MODEL ANSWER

WINTER– 17 EXAMINATION

Subject Title: Analog Communication

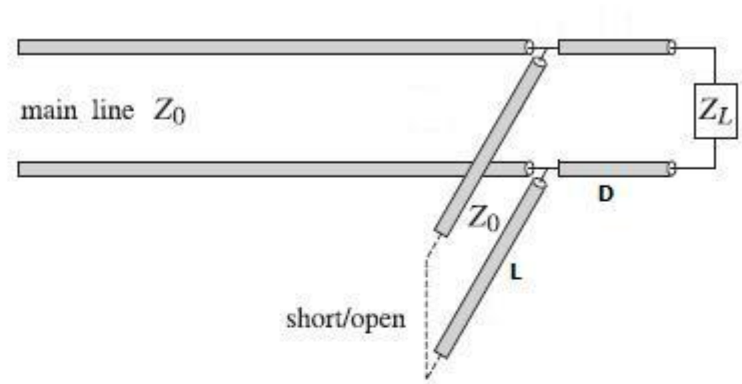
Code: 17440

Important Instructions to examiners:

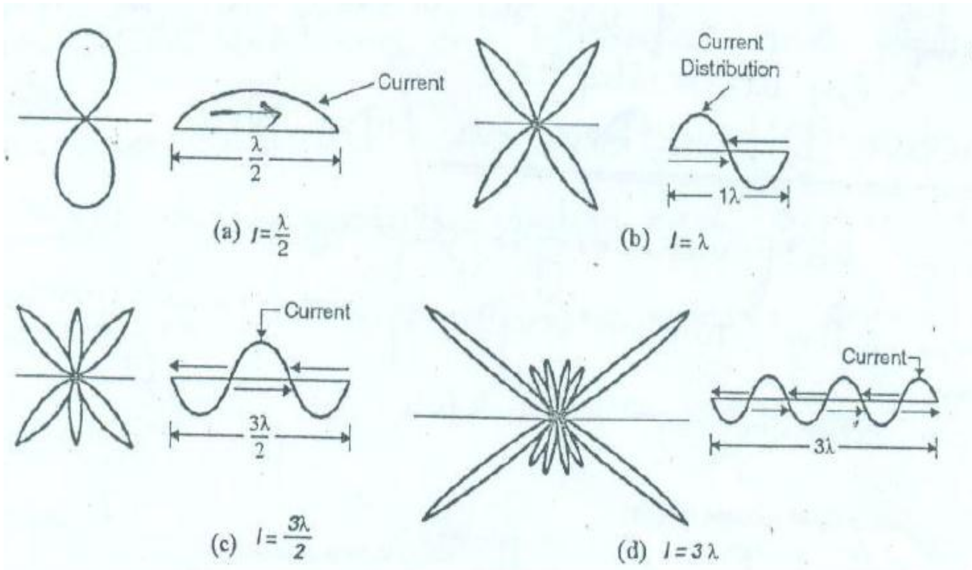
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 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**
	(i)	**State the frequency range for audio frequency and voice frequency.**	**2M**
	Ans:	• The generally accepted standard range of audible frequencies is 20 to 20,000 Hz, • The usable voice frequency band ranges from approximately 300 Hz to 3400 Hz.	**1 M each.**
	(ii)	**Define modulation? State the desirable value of modulation index of AM.**	**2M**
	Ans:	Modulation: It is the process in which any of these Parameters (Amplitude, Frequency, Phase) of high frequency signal (carrier signal) are varied in accordance with low frequency signal(modulating signal) For an AM, modulation index range is 0 to 1.	**1M each.**
	(iii)	**Define pulse modulation and list it's types.**	**2M**
	Ans:	Pulse Modulation - consists essentially of sampling analog information signals and then converting those samples into discrete pulses. **OR** It consists essentially of sampling analog information signals and then converting those samples into discrete pulses and transporting the pulses from a source to a	**1M definition and 1M Types.**

		destination over a physical transmission medium. **OR** Pulse modulation is a technique in which continuous waveforms are sampled at regular intervals. i.e. carrier is a train of discrete pulses. **Types:-** i) Analog Pulse modulation - PAM - PWM – PPM ii) Digital Pulse Modulation - PCM - DM – ADM ***Note: Any other relevant definition of PM should also be considered***	
	(iv)	**State the IF frequency and bandwidth of FM receiver.**	**2M**
	Ans:	• IF for FM receiver: 10.7 MHz. • Bandwidth of FM receiver:88MHz to 108 MHz	**1M each**
	(v)	**State the process FM detection? State it's any two types.**	**2M**
	Ans:	**FM detection:** In any radio that is designed to receive frequency modulated signals there is some form of FM demodulator or detector. This circuit takes in frequency modulated RF signals and takes the modulation from the signal to output only the modulation that had been applied at the transmitter. In order to be able to demodulate FM it is necessary for the radio receiver to convert the frequency variations into voltage variations. It is necessary to have a response that is as linear as possible over the required bandwidth. The response that is normally seen for an FM demodulator / FM detector is known as an "S" curve for obvious reasons. There is a linear portion at the centre of the response curve and towards the edge the response becomes very distorted.	**1M**
		The different types of FM Detectors are: 1. Simple Slope Detector 2. Balanced Slope Detector 3. Ratio Detector 4. Phase Discriminator 5. FM Detector using Phase Locked Loop (PLL)	**1M(Any two)**
	(vi)	**What is stub? What do you mean by single stub matching.**	**2M**
	Ans	Stub is a 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.	**1M**

		Single Stub Matching :  **OR** **Single Stub Matching** – Stub matches are widely used to match any complex load to a transmission line. They consist of shorted or opened segments of the line, connected in parallel or in series with the line at a appropriate distances from the load. In coaxial cable or two-wire line applications, the stubs are obtained by cutting appropriate lengths of the main line. Shorted stubs are usually preferred because opened stubs may radiate from their opened ends. The single stub match is perhaps the most widely used matching circuit and can match any load.	**1M(either diagram or explainatio n)**
	(vii)	**Why electromagnetic waves are said to be transverse wave ? Explain.**	**2M**
	Ans:	The electromagnetic waves are oscillations which propagate through free space. In electromagnetic waves the direction of electric field, magnetic field & propagation are mutually perpendicular. Hence electromagnetic waves are called as transverse wave.	**2M**
	(viiii)	**State the types of electromagnetic polarization? Define any one of it.**	**2M**
	Ans:	**Transverse electromagnetic wave**:- The polarization of a plane EM wave is simply the orientation of the electric field vector with respect to the surface (i.e. looking at the horizon) If the polarization remains constant then it is called as the linear polarization. **The linear polarization can be of two types : 1) Horizontal polarization 2) Vertical polarization** **Horizontal Polarization**:- If the electric field propagates in parallel with the earth surface then EM wave is said to be horizontally polarized.	**For Types 1M and any one Explanatio n 1M**

