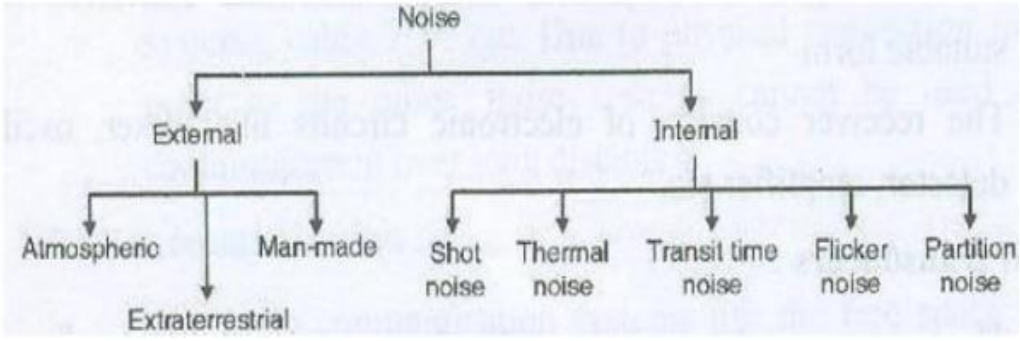
MODEL ANSWER

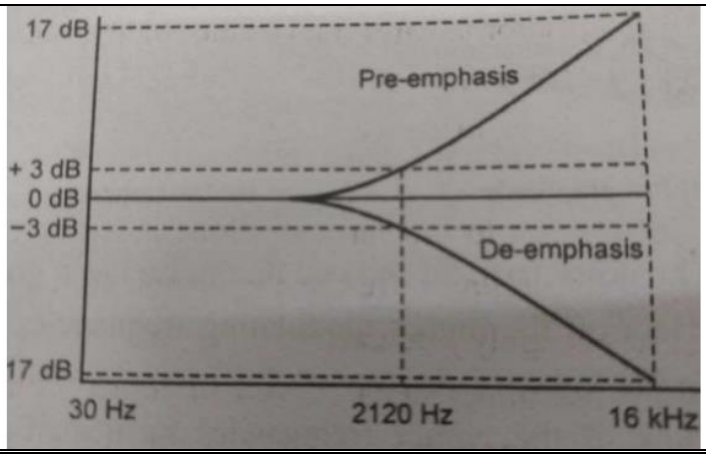
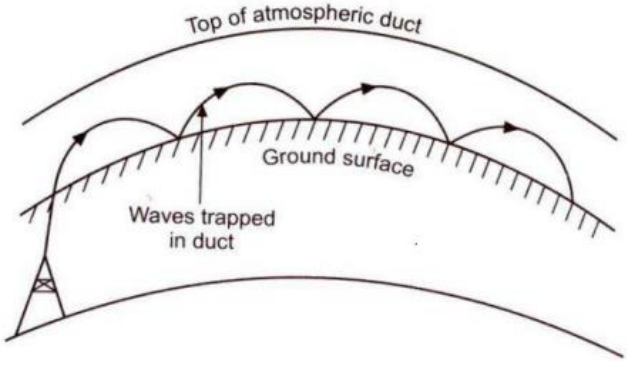
WINTER– 18 EXAMINATION

