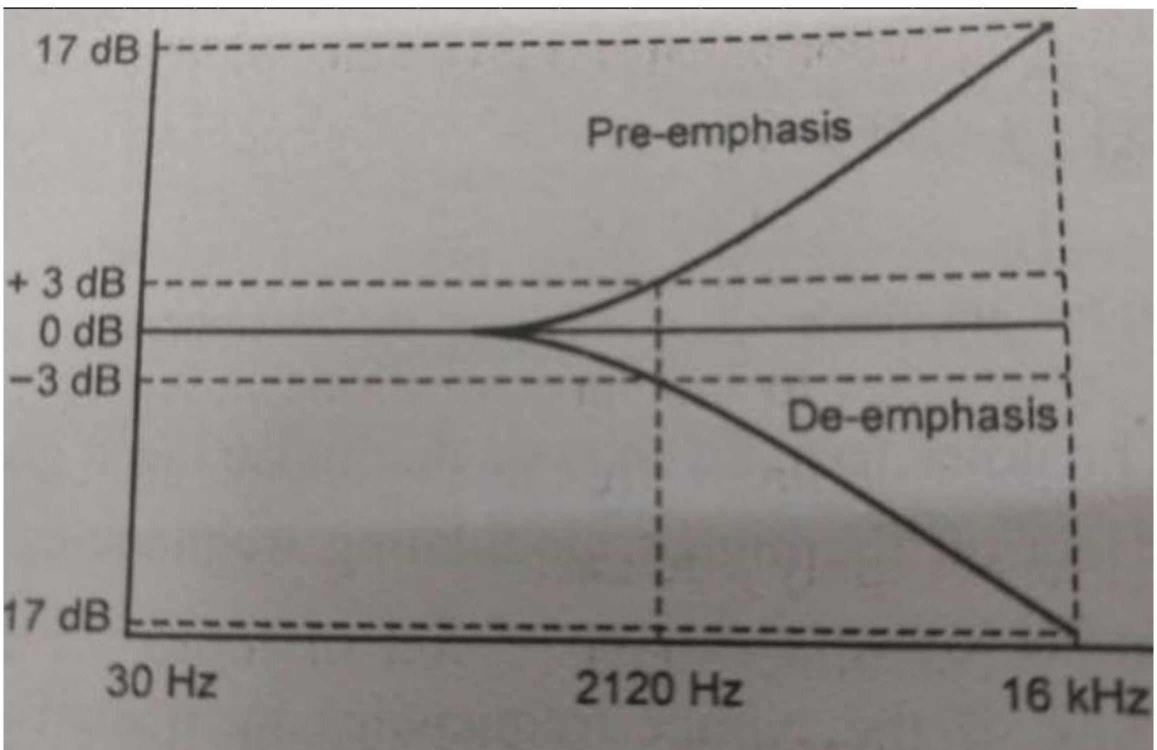
		• The artificial boosting of higher audio modulating frequencies in accordance with prearranged response curve is called pre-emphasis. • In FM, the noise has a greater effect on the higher modulating frequencies. This effect can be reduced by increasing the value of modulation index (mf). • This can be done by increasing the deviation and can be increased by increasing the amplitude of modulating signal at higher frequencies. **De-emphasis:**  	**(De-emphasis-2 M)**

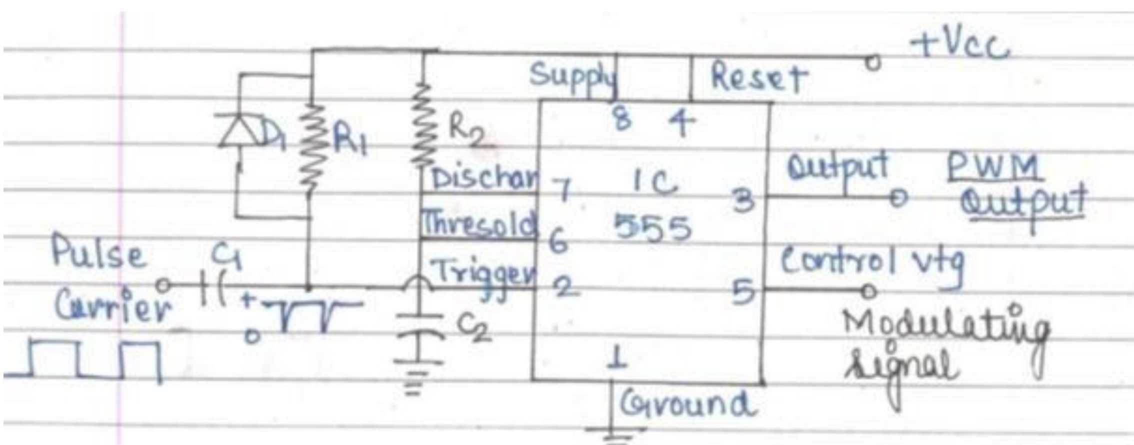
Fig. Emphasis curves

In FM, noise has greater effect on higher modulating frequencies than the lower one. Therefore the higher modulating frequencies have to be boosted artificially at the transmitter before modulation and corresponding cut off at the receiver after demodulation.

This boosting of higher modulation frequencies at the transmitter in order to improve noise immunity is called as pre-emphasis. The compensation at the receiver ie. Attenuation of this higher modulation frequency after detector at receiver is called as De-emphasis, which is basically a low pass filter.