		Vertical polarization:- If the electric field propagates in perpendicular to the surface of the earth then EM wave is said to be vertically polarized . **Circular polarization**:- If the polarization vector rotates 3600 as the EM wave travels wavelength through the space and the filed strength is equal at all angles of polarization then the EM wave is said to have a circular polarization. **Elliptical polarization**:- In the circular polarization if the field strength varies with change in polarization the wave is said to have an elliptical polarization	
	B)	**Attempt any <u>TWO</u> of the following :**	**8M**
	(i)	**Define:** **1)Frequency** **2)Bandwidth** **3)Wavelength** **4)Time period**	**4M**
	Ans:	**<u>Frequency:</u>** Frequency is the number of cycles per second. **<u>Bandwidth:</u>** A range of frequencies within a given band, in particular that used for transmitting a signal. **<u>Wavelength:</u>** *Wavelength* can be defined as the distance between two successive crests or troughs of a wave. It is measured in the direction of the wave. **<u>Time period:</u>** A Time period (denoted by 'T') is the time needed for one complete cycle of vibration to pass a given point. **<u>OR</u>** Time period=1/frequency	**1M each**
	ii)	**Draw radiation pattern for the resonant dipoles with following length:** **1) /=λ/2** **2) /=λ** **3) /=3λ/2** **4) /=3λ/**	**4M**
	Ans:		.



Each correct pattern 1M

iii)	**Compare ground wave propagation. Sky wave propagation and space wave propagation.**	**4M**
Ans:	(see table below)	**Any 4 - -1M each**

Sr. No	Parameter	Ground Wave Propagation	Sky Wave Propagation	Space wave Propagation
1	Frequency Range	30 kHz to 3 MHz	3 MHz to 30 MHz	frequencies above 30 MHz
2	Polarization	Vertical	vertical	Horizontal
3	Applications	Radio Broadcasting (MW Range)	Radio Broadcasting (SW Range)	Satellite communication, TV , frequency modulation broadcast, RADAR system etc
4	Range of Communication	Less (OR) Few hundred Km	More (OR) Few Thousand Km	More (OR) Few Thousand Km

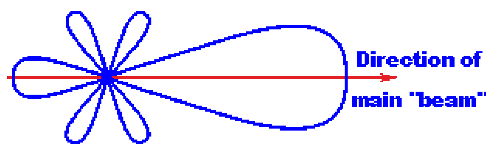
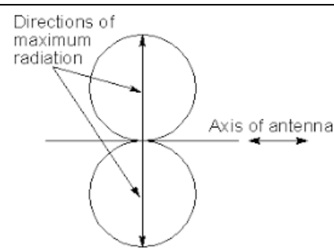
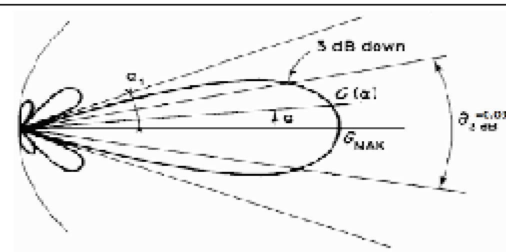
5	Limitations	Limited Range, Tall Antenna Required, High transmission power.	Skip Distance, Power loss due to absorption of energy in layers.	These waves are limited to the curvature of the earth. 2. These waves have line of sight propagation, ...
6	Fading Problem	less	Severe	Less

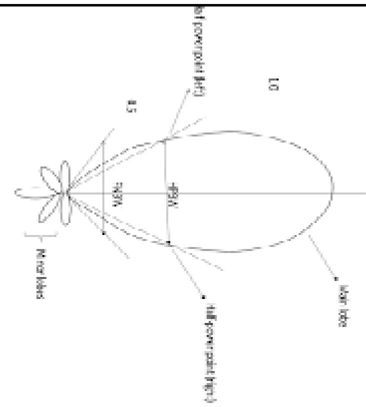
Q 2		Attempt any FOUR of the following:	16M

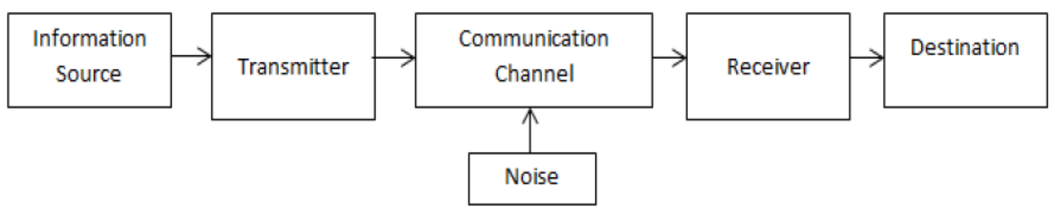
a) **Draw radiation pattern for following antenna** — **4M**

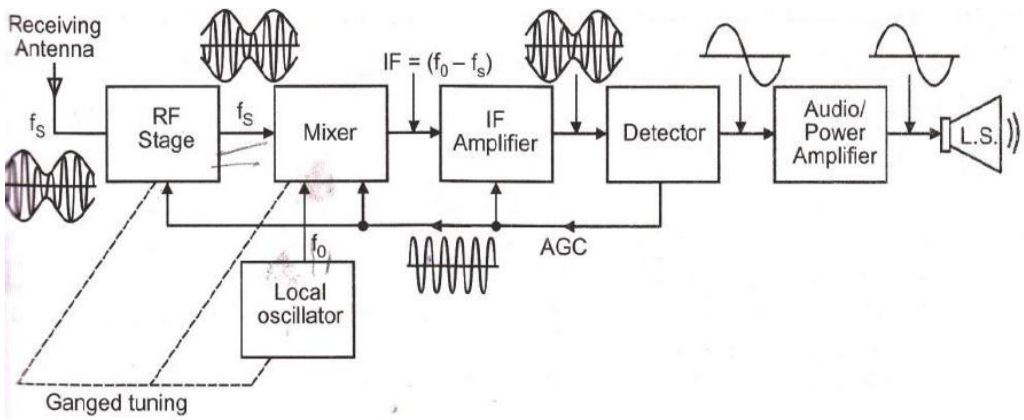
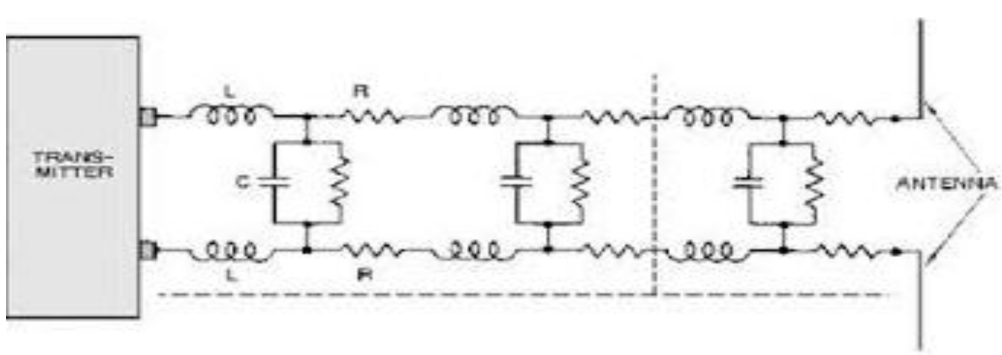
i) **Yagi-Uda antenna**
ii) **Loop antenna**
iii) **Dish antenna**
iv) **Horn antenna**