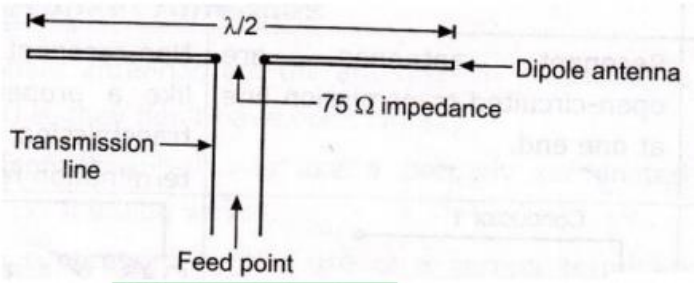
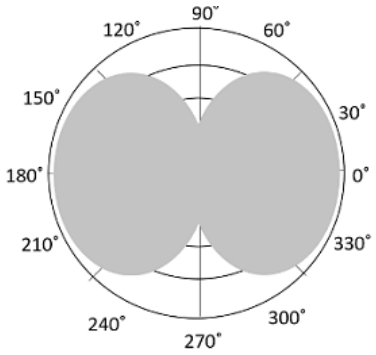
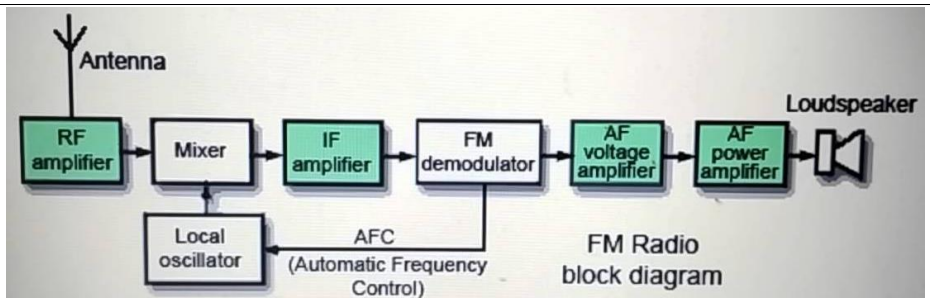
Subject Title: Principles of Electronic Communication Subject Code: 22334

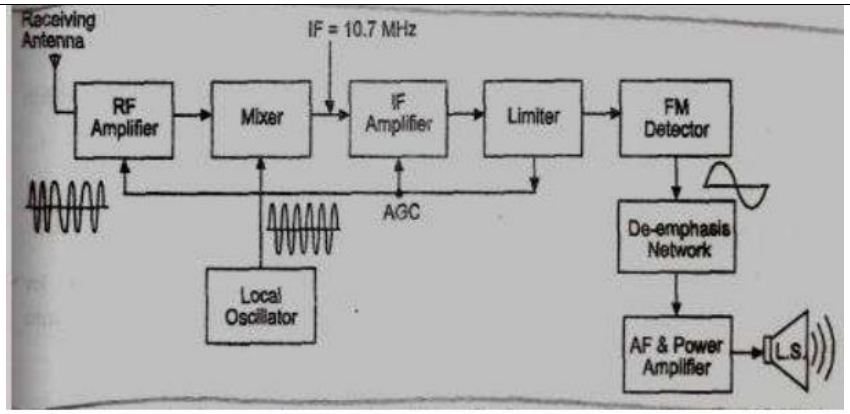
Important Instructions to examiners:

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.

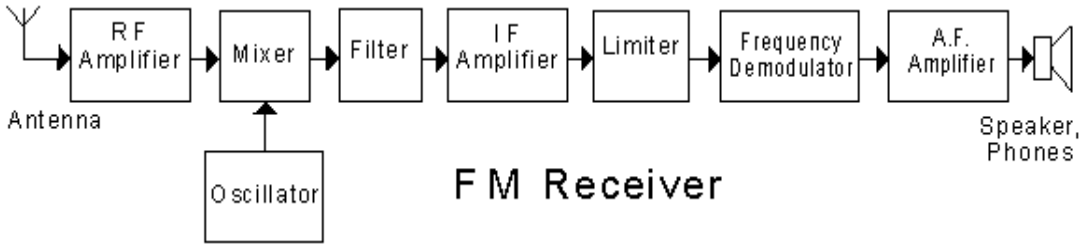
Q. No.	Sub Q.N.	Answer	Marking Scheme
Q.1		**Attempt any Five :**	**10-Total Marks**
	a)	**Define the term electrical noise. List types of noises.**	**2M**
	Ans:	**Electrical Noise:-** It can be defined as undesirable electrical signals, which distort or interfere with an original (or desired) signal. **Types of noises:-**  	**1M for definition and 1M for types**
	b)	**State formula to calculate bandwidth of AM signal.**	**2M**
	Ans:	Bandwidth of AM signal = 2* Fm Where	**Correct formula -2M**