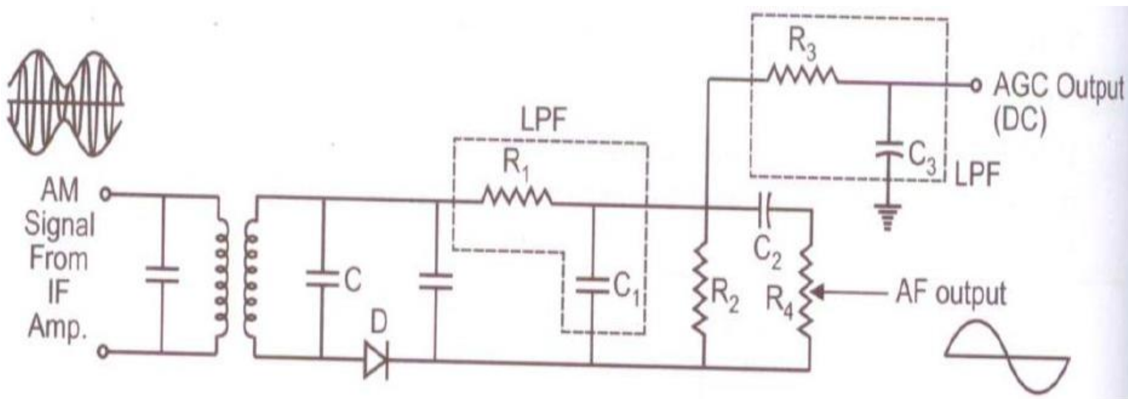
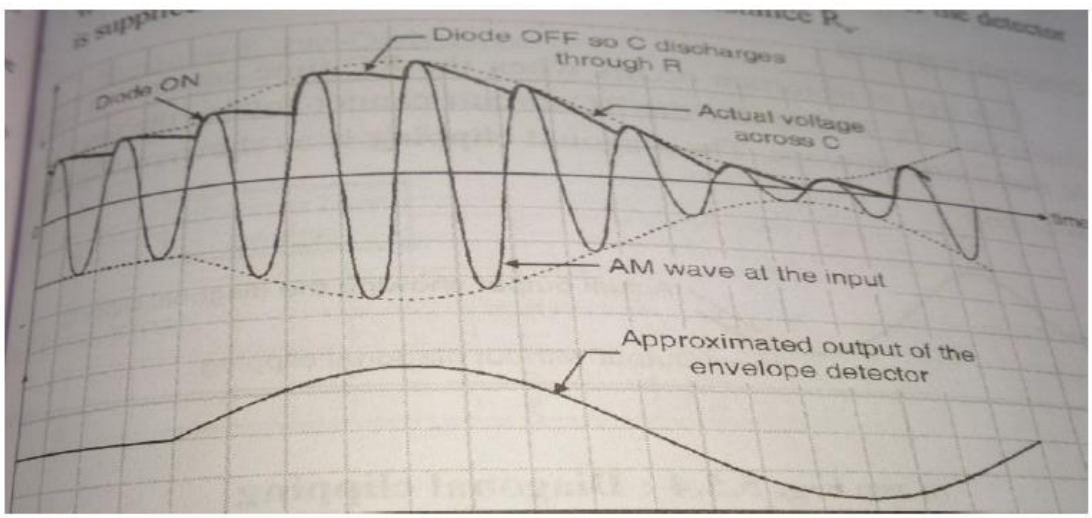
Pre-emphasis is used at transmitter and de-emphasis at receiver to o\improve the noise immunity.

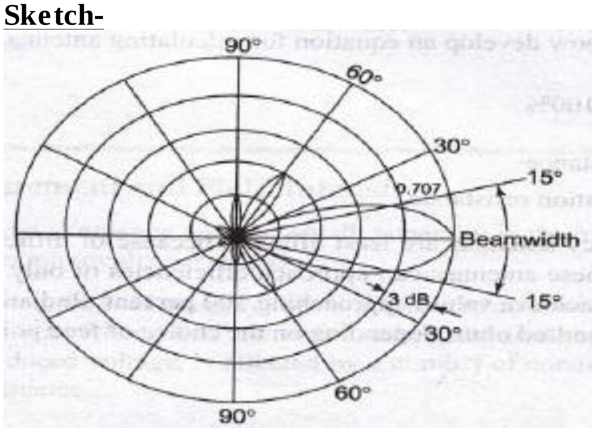
c)	**Draw and explain the generation of PWM using IC555.**	**4M**
Ans:	**Circuit Diagram -**	**(Circuit Diagram – 2 M, Operation – 2 M)**



Operation:

1. The timer IC555 is operated in Monostable mode.
2. The negative going carrier pulses are to the differentiator formed by R1 & C1. The differentiator produces sharp negative pulses which are applied to trigger input pin (2) of IC 555.
3. These triggering decides the starting instants (leading edge) of the PWM pulses. The PWM pulses go high at the instants of arrival of these triggering pulses.
4. The termination of the pulses is dependent upon,
   - R2, C2 discharge time
   - The modulating signal applied to control input pin (5)
5. The modulating signal applied to pin no (5) will vary the control voltage to IC 555 in accordance to the modulating voltage.
6. As this voltage increases, the capacitor C2 is allowed to charge through R2 up to a higher voltage & hence for a longer time (as R2 C2 time constant is fixed). The width of the corresponding output pulse will increase due to this action. As soon as VC2 is equal to the control voltage, the PWM pulse goes to zero.
7. Thus PWM signal is generated at the output pin (3) of IC555 as Monostable

		multivibrator	
	d)	**Draw the circuit diagram of practical AM diode detector. Sketch its i/$_p$ and o/$_p$ waveforms.**	**4M**
	Ans:	  	**(Diagram-2 M,Waveforms-2 M)**
	e)	**Explain how different types of losses affect the use of transmission line in different applications.**	**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:-** • It 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.	***Note:- Explanation of any two losses and its effect is expected***

		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	
	f)	**Define and explain the term beam width related to antenna with a sketch.**	**4M**
	Ans:	**<u>Definition:</u>** • 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 30^0 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.) **<u>Sketch-</u>**  	**(Definition Beam width- 2M)** **(Sketch- 02 M)**
Q. 3		**Attempt any <u>FOUR</u> of the following:**	**16M**
	a)	**The equation of FM wave is given by** $I_{FM} = 20 \sin(10^8 t + 4 \sin 10^3 t)$ **Calculate:** **(i) Carrier frequency**	**4M**

		(ii) Modulating frequency **(iii) Modulation index** **(iv) Power dissipated in 10 Ω resistor.**	
	Ans:	FM signal is represented as $e_{FM} = V_c \sin(\omega_c t + m_f \cos \omega_m t)$ Given FM = $20 \sin(10^8 t + 4 \sin 10^3 t)$ $V_c = 20$ $\omega_c = 10^8$ $2\pi f_c = 10^8$ $f_c = \frac{10^8}{2\pi} = 15.9$ MHz Carrier frequency: 15.9 MHz $\omega_m = 10^3 = 1000$ $2\pi f_m = 1000$ $f_m = \frac{1000}{2\pi} = 159$ Hz Modulation index $m_f = 4$ Power dissipated in 10Ω resistor $P = \frac{V_{rms}^2}{R} = \frac{(V_c/\sqrt{2})^2}{R} = \frac{(20/\sqrt{2})^2}{10} = 20$ Watts ∴ Power dissipated = 20 watts	**(Each parameter-1M)**
	b)	**Draw circuit diagram of transistor reactance modulator. Explain its working.**	**4M**
	Ans:		**(Circuit Diagram:2 M)**