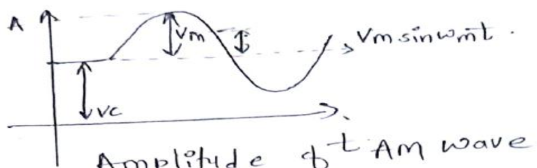
Ans: — **1M each**

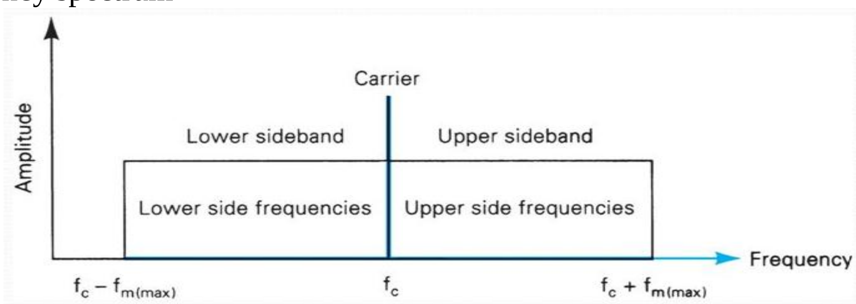
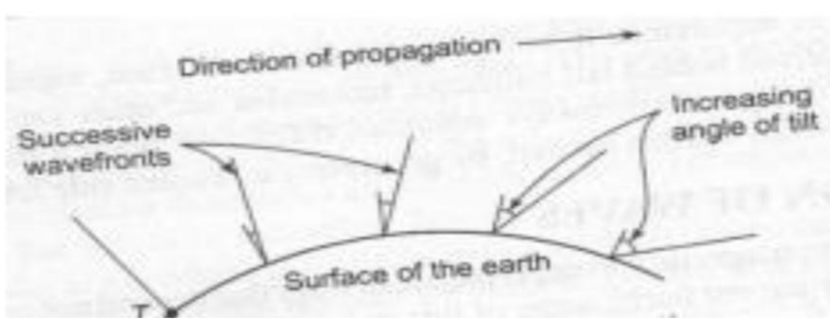
Type of antenna	Radiation Patteren
Yagi-Uda antenna	
Loop antenna	
Dish antenna	

		Horn antenna 	
	b)	**Explain how modulation reduces height of antenna and avoid mixing of signals.**	**4M**
	Ans:	**<u>Modulation reduces antenna height:</u>** For the transmission of radio signals, the antenna height must be multiple of λ/4 ,where λ is the wavelength . $\lambda = c/f$ **where c : is the velocity of light** **f: is the frequency of the signal to be transmitted** **The minimum antenna height required to transmit a baseband signal of f = 10 kHz is calculated as follows :** $Minimum\ antenna\ height = \frac{\lambda}{4} = \frac{c}{4f} = \frac{3 \times 10^8}{4 \times 10 \times 10^3} = 7500\ meters\ i.e. 7.5\ km$ **The antenna of this height is practically impossible to install.** **Now, let us consider a modulated signal at f = 1 MHz. The minimum antenna height is given by,** $Minimum\ antenna\ height = \frac{\lambda}{4} = \frac{c}{4f} = \frac{3 \times 10^8}{4 \times 10 \times 10^6} = 75\ meters$ **This antenna can be easily installed practically. Thus, modulation reduces the height of the antenna.**	**2M**

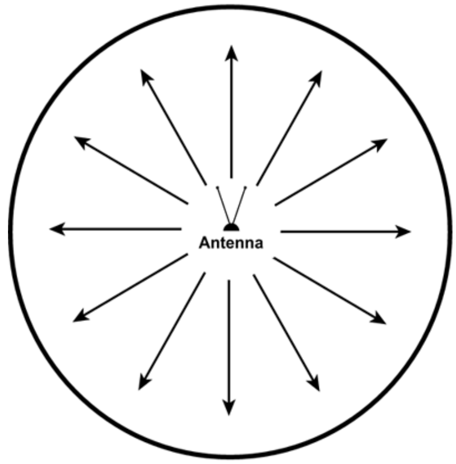
		Avoids mixing of signals: If the baseband sound signals are transmitted without using the modulation by more than one transmitter, then all the signals will be in the same frequency range i.e. 0 to 20 kHz . Therefore, all the signals get mixed together and a receiver cannot separate them from each other . Hence, if each baseband sound signal is used to modulate a different carrier then they will occupy different slots in the frequency domain (different channels). Thus, modulation avoids mixing of signals.	**2M**
	c)	**Draw and explain block diagram of electronic communication system.**	**4M**
	Ans:	**Block diagram of electronic communication system.**  **Explanation-** **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 in to sound signal.	**2M** **2M**

	d)	**Draw and block diagram of super heterodyne AM receiver and state the function of RF stage and mixer. What is IF?**	**4M**
	Ans:	**<u>Diagram-</u>**  **<u>Explanation-</u>** **<u>RF stage-</u>** Selects wanted signal and rejects all other signals and thus reduces the effect of noise. **Mixer**- Receives signal from RF stage Fs and the local oscillator Fo and are mixed to produce intermediate frequency signal IF which is given as: IF= Fo- Fs **IF is intermediate frequency** IF= Fo- Fs	**2M** **2M**
	e)	**Define the transmission line? Draw it's general equivalent circuit.**	**4M**
	Ans:	**<u>Transmission line:</u>** A conductor or conductors designed to carry electricity or an electrical signal over large distances with minimum losses and distortion. **<u>Equivalent circuit:</u>**  	**2M each**