		Fm is the modulating signal frequency	
	c)	**State the need of modulation in communication system.**	**2M**
	Ans:	**Need of modulation:-** 1. To reduce the height of antenna 2. To avoids mixing of signals 3. To increases the range of communication 4. To make multiplexing of maximum signal is possible 5. To improve the quality of reception	**Any 4 points ½ M each**
	d)	**List different methods of demodulation of FM signal.**	**2M**
	Ans:	• Balanced Slope detection • Ratio detector • Foster Seeley discriminator • Phase locked loop demodulator	**½ M each**
	e)	**Sketch the graph of pre-emphasis and de-emphasis.**	**2M**
	Ans:		**2M**
	f)	**Sketch neat diagram of duct propagation.**	**2M**
	Ans:		**2M**
	g)	**Draw sketch of half wave dipole antenna and its radiation pattern.**	**2M**

	Ans:	**Diagram:-**  **Half wave dipole antenna** **Radiation pattern:-**  	**1M each**
Q 2		**Attempt any Three :**	**12-Total Marks**
	a)	**State the frequency range for the following :** **i) Voice frequency** **ii) High frequency** **iii) IR frequency** **iv) Visible frequency.**	**4M**
	Ans:	• **Voice frequency:-** 300 Hz to 3400 Hz • **High frequency:-** 3MHz to 30 MHz • **IR frequency:-** 300 GHz -430THz- • **Visible frequency:-** 430 THz -790 THz	**1M each**
	b)	**Draw neat block diagram of FM receiver and explain function of each block**	**4M**
	Ans:	 **OR**	**Diagram 2M**



OR



Explanation:-

RF amplifier:

There are two important functions of RF amplifier:

1) To increase the strength of weak RF signal.

2) To reject image frequency signal. In FM broadcast the channel bandwidth is large as compared to AM broadcast.

Hence the RF amplifier must be design to handle large bandwidth.

Frequency Mixer:

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

Local oscillator:

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

(fi = fs-fo).

IF amplifier:

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

Amplitude limiter:

The function of amplitude limiter is to remove all amplitude variation of FM carrier voltage that may occur due to

atmospheric disturbances. Use of amplitude limiter makes the system less noisy.

FM Discriminator or detector:

Function of each block - 2M

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

Audio frequency voltage and power amplifier:

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

c) **Compare AM with FM with respect to following points:** **4M**

a) **Definition.**
b) **Modulation index.**
c) **Bandwidth.**
d) **Side band.**

Ans: **1M each**

Parameters	AM	FM
Definition	It is the process in which the amplitude of carrier signal is varied in accordance with the instantaneous value of modulating signal keeping frequency and phase constant.	It is the process in which the frequency of carrier signal is varied in accordance with the instantaneous value of modulating signal keeping amplitude and phase constant.
Modulation index	The value of modulating index is less than or equal to 1	The value of modulating index is always greater than 1
Bandwidth	Twice the highest modulating frequency.	Twice the sum of the modulating signal frequency and the frequency deviation.
Side band	There are two sidebands	Infinite number of sideband

d) **A super heterodyne radio receiver with an IF of 455kHz is tuned to 1000kHz .Find:** **4M**

a) **Image frequency.**
b) **Local oscillator frequency.**

Ans:

Tuned frequency is 1000 KHz means it is RF frequency
IF frequency is 455 KHz

i) **Image frequency** = RF frequency ± 2 * IF frequency

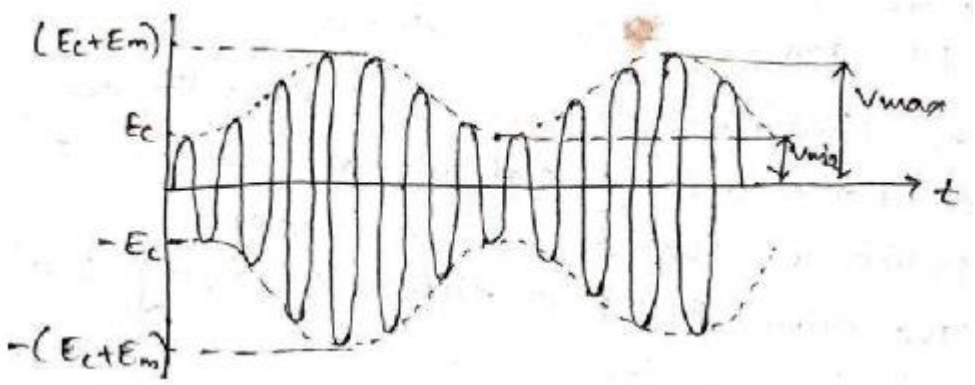
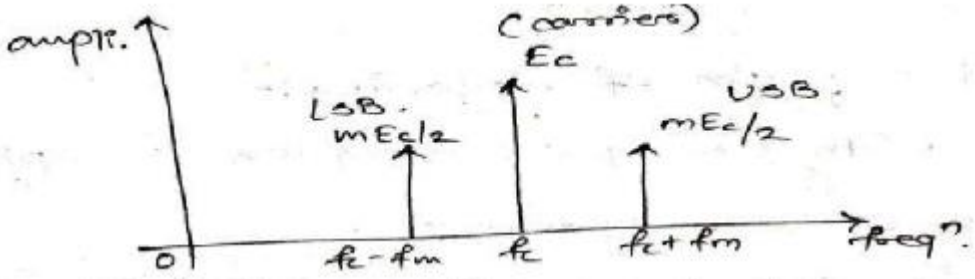
= $1000 * 10^3 \pm 2 * 455 * 10^3$
= 1910 KHz (sum frequecy)

OR = 90KHz (difference frequency) this frquency is not possible
Hence the image frequency is 1910KHz

Formula of each -1M

Correct answer-1M each

ii) **Local oscillator frequency =** RF frequency - IF frequency

		= 1000 KHz – 455 KHz = 545 KHz	
Q.3		**Attempt any three:**	**16-Total Marks**
	a)	**Draw AM signal in** **i) Time domain** **ii) Frequency domain.**	**4M**
	Ans:	(i) **AM in Time domain**  **(ii)AM in frequency domain**  	**2 marks** **2 Marks**
	b)	**Find out type of propagation for following applications:** **1) AM radio broadcasting** **2) Ship to shore propagation.** **3) Microwave links.** **4) Satellite communication.**	**4M**
	Ans:	**1) AM radio broadcasting:-**Ground Wave Propagation **2) Ship to shore propagation:-** Ground Wave Propagation **3) Micro wave links**:-Space Wave Propagation/ line of sight **4) Satellite communication:-**Space Wave Propagation/ line of sight	**1 mark for each type**

c) **Compare characteristics of asynchronous and synchronous transmission mode (four points).** **4M**

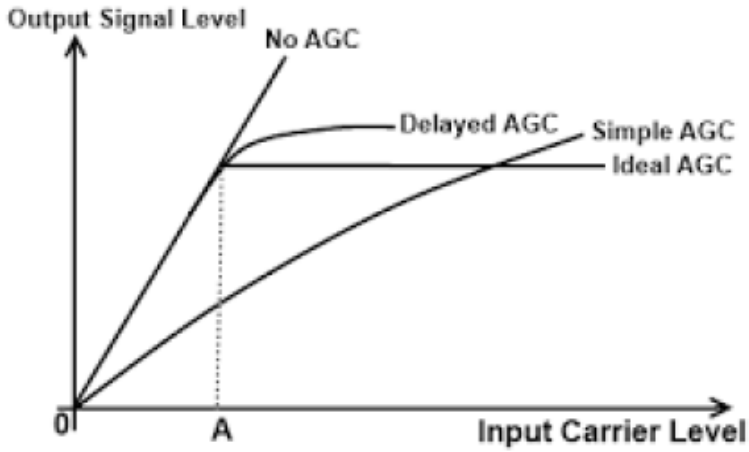
Ans:

Synchronous transmission	Asynchronous transmission
1. Synchronous transmission are synchronized by an external clock.	1. Asynchronous transmission are synchronized by special signals along the transmission media.
2.In synchronous transmission data flows in a full duplex mode in the form of blocks or frames.	2. In asynchronous transmission data flows in a half duplex mode, 1byte or a character at a time.
3. In synchronous transmission ,data transmission speed is fast.	3. In asynchronous transmission, data transmission speed is slow.
4. Synchronous transmission is cost expensive.	4. Asynchronous transmission is economical.
5. Synchronous transmission is used for transferring the bulk of data as it is efficient.	5. Asynchronous transmission is used for transferring a small amount of data as it is simple and economical.

1 mark for each point

d) **Explain simple AGC and delayed AGC with the help of neat graph.** **4M**

Ans:



1) Simple AGC:-

- Simple AGC is a system by means of which overall gain of a radio receiver is varied, automatically with the changing strength of the receiver signal to keep the output substantially constant.
- Hence the receiver gain is automatically reduced as the input signal becomes more & more strong
- There is a reduction in gain for weak signals.
- It is used in domestic radio receiver.

2) Delayed AGC:-

- As shown in the diagram, AGC biased is not applied until the input signal strength reaches the predetermined level of point A
- After this level, the point A AGC bias is applied just like simple AGC but

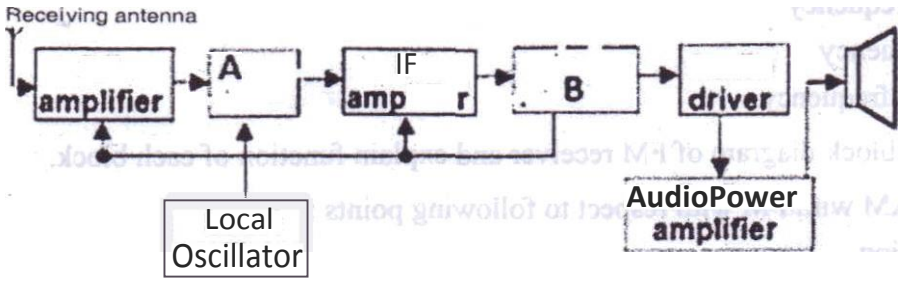
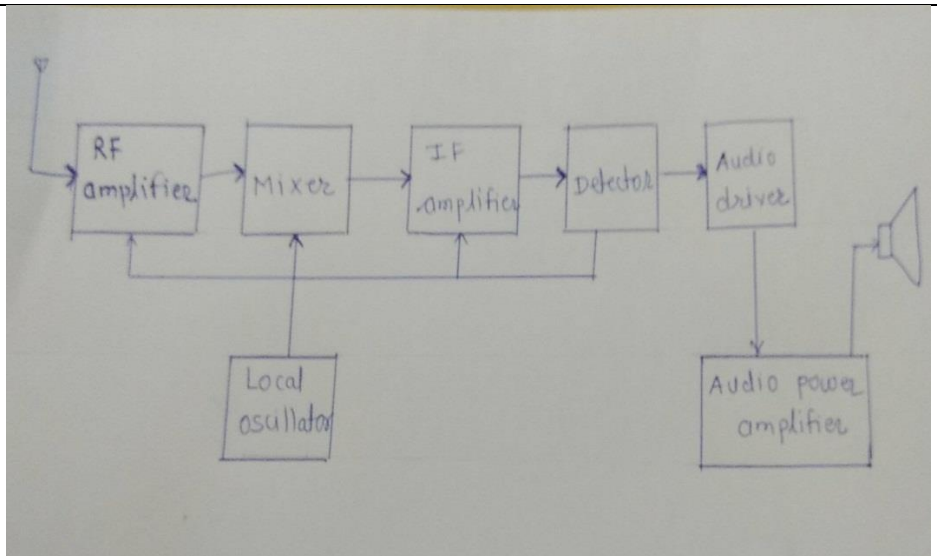
2 marks for graph,1 mark for each type explanation