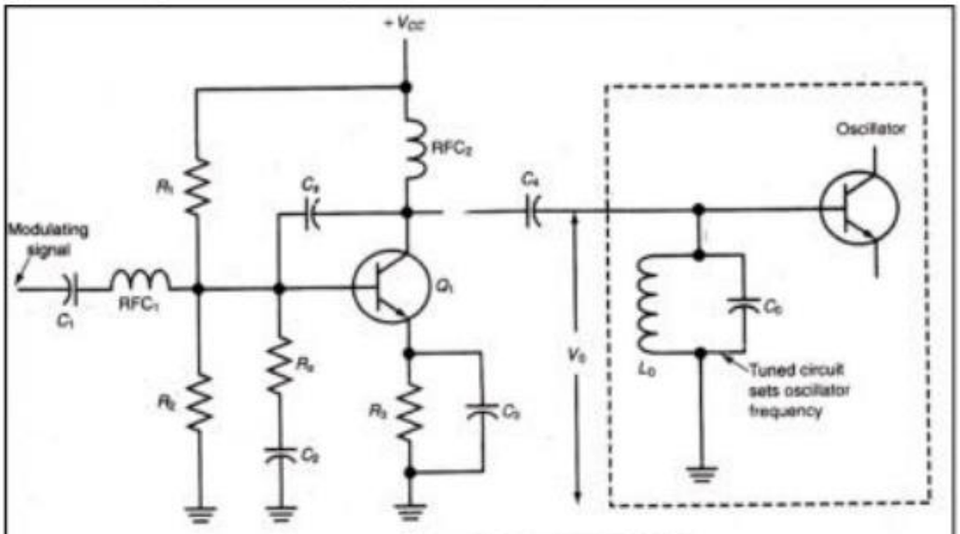


Fig. A reactance modulator.

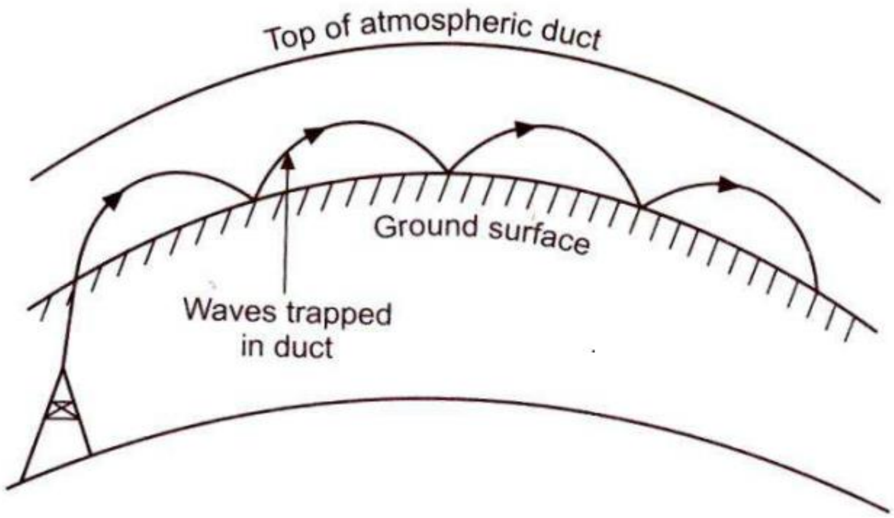
(Explanation -2M)

Explanation-

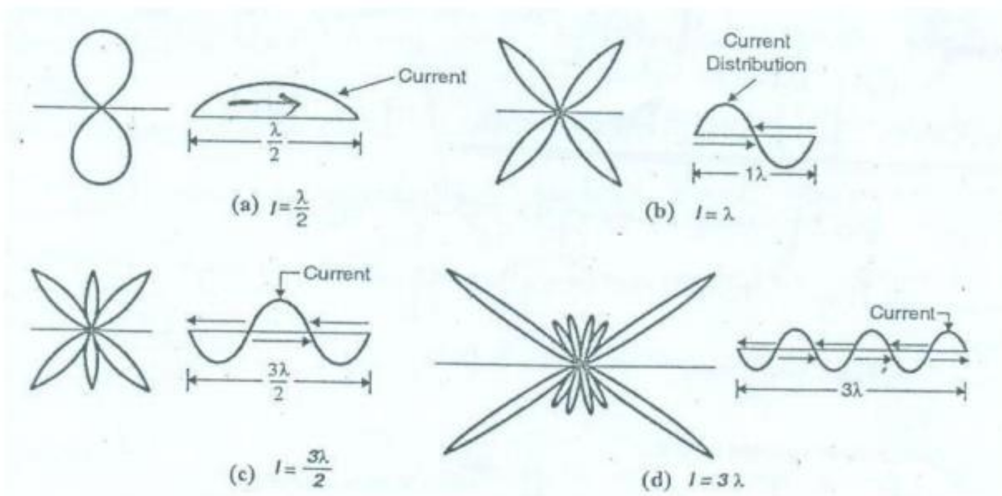
- A reactance modulator is illustrated in figure. It is basically a standard common-emitter class A amplifier. Resistors R1 and R2 from a voltage divider to bias the transistor into the linear region. R3 is an emitter bias resistor.
- The oscillator signal from the RC phase-shift circuit made up of Cs and Rs.
- The value of Cs is chosen so that its reactance at the oscillator frequency is about 10 or more times of the value of Rs. if the reactance is much greater than the resistance, the circuit will appear predominantly capacitive; therefore the current through the capacitor and Rs will lead the applied voltage by about 90◦.
- Since the collector current is in phase with the base current, which in turn is in phase with the base voltage, the collector current in Q1 leads the oscillator voltage V0 by 90 ◦. Of course, any circuit whose current leads its applied voltage by 90◦ looks capacitive to the source voltage.
- The modulating signal is applied to the modulator circuit through C1 and RFC1. The RFC helps keep the RF signal from the oscillator out of the audio circuit from the modulating signal usually comes. The audio modulating signal will vary the base voltage and current of Q1 according to the intelligence to be transmitted.
- The collector current will also vary in proportion. As the collector current amplitude varies, the phase shift angle changes with respect to the oscillator, voltage, which is interpreted by the oscillator as a change in the capacitance. So as the modulating signal changes, the effective capacitance of the circuit varies and the oscillator frequency is varied accordingly
- An increase in capacitance lowers the frequency, whereas a lower capacitance increases the frequency. The circuit produces direct frequency modulations.

c) **A superheterodyne radio receiver with an IF of $455KH_Z$ is turned to $1000KH_Z$. Find:**
(i) Image frequency
(ii) Local oscillator frequency — **4M**