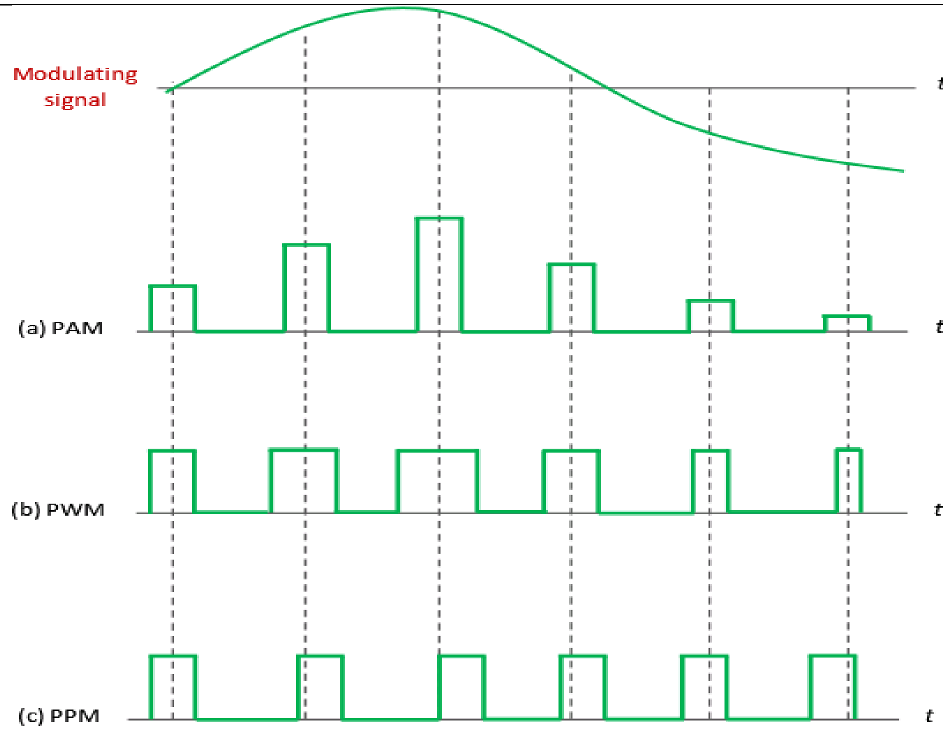
	f)	**Show that AM wave consist of two side bands and carrier. Also prove the bandwidth of AM is double of the modulating frequency.**	**4M**
	Ans:	∴ The frequency present in AM wave are the carrier frequency & the first pair of side band frequencies. Where side band frequency $f_{SB} = f_c \pm nf_m$ $(n=1)$  Amplitude of AM wave. $m = V_m/V_c$ { where m is the modulation Index $m = 0$ to 1. ∴ $A = V_c + V_m$ $= V_c + V_m \sin\omega_m t$ $= V_c + mV_c \sin\omega_m t$ $= V_c[1 + m\sin\omega_m t]$ ∴ The instantaneous voltage of the resulting amplitude-modulated wave is, $V = A\sin\theta$ $= A\sin\omega_c t$ $= V_c[1 + m\sin\omega_m t]\cdot\sin\omega_c t$ Acc. to trigno theory $\sin x\cdot\sin y = 1/2[\cos(x-y) - \cos(x+y)]$ ∴ $V = \underbrace{V_c\sin\omega_c t}_{carrier} + \underbrace{\frac{mV_c}{2}\cos(\omega_c-\omega_m)t}_{L.S.B} - \underbrace{\frac{mV_c}{2}\cos(\omega_c+\omega_m)t}_{USB}$ It shows that AM consist carrier, & two side Band. $B.W = USB - LSB$ $= (\omega_c+\omega_m) - (\omega_c-\omega_m)$ $B.W = 2\omega_m$ ∴ $\boxed{B.W = 2\omega_m}$ ∴ double of Modulating freq.	**3M** **To prove the bandwidth of AM is double of the modulating frequency= 1M**
Q. 3		**Attempt any FOUR of the following:**	**16M**
	a)	**A modulating signal $9\sin(2\pi\times10^2t)$ is used to modulate a carrier signal $12\sin(2\pi\times10^3t)$.Find modulation index, percentage modulation. frequencies of sidebands components and their amplitudes, bandwidth of modulated signal. Also draw frequency spectrum of AM wave.**	**4M**

	Ans:	$V_m=9\sin(2\pi\times10^2t)$ $V_c=12\sin(2\pi\times10^3t)$ i) modulation index=Vm/Vc=9/12=0.75 percentage modulation=75% ii)frequencies of sidebands=fc+fm=1000+100=1100Hz = fc-fm=1000-100=900Hz Amplitude of side band component=mVc/2=4.5V iii) Bandwidth of modulated signal =2fm=2*100=200Hz iv) frequency spectrum 	**Modulation index, percentage modulation - 1M** **frequencies of sidebands components and their amplitudes-1M** **bandwidth-1M** **frequency spectrum-1M**
	b)	**A super heterodyne AM receiver is tuned to a station operating at 1200 KHz .Find local oscillator frequency and image frequency.**	**4M**
	Ans:	A super heterodyne AM receiver is tuned to a station operating at 1200 KHz Intermediate frequency is 455KHz. IF frequency=f_0-f_s Local oscillator frequency is f_0=IF +fs=455K+1200K=1655kHz The image frequency which gives the same IF is f_0+2*IF=2110KHz	**local oscillator frequency - 2M** **image frequency-2M**
	c)	**Explain ground wave propogation with neat sketch.**	**4M**
	Ans:	**<u>Sketch-</u>** 	**2M**

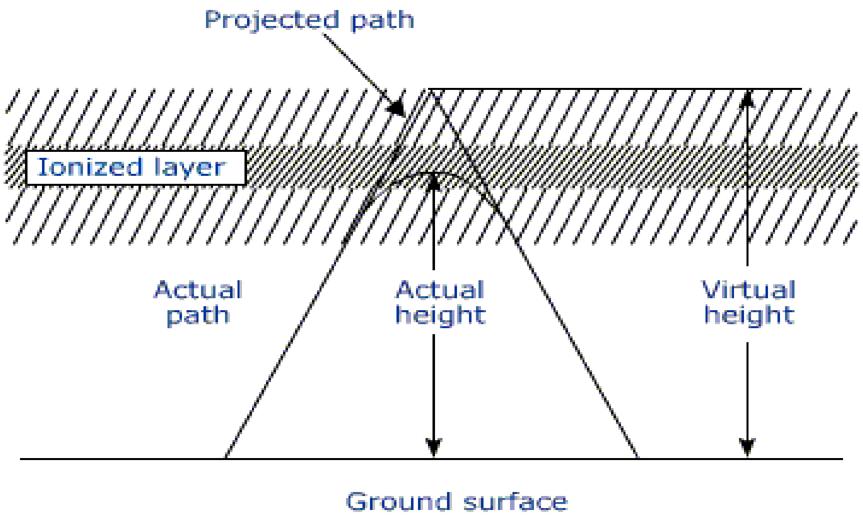
		<u>Explanation-</u> **i)** It consists of direct wave which travels near the ground from Transmitter to Receiver. **ii)** The electromagnetic wave leaves the transmitting antenna & remains close to earth surface. The ground wave actually follows curvature of earth & hence travels beyond the horizon **iii)** 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	**2M**
	d)	**A telephone cable has following primary constants per loop kilometer ,R=30Ω, L=20mH,C=0.06µF,G=0.If the applied signal has an angular frequency of 5000 rad/sec..,** **Determine** **(i) Characteristics impedence** **(ii) Attenuation constant**	**4M**
	Ans:	Given $R = 30\,\Omega$ $C = 0.06\,\mu f$ $L = 20\,mH$, & $G = 0$, $\omega = 5000$ rad/sec. Characteristic Impedance $Z_0 = \sqrt{\frac{Z}{Y}}$ $Z_0 = \sqrt{\frac{R + j\omega L}{G + j\omega C}}$ $Z_0 = \sqrt{\frac{30 + j(5000)(20 \times 10^{-3})}{0 + j(5000)(0.06 \times 10^{-6})}}$ $= \sqrt{\frac{30 + j100}{j(3 \times 10^{-4})}}$ $= \sqrt{\frac{104.4 \angle 73^\circ}{3 \times 10^{-4} \angle 90}}$ $Z_0 = \sqrt{348000 \angle (73 - 90)}$ $Z_0 = 589.9 \angle -8.5\,\Omega$ Attenuation constant $= \alpha = R/2Z$ Neper/km. $= \frac{30}{2(104)}$ $= \frac{30}{208}$ $\alpha = 0.144$ Neper/km	**Characteristics impedence-2M** **Attenuation constant-2M**
	e)	**Explain isotropic radiator with neat sketch.**	**4M**