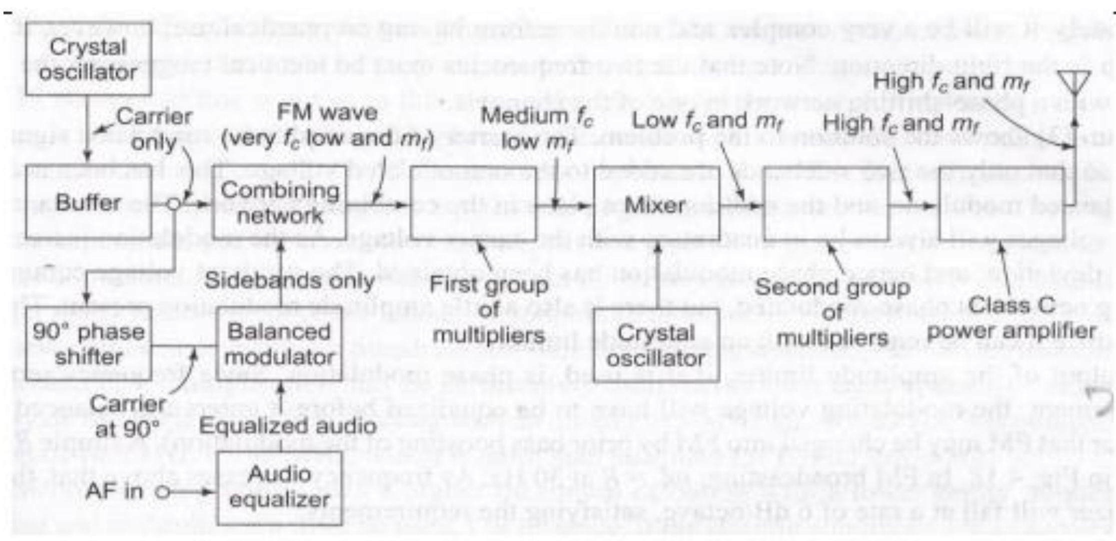
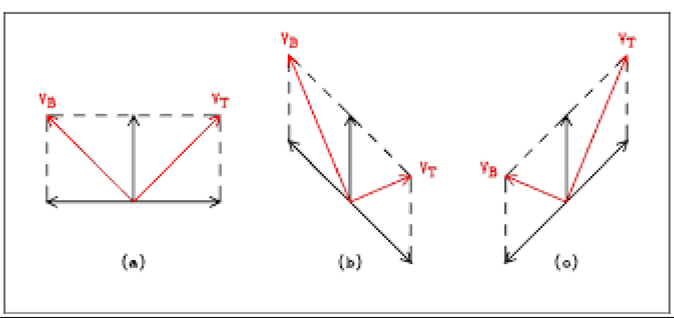
	Ans:	Given Intermediate Frequency fi=455KHz Signal frequency =fs=1000KHz Local oscillator frequency fo=fs+fi Fo=1000KHz+455KHz =1455KHz Image frequency is the input frequency which produces the same intermediate frequency fsi=fs+2fi =1000KHz+2*455KHz =1910KHz	**(Image frequency - 2M , Local oscillator frequency- 2M)**
	d)	**A loss less transmission line of 80 Ω characteristics impedance connects a 100KHz generator to 120 Ω load. Calculate reflection coefficient and VSWR.**	**4M**
	Ans:	Ans: Reflection coefficient 2M VSWR = 2M Given characteristic impedance $Z_0 = 80\Omega$ Load impedance $Z_L = 120\Omega$ $VSWR = \frac{Z_L}{Z_0} = \frac{120}{80} = 1.5$ $\therefore VSWR = 1.5$ $VSWR = \frac{1+K}{1-K}$ where K is the reflection coefficient $K = \frac{VSWR-1}{VSWR+1} = \frac{1.5-1}{1.5+1} = 0.2$	**(Reflection coefficient - 2M VSWR- 2M)**
	e)	**Explain duct propagation with neat sketch.**	**4M**

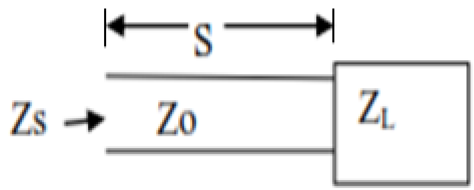
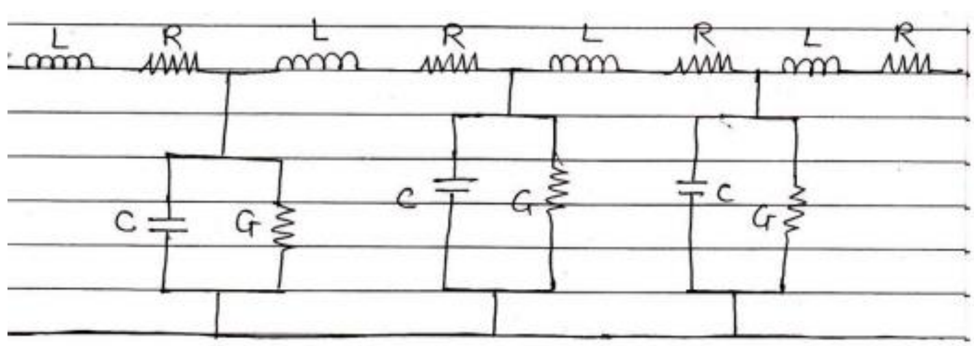
	Ans:	 • Duct propagation is a special type and used for very high microwave frequencies. • New phenomenon which occurs in super-refraction, also known as ducting. • As the height above earth increases, the air density decreases and refractive index increases. • Under certain special atmospheric conditions, a layer of warm air may be trapped above cooler air, often over the surface of water. • So that refractive index will decrease far more rapidly with height than is usual. • This happens near ground within 30 m of it. • Due to this rapid reduction of refractive index, the microwaves completely bend back towards earth surface as shown in fig. • Microwaves are thus continuously refracted in duct and reflected back by the ground, so that they are propagated around the curvature of the earth for distances which many of times exceed 1000km. • The main requirement of formation of atmospheric ducts is the so-called temperature inversion. • Temperature inversion is the increase of air temperature with height, instead of the usual decrease in temperature of 6.50C/km in the standard atmosphere. • The Duct propagation is used for very high frequencies in GHz range.	**(Diagram:1 M,** **Explanation :3M)**
	f)	**Draw radiation pattern for following resonant dipoles for following lengths:** **(i) $l = \lambda/2$** **(ii) $l = \lambda$** **(iii) $l = 3\lambda/2$** **(iv) $l = 3\lambda$**	**4M**
	Ans:		**(Each correct pattern-1M)**

where l = length of dipole

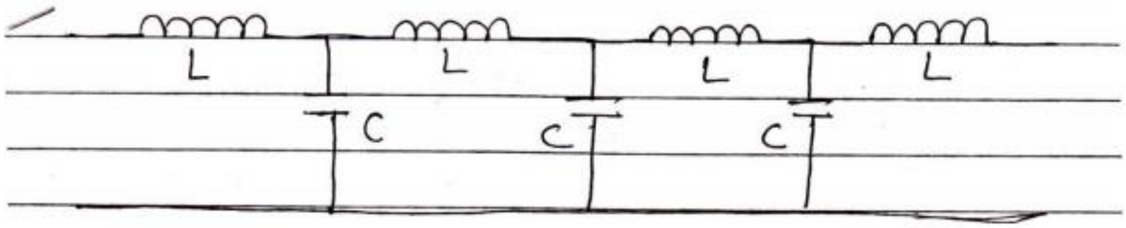


Q. 4		**Attempt any <u>FOUR</u> of following:**	**16M**
	a)	**A 10 kW carrier wave is amplitude modulated of 75% depth of modulation by a modulating signal. Calculate side band power, total power and transmission efficiency of AM wave.**	**4M**
	Ans:	Given carrier power 10KW Modulation Index 0.75 Total Power Pt=Pc(1+m 2 /2) = 10K(1+(0.75) 2 /2) =12.8KW Power in side bands=Total Power-Carrier Power =Pt-Pc =12.8 KW -10 KW =2.8KW The percent transmission efficiency is given by , $\eta = \frac{m^2}{2+m^2}$ x 100% = $(0.75)^2/(2+0.75^2)*100$ =21.95%	**(Side band power=1½ M, Total power=1½ M, Transmission efficiency=1 M)**
	b)	**With suitable diagram, explain Armstrong method of FM generation. Draw phasor**	**4M**