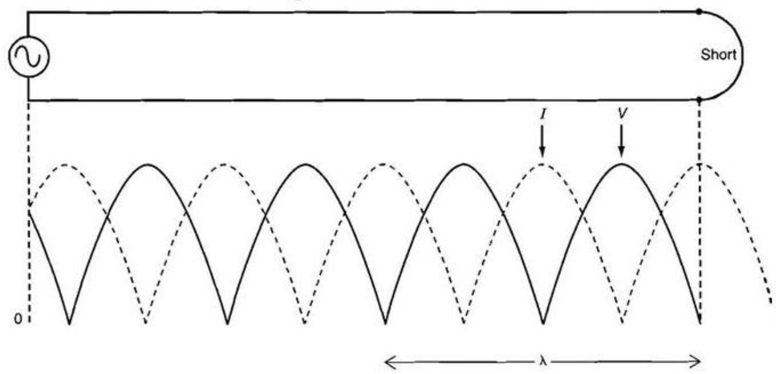
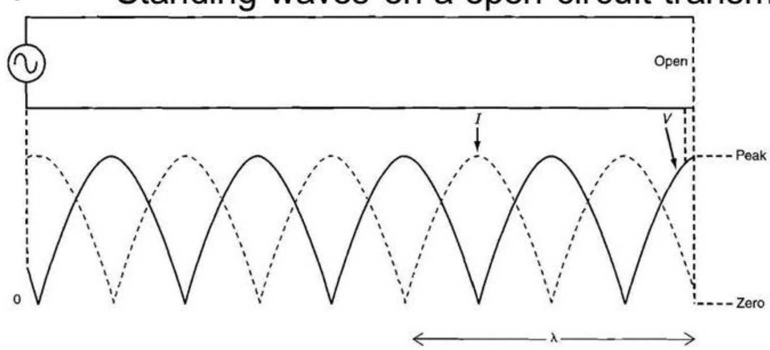
	Ans:	An isotropic radiator is a point source that radiates equally in all the directions.  It is a hypothetical antenna used as a reference to describe real antenna. The radiation is represented by a sphere with center coincides with location of isotropic radiator.	**Sketch-2M** **Explanation-2M**
	f)	**Compare AM and FM on the basis of** **i)Definition** **ii)Bandwidth** **iii) Wave propogation** **iv)Number of sidebands**	**4M**
	Ans:	(see table below)	**1M for each point**
Q. 4	**A)**	**Attempt any <u>FOUR</u> of the following:**	**16M**
	a)	**Define PAM, PWM, and PPM. Draw waveforms.**	**4M**
	Ans:		

Parameter	AM	FM
Definition	Amplitude of the carrier signal is varied in accordance to the instantaneous value of the modulating signal keeping frequency and phase of carrier constant.	Frequency of the carrier signal is varied in accordance to the instantaneous value of the modulating signal keeping amplitude and phase of carrier constant
Bandwidth	BW = 2 fm	BW = 2 (δ+ fm (max))
Wave propogation	Ground and sky wave propagation	Space wave propagation
Number of sidebands	Two	infinite

		 Pulse amplitude modulation is defined as a process of varying the amplitude of the carrier pulse in accordance to the modulating signal variations. Pulse width modulation is defined as a process of varying the width of the carrier pulse in accordance to the modulating signal variations. Pulse Position modulation is defined as a process of varying the position of the carrier pulse, in accordance to the modulating signal variations.	**Waveform-2M** **Definition-2M**
	b)	**In a FM system, the maximum deviation is 75KHz. Find bandwidth for modulating frequency** **i. fm=500Hz** **ii. fm=5KHz** **iii. fm=10KHz** **Draw conclusion for bandwidth of FM from answer.**	**4M**
	Ans:	Given deviationΔ=75kHz i) fm=500Hz bandwidth B.W=2(Δ+fm) =2(75k+500)=151kHz ii). fm=5KHz bandwidth B.W=2(Δ+fm) =2(75k+5k)=160KHz	**Calculation 3M**

		iii) fm=10KHz bandwidth B.W=2(Δ+fm) =2(75k+10k)=170KHz As the modulating frequency increases bandwidth also increases.	**Conclusion-1M**
	c)	**a) For a transmission line, Find SWR and reflection coefficient R if,** **i. There is no reflected voltage.** **ii. Reflected voltage and incident voltage is equal.** **iii. If reflected voltage=20V and incident voltage=10V.** **iv. If reflected voltage=10V and incident voltage =20V.**	**4M**
	Ans:	reflection coefficient R=Vr/Vi **i. There is no reflected voltage.** i.e,Vr=0 R=0 SWR= 1+R/1-R=1 **ii. Reflected voltage and incident voltage is equal.** Vr=Vi; R=1 SWR= 1+R/1-R=1+1/1-1=infinity **iii. If reflected voltage=20V and incident voltage=10V.** Vr=20 and Vi=10 R=20/10=2 SWR= 1+R/1-R= 1+2/1-2= -3 **iv)If reflected voltage=10V and incident voltage =20V.** Vr=10 and Vi=20 R=10/20=0.5 SWR= 1+R/1-R=1+.5/1-.5=3	**Each Point 1M**
	d)	**Explain virtual height with respect to wave propagation with neat sketch.**	**4M**
	Ans:	In ionization layer the incident wave refracts and bends down gradually than sharply.	**Sketch-2M Explanation -2M**

		 a The incident and refracted rays follow paths that are exactly the same as they would have been if reflection had taken place from a surface located at a greater height called virtual height of this layer.	
	e)	**Write one application of following antenna** **i. Rectangular antenna** **ii. Dish antenna** **iii. Yagi-Uda antenna** **iv. Horn antenna**	**4M**
	Ans:	i. Rectangular antenna is used in direction finding in portable recievers. ii. Dish antenna is used to transmit and receive signal from satellite. iii. Yagi-Uda antenna is used in HF and VHF range as a TV receiving antenna. iv. Horn antenna is used in satellite tracking. (Any other application should be considered)	**1M for each application**
	f)	**Draw waveform for standing waves on an open and shorted line. Prove that impedance is inverted at every quarter wavelength interval.**	**4M**