		diagram.	
	Ans:		**(Circuit Diagram-2M)**
		Explanation: • The crystal oscillator generates the carrier at low frequency typically at 1 MHz This is applied to the combining network and a 90o phase shifter. • The modulating signal is passed through an audio equalizer to boos the low modulating frequencies for the reason discussed earlier. The modulating signal is than applied to a balanced modulator. • The balanced modulator produces two sidebands such that their resultant is 90o phase shifted with respect to the un-modulated carrier • The un-modulated carrier and 90o shifted sidebands are added in the combining network. • As discussed earlier, at the output of the combining network we get FM wave. This FM wave has a low carrier frequency fc and low value of the modulation index mf. • The carrier frequency and the modulation index are then raised by passing the FM wave through the first group of multipliers. The carrier frequency is then raised by using a mixer and then fc and mf both are raised to the required high values using the second group of multipliers. The effect of multiplication and mixing is as discussed earlier. • The FM signal with high fc and high mf is then passed through a class C power amplifier to raise the power level of the FM signal.	**(Explanation -1M)**
		Phasor Diagram: 	**(Phasor Diagram-1 M)**
	c)	**Explain how quarter wave transformer is used for impedance matching.**	**4M**
	Ans:	In all applications of transmission line, it is required that the load be matched to line,	**4M**

		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  $Z_s = \frac{Z_o^2}{Z_L}$ 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 ratio 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 ZL. If ZL = Zo then it acts as 1 : 1 transformer. If ZL > Zo then it acts as a Step down transformer If ZL < Zo then it acts as a Step up transformer	
	d)	**Draw the equivalent circuit of transmission line and explain the same.**	**4M**
	Ans:	**General equivalent circuit of transmission line:**  **<u>OR</u>**	**Equivalent Ciruit:2M**

RF Equivalent Circuit of transmission line:-

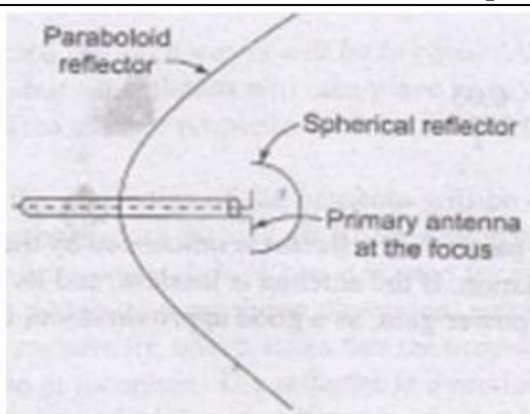


Explanation : — **Explanation :2M**

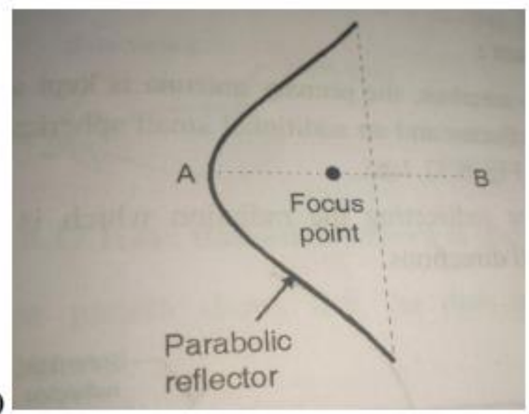
Since each conductor has a certain length and diameter, it will have a resistance and an inductance. Since there are two wires close to each other, there will be capacitance between them. The wires are separated by a medium called dielectric which cannot be perfect in its insulation; the current leakage through it can be represented by a shunt conductance. At radio frequencies, the inductive reactance is much larger than the resistance. The capacitive susceptance is much larger than the shunt conductance. Thus both R and G can be ignored.

e)	**Draw the sketch of dish antenna. Explain the same with radiation pattern.**	**4M**

Ans: — **Sketch-1M Explanation -2M**



(OR)

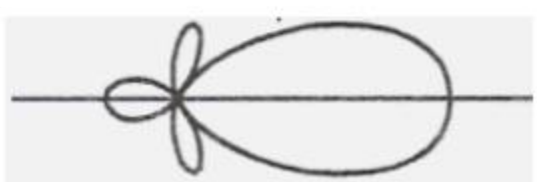


Dish antenna uses simple reflection principle, just as a mirror can reflect light and a curved mirror can reflect and focus light at a single point, the dish reflects and focuses the radio waves.

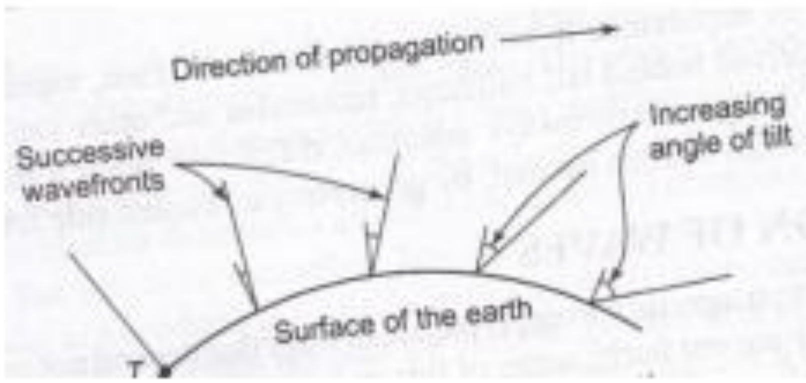
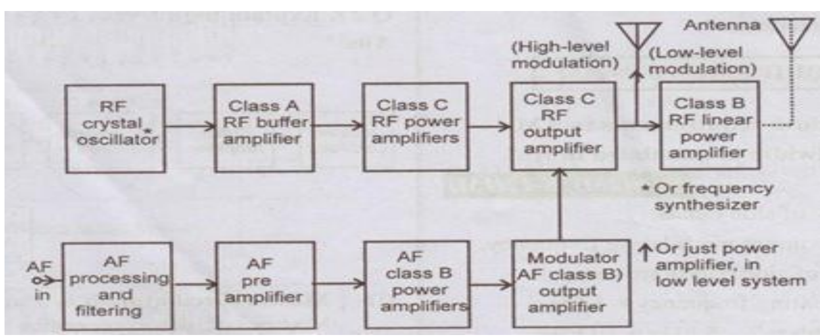
This is the same principle and shape that is used as reflector in a flashlight or headlight behind the bulb.

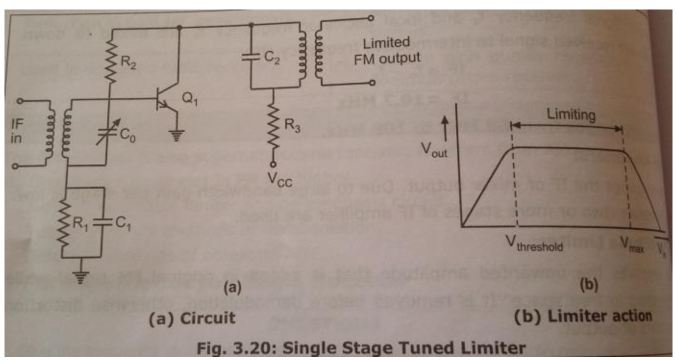
Dish antennas are used for systems that transmit and receive as well as receive only.

Radiation Pattern: — **1M**



f)	**Explain ground wave propagation along with sketch.**	**4M**

	Ans:	 i) It consists of direct wave which travels near the ground from Transmitter to Receiver. ii) The electromagnetic wave leaves the transmitting antenna & remains close to earth surface. The ground wave actually follows curvature of earth & hence travels beyond the horizon. iii) The ground waves are vertically polarized. iv) It is strongest at the low & medium frequency ranges. The ground wave is the path chosen when frequency in between 30 KHz & 3 MHz	**(Sketch-2M, Explanation -2M)**
Q.5		**Attempt any <u>FOUR</u> of following:**	**16M**
	a)	**Draw the block diagram of AM transmitter. State the function of each block.**	**4M**
	Ans:	**<u>Diagram:</u>**  **<u>Functions:</u>** **RF crystal oscillator:** It is used to generate stable and constant RF carrier signal. **Buffer amplifier:** It is used to avoid the loading effect on the RF crystal oscillator. **Power amplifier:** It is used to amplify the modulating signal at adequate power level. **Class c output amplifier:** Modulation takes place in this stage. The output of this block is AM wave which can be directly transmitted to the air in the form of electromagnetic wave.	**(Diagram: 2M)** **(Functions: 2M)**
	b)	**Explain why the local oscillator frequency should be always greater than signal frequency in radio receiver.**	**4M**

	Ans:	**<u>Reason for LO frequency to be greater than signal frequency :</u>** The local oscillator frequency (f0) is made greater than signal frequency (Fs) in radio receiver: Local oscillator frequency range is 995 KHz to 2105 KHz for MW band. Fmax/Fmin = 2105/995 = 2.2 If local oscillator has been designed to be below signal frequency, the range would be 85 to 1195 KHz and frequency ratio is, Fmax/Fmin = 1195/85 =14.0 The normal tunable capacitance ratio is, Cmax/Cmin = 10 So this capacitance ratio easily gives the frequency ratio of 2.2:1. Hence, the 2.2:1 ratio required for the local oscillator operating above signal frequency is well within range whereas the other system has a frequency ratio of 14:1 whose capacitance are not practically available.	**4M**
	c)	**Explain the working of amplitude limiter in FM receiver with circuit diagram.**	**4M**
	Ans:	**<u>Amplitude limiter:</u>** 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 **<u>Circuit Diagram:</u>**  Fig. 3.20: Single Stage Tuned Limiter	**2M** **2M**
	d)	**State the need of stub. Explain single stub and double stub matching.**	**4M**
	Ans:	**<u>Stub:-</u>** Stub is the piece of short circuited transmission line which is used to tune out the reactance of the load when connected across the transmission line as close as possible. **<u>Single stub:</u>** Stub is the piece of short circuited TL which is used to tune out the reactance of the load when connected across the TL as close as possible.	**2M**

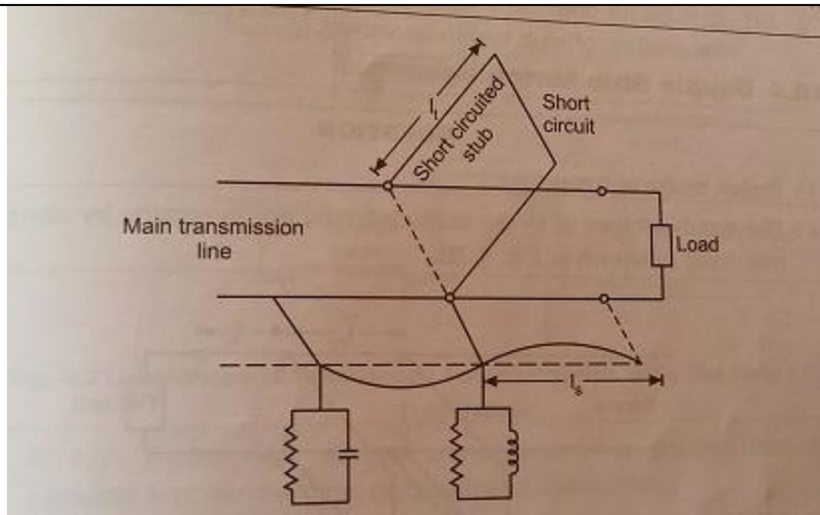


Fig. 4.19: Single Stub Matching

1. The most important feature of single stub matching is that the stub should be located as near to the load as possible.
2. The characteristic admittance of the stub so connected in shunt should be same as that of the main line.
3. The main element of this transmission line is a short circuited section of line whose open end is connected to the main line at a particular distance from the load end.
4. Where the input conductance at that point is equal to the characteristic conductance of the line, and the stub length is adjusted to provide a susceptance equal in value but opposite in sign, to the input susceptance of the main line at that point.
5. So the total susceptance of the main line at that point is zero.
6. The combination of stub and the line will thus present a conductance which is equal to the characteristic impedance of the line, i.e. the main length of the HF transmission line will be matched.

2M

Double stub:

The disadvantages of single stub matching are overcome by using double stub matching as shown in fig.