	Ans:	**<u>Waveform-</u>** Standing waves on a shorted transmission line  Standing waves on a open-circuit transmission line  	**2M**
		<u>Explanation-</u> When the transmission line is short circuited voltage is zero and current is maximum.The variation is according to the wavelength. When the transmission line is open circuited voltage is maximum and current is zero.The pattern repeats for every half wavelength. Thus impedance is inverted at every quarter wavelength interval.	**2M**
Q.5		**Attempt any <u>FOUR</u> of the following:**	**16M**
	a)	**A frequency modulated signal is represented by the voltage equation CFM=10 sin (6*10^{8}t+5 sin 1250t).Find** **i. Carrier frequency** **ii. Modulating frequency** **iii. Maximum deviation** **iv. Power dissipated in 20Ω resistor**	**4M**

	Ans:	a) $e_{FM} = 10 \sin(6\times10^{8}t + 5 \sin 1250t)$ Calculate i) Carrier frequency, f_c We know $e_{FM} = 10 \sin\left(\omega_c t + \frac{\delta f}{f_m} \cos \omega_m t\right)$ $\omega_c = 6\times10^{8}$ $2\pi f_c = 6\times10^{8}$ $f_c = \frac{6\times10^{8}}{2\pi} = 95.492\times10^{6}$ Hz ≈ 95.5 MHz Carrier frequency = 95.5 MHz. ii) Modulating frequency, f_m $\omega_m = 1250$ $2\pi f_m = 1250$ $f_m = \frac{1250}{2\pi} = 198.94$ Hz.	**1M each for proper answer**

iii) Maximum deviation δf

$$\frac{\delta f}{f_m} = 5$$

$$\delta f = 5 \times 198.94$$
$$= 998.718\,Hz.$$

$\therefore$ maximum deviation = 998.718 Hz

iv) Power dissipiated in 20Ω resisto
(P)

$$P = \frac{V_{rms}^2}{R_c} = \frac{(V_c/\sqrt{2})^2}{R_c}$$

Given $V_c = 10$
$R_c = 20\Omega$

$$\therefore P = \frac{(10/\sqrt{2})^2}{20} \text{ Watts}$$

$$P = 2.5 \text{ Watts}.$$

$\therefore$ Power dissipiated = 2.5 Watts.

	b)	**Why should local oscillator frequency be greater than signal frequency in AM receiver? Also explain why IF has constant value?**	**4M**

	Ans:	**Reason for LO frequency to be greater than signal frequency** 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. ***Note-(Any relevant correct explanation to be considered)*** **Why IF has constant value?** *The problem in the TRF receiver are solved in this receiver by converting every selected RF signal to a fixed lower frequency called as the Intermediate frequency(IF) *This frequency contains the same modulation as the original carrier. The IF signal is then amplified and detected to get back the modulating signal. *As the IF is lower than the lowest RF signal frequency the possibility of oscillations and instability is minimized. *Also the required value of Q for constant BW does not depend on the frequency of desired signal because the IF is constant and same for all the incoming RF signal.	**2M** **2M**
	c)	**A load of 200 ohm is used to match 300 ohm transmission line to achieve SWR=1. Find out the required characteristic impedance of a quarter of a quarter wave transformer connected directly to the load.**	**4M**
	Ans:		

2M each

Q 5 c

Given $Z_L = 200\,\Omega = Z_R$

$SWR = 1$

$Z_0 = ?$

i) First calculate reflection coefficient

$$SWR = \frac{1+R}{1-R}$$

$$1 = \frac{1+R}{1-R}$$

$$1 - R = 1 + R$$

$$R = 0$$

ii) Characteristic impedance Z_0.

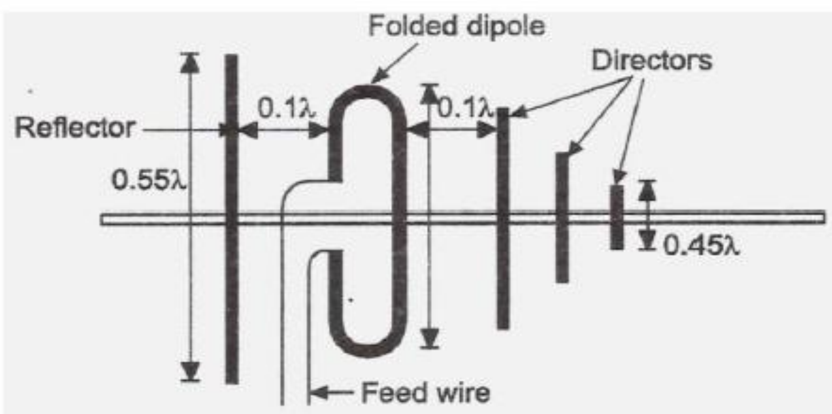
$$R = \frac{Z_R - Z_0}{Z_R + Z_0}$$

$$0 = \frac{Z_R - Z_0}{Z_R + Z_0}$$

$$\therefore \boxed{Z_0 = Z_L = 200\,\Omega}$$

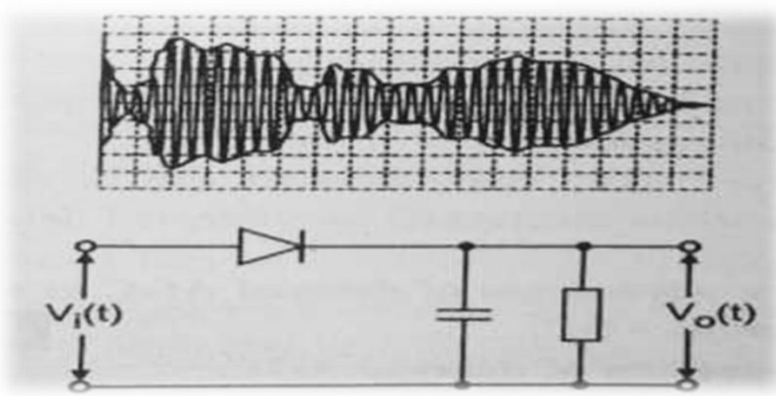
d)	**Draw construction of Yagi-Uda antenna and explain.**	**4M**