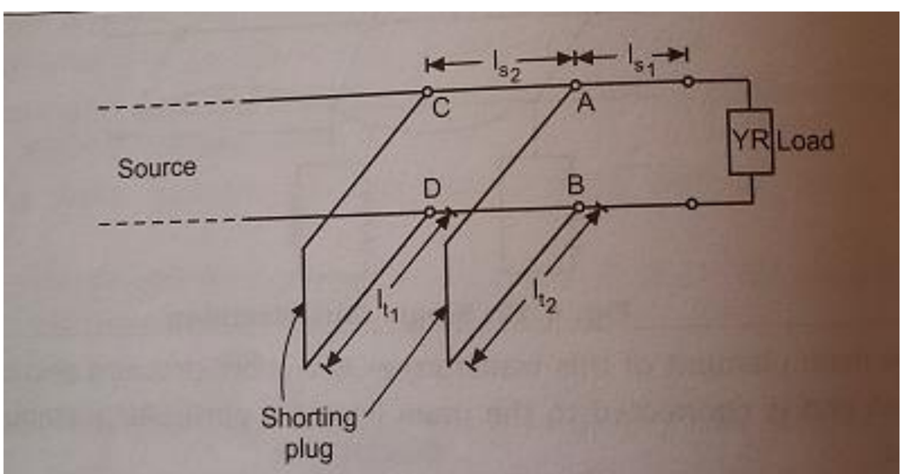


Fig. 4.20: Double Stub Matching

<table>
<tr><td></td><td></td><td>Here, two short circuited stubs at two fixed point usually $\lambda/4$ apart are utilized.
Their positions are fixed but lengths are independently adjustable.
The double stub matching provides wide range of impedance matching.</td><td></td></tr>
<tr><td></td><td>e)</td><td>Calculate the characteristics impedance for a transmission line having L=0.5 mH/Km, C=0.08 µF and negligible R and G.</td><td>4M</td></tr>
<tr><td></td><td>Ans:</td><td>L=0.5 mH/Km
C=0.08 µF

Characteristic Impedance:
$Z_0 = \sqrt{\frac{L}{C}}$
$= \sqrt{\frac{0.5 \times 10^{-3}}{0.08 \times 10^{-6}}}$
$= \sqrt{\frac{50}{8} \times 10^{3}}$
$= \frac{2.236}{\sqrt{8}} \times 10^{2}$
$\boxed{Z_0 = 79.08\ \Omega}$</td><td>4M</td></tr>
<tr><td></td><td>f)</td><td>Draw the structure and state applications of:
i) Ferrite loop (rod) antenna
ii) Horn antenna</td><td>4M</td></tr>
<tr><td></td><td>Ans:</td><td><u>Horn antenna:</u>

<u>Application:-</u>
i) Used at microwave frequency.
ii) Used in satellite tracking.

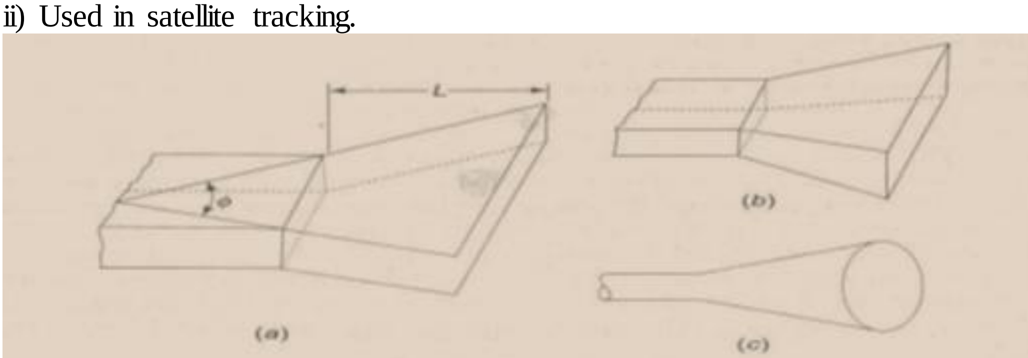



Fig. 11.32 Horn antennas. (a) Sectoral; (b) pyramidal; (c) circular.</td><td>1M

1M</td></tr>
</table>

Ferrite loop antenna:

Application:- (1M)

In Am radio receiver to receive MW and SW band signals.

In FM radio receiver (1M)

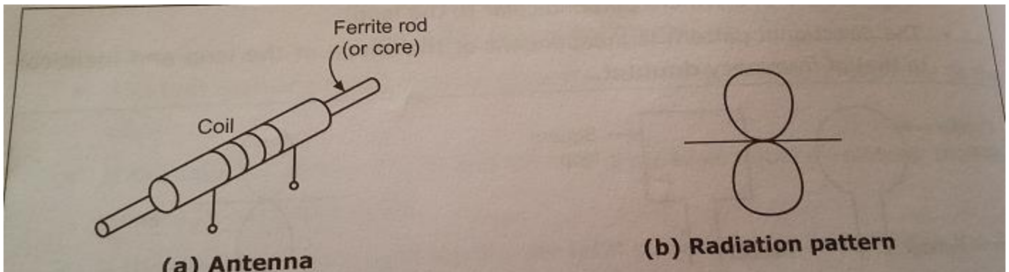
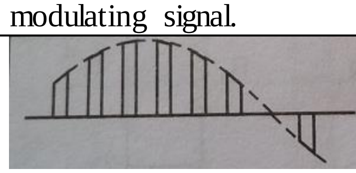
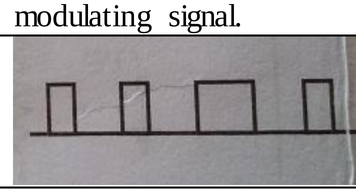


Fig. 6.13: Ferrite Loop Antenna

Q.6		Attempt any **FOUR** of following:	16M
	a)	**Compare PAM and PWM with reference to:** **(i)Definition** **(ii)waveforms** **(iii)Advantage and** **(iv)Application**	4M

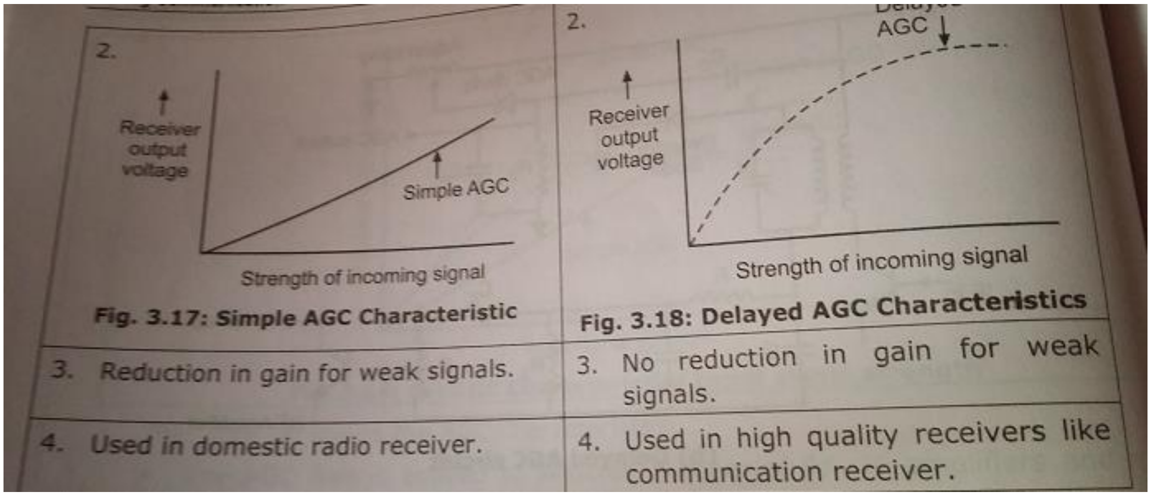
Ans: (Each point- 1M)