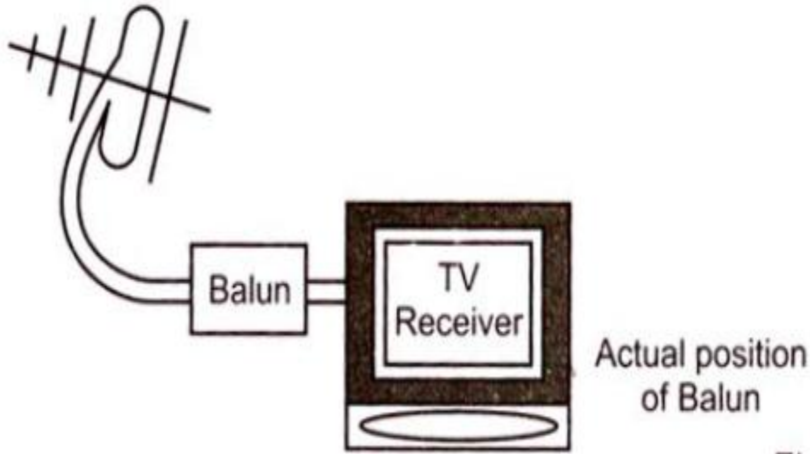
Ans: **2M**

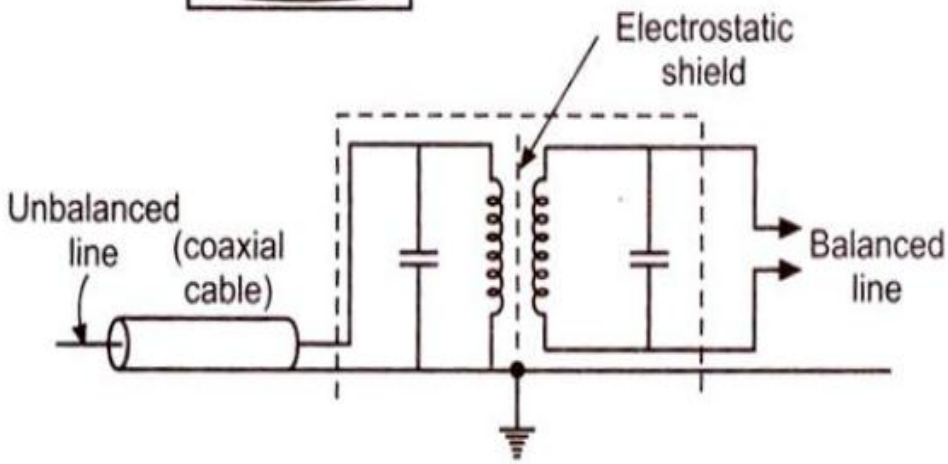


Explanation- **2M**

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 called reflector and one or more directors.	
	e)	**Explain working of envelope detector with suitable diagram and waveform.**	**4M**
	Ans:	**Envelope Detector:** • An Envelope Detector is an electronic circuit that takes a high frequency signal as input and provides an output which is as "envelopes"of the original signal. • The capacitor in the circuit stores up charge on rising edge and releases it slowly through the resistor when the signal falls. The diode in series rectifies the incoming signal, allowing current flow only when the positive input terminal is at a higher potential than the negative input terminal. • Most practical envelope detectors use either half –wave or full wave rectification of the signal to convert the AC audio into a pulsed DC signal. • Filtering is then used to smooth the final result .This filtering is rarely perfect and some "ripple" is likely to remain on the envelope follower output • More filtering gives a smoother result, but decreases the responsiveness thus, real-world designs must be optimized for the application. 	**2M** **2M**
	f)	**Explain "BALUN" with neat sketch**	**4M**
	Ans:	**Diagram-**	**2M**





Explaination-

1. A Balun or a balance to unbalance transformer, is a circuit element used to connect a balanced line to unbalanced line. i.e. it is used to connect an unbalanced (coaxial) line to a balance antenna such as a dipole.
2. As shown in fig. here the windings associated with the balanced system is symmetrically arranged with respect to a grounded electrostatic shield so that stray capacitances inevitably present will not introduce unbalance.
3. At high frequencies, several transmission line baluns used for differing purposes and narrow band or broadband application.

   e.g. if impedance of parallel wire is 300 Ω and co-axial is 75 Ω then,

   $$Zo = \sqrt{Z1Z2} = \sqrt{300 \ X \ 75} = 150 \ \Omega$$
4. The most common balun a narrow band one shown in fig. it is known as choke, sleeve or bazooka balun.

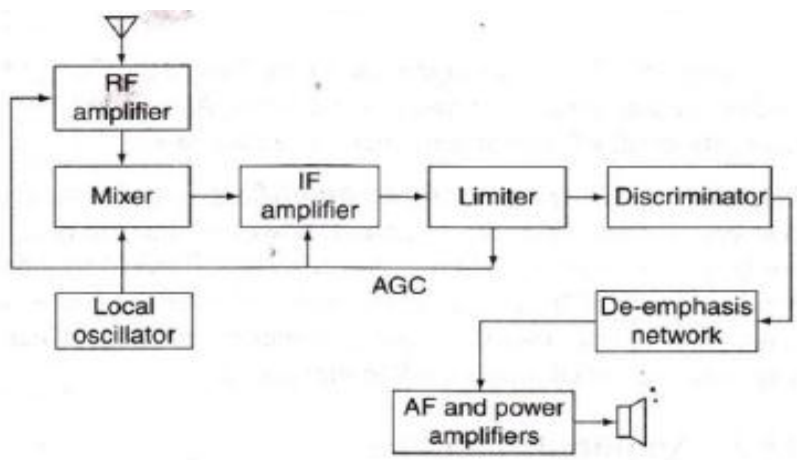
2M

Q.6		**Attempt any FOUR of the following:**	**16M**
	a)	**Compare PAM, PWM, and PPM on the basis of**	**4M**

		i. Variable characteristics **ii. Bandwidth** **iii. Information contained in** **iv. Transmitted power**	
	Ans:	(see table below)	**Each Point 1M**
	b)	**Draw block diagram of FM receiver and explain the use of limiter circuit.**	**4M**
	Ans:	**Diagram-** (see below)	**2M**
		Explanation- **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.	**2M**

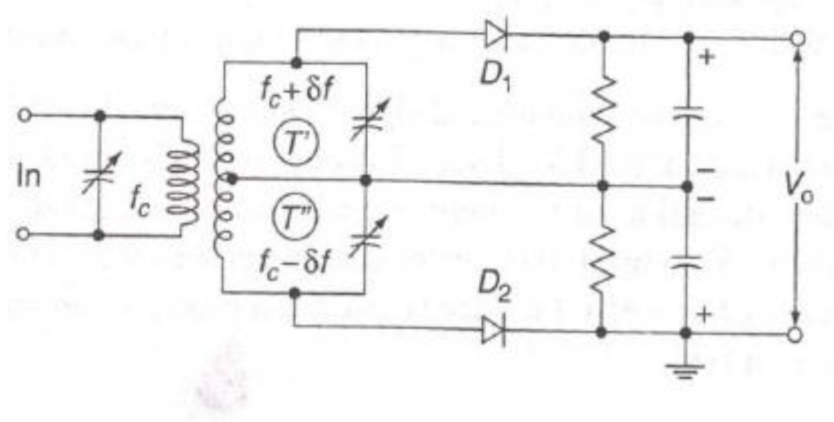
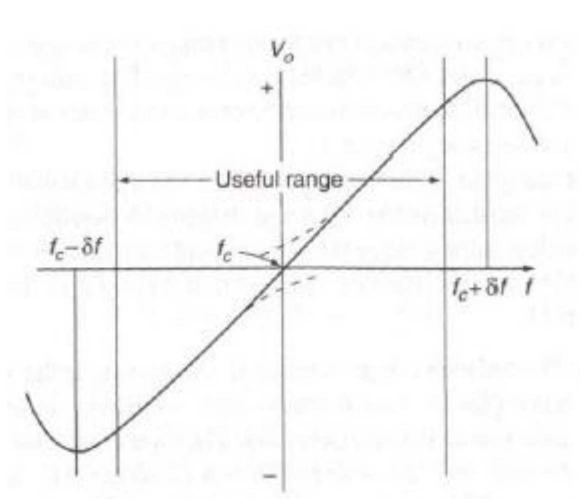
PARAMETRES	PAM	PWM	PPM
Variable characteristic	Amplitude	Width	Position
Bandwidth	Low	High	High
Information contained in	Amplitude variations	Width variations	Position variation
Transmitted power	Varies with amplitude of pulses	Varies with variation in width	Remains constant