Parameter	PAM	PWM
Definition	In this modulation amplitude of carrier pulse is varied in accordance with instantaneous value of modulating signal.	In this modulation width of carrier pulse is varied in accordance with instantaneous value of modulating signal.
waveforms		
Advantage	It is easy to generate and demodulate PAM	high bandwidth high noise immunity
Application	Used in radio telemetry for remote monitoring and sensing	Used in special purpose communication system mainly for military.

	b)	**Compare between simple AGC and delayed AGC(any four points)**	4 M

Ans: (Each point- 1 M)

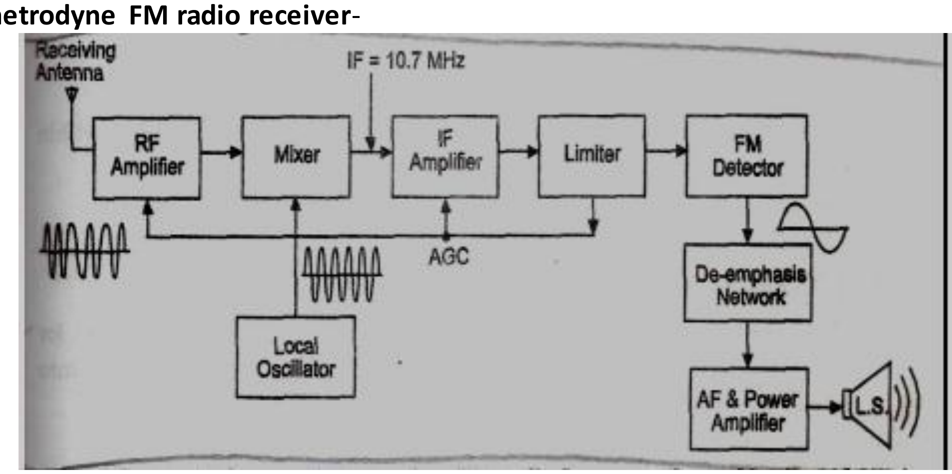
Simple AGC	Delayed AGC
1. Simple AGC means which will change the overall gain of a receiver automatically starting from initial point.	1. Delayed AGC means in which AGC bias is not applied until the input signal strength reaches at particular level.



2. Receiver output voltage Simple AGC Strength of incoming signal **Fig. 3.17: Simple AGC Characteristic**	2. AGC Receiver output voltage Strength of incoming signal **Fig. 3.18: Delayed AGC Characteristics**
3. Reduction in gain for weak signals.	3. No reduction in gain for weak signals.
4. Used in domestic radio receiver.	4. Used in high quality receivers like communication receiver.

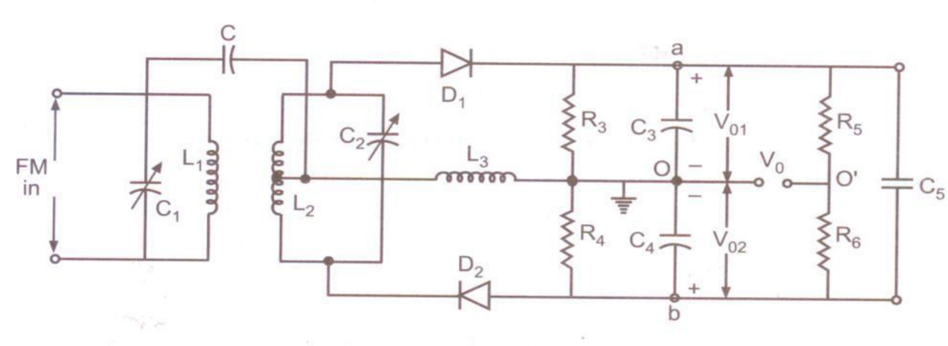
c) **Draw block diagram of FM radio receiver .Draw waveform at the o/p of each block.** **4M**

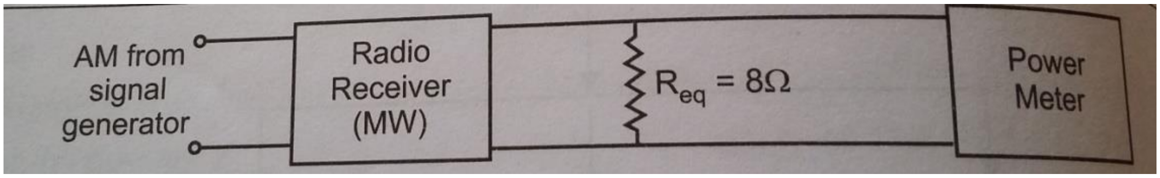
Ans: **Superhetrodyne FM radio receiver-**



d) **Draw and label the circuit diagram of ratio detector** **4M**

Ans:



	e)	**Draw practical set-up and explain the procedure to measure selectivity of radio receiver.**	**4M**
	Ans:	 **<u>Procedure to measure selectivity of radio receiver:</u>** • Throughout the measurement the receiver is kept tuned to desired frequency 950 Khz. • Now the generator output frequency is deviated below and above the 950 Khz in suitable steps. • Everytime the generator output voltage is adjusted to get a standard 50 miliwatt receiver output power.	**2M** **2M**
	f)	**Define the following terms related to antennas;** **(i) Antenna resistance** **(ii) Directivity** **(iii) Antenna gain** **(iv) Power density**	**4M**
	Ans:	**<u>Antenna Resistance –</u>** The resistance of an antenna has two components: 1. Its radiation resistance due to conversion of power into electromagnetic waves 2. The resistance due to actual losses in the antenna. **OR** The component of **antenna resistance** that accounts for the power radiated into space and is equal in ohms to the radiated power in watts divided by the square of the effective current in amperes at the point of power supply. **<u>Antenna Gain –</u>** The directional antennae radiate more power in certain direction. The Omni-directional antenna radiates information equally in all directions. A directional antenna is said to have 'gain' in a particular direction. **<u>Directivity-</u>** 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** **<u>Power density-</u>**	**(Each Definition- 1M)**

		The power density at any distance from an isotropic antenna is simply the transmitter power divided by the surface area of a sphere ($4\pi R2$) at that distance.	