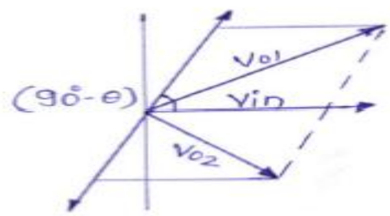
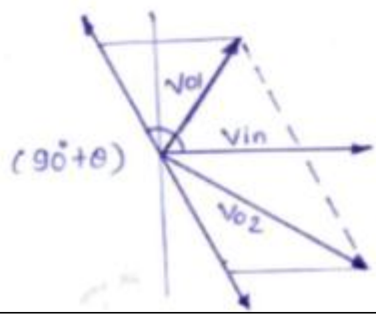
Diagram-

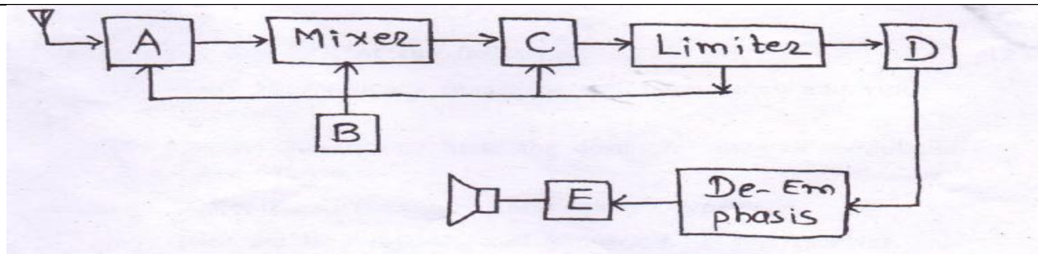
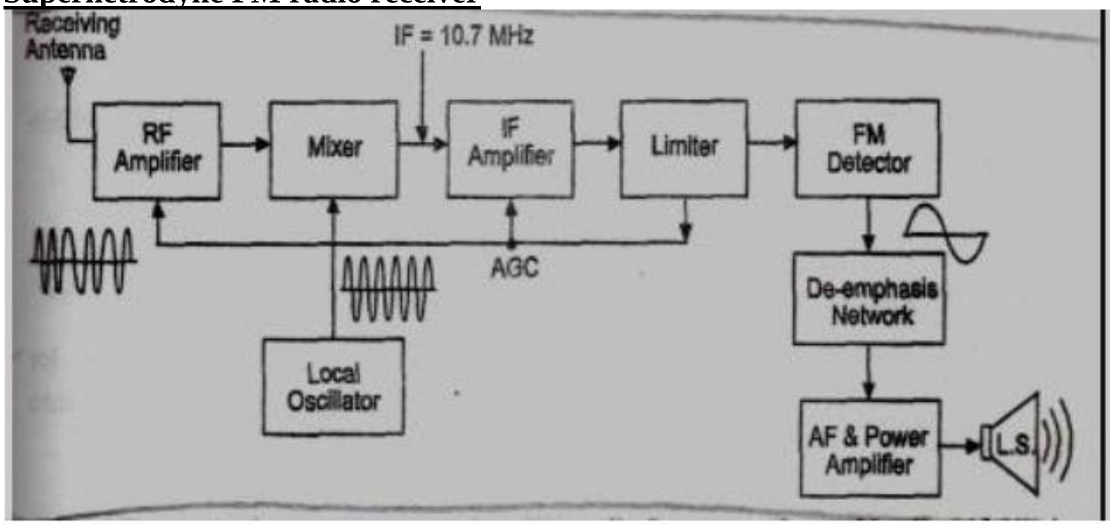


Explanation-

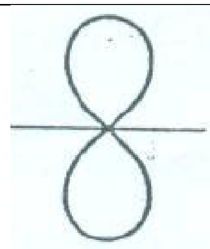
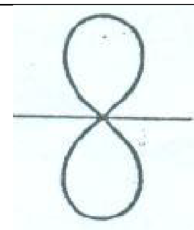
Amplitude limiter:
The function of amplitude limiter is to remove all amplitude variation of FM carrier voltage that may occur due to atmospheric disturbances. Use of amplitude limiter makes the system less noisy.

	c)	**Explain operation of balanced slope detector with 's' curve.**	**4M**
	Ans:	**Diagram:**  **Explanation:** The circuit uses two slope detectors. They are connected back to back to the opposite ends of the If by an amount which, in FM receiver with a deviation of 75 KH_Z, is 100KH_Z. The bottom circuit is similarly tuned below the IF by the same amount. Each tuned circuit is connected to a diode detector with an RC load. The output is taken from across the series combination of the two loads, so that it is the sum of the individual outputs. **Curve:**  *Balanced slope detector characteristic.*	**1M** **2M** **1M**

	d)	**Explain operation of phase discriminator with suitable phasor diagrams when input frequency and center frequency are unequal.**	**4M**
	Ans:	When $f_{in} > f_c$ Primary and secondary voltages are less than 90° out of phase Input at D1 > Input at D2 $V_{o1} > V_{o2}$ Vo is positive  When $f_{in} < f_c$ Primary and secondary voltages are more than 90° out of phase Input at D2 > Input at D1 $V_{o2} > V_{o1}$ Vo is Negative 	**2M each**
	e)	**Identify the block diagram label the blocks A,B,C,D,E.**	**4M**

		 Fig. No. 1	
	Ans:	**<u>Superhetrodyne FM radio receiver</u>**  A= RF Amplifier B=Local Oscillator C=IF Amplifier D=FM Detector E=AF & Power Amplifier	**Identifacation:1.5M** **Label block:2.5M (0.5M For each block)**
	f)	**Compare loop and ferrite core antenna with respect to following points** **i. Working principle** **ii. Construction** **iii. Radiation pattern** **iv. Application**	**4M**

Ans:

PARAMETERS	LOOP ANTENNA	FERRITE CORE ANTENNA
Working principle	When EM waves passes over a conductor an emf is induced into it.	When EM waves passes over a conductor an emf is induced into it.
Construction	A Single turn coil	It is a multiple turn coil around on a ferrite rod
Radiation pattern		
Application	1.Direction finding 2.Portable radio	As a receiving antenna in radio receiver.

Each Point -1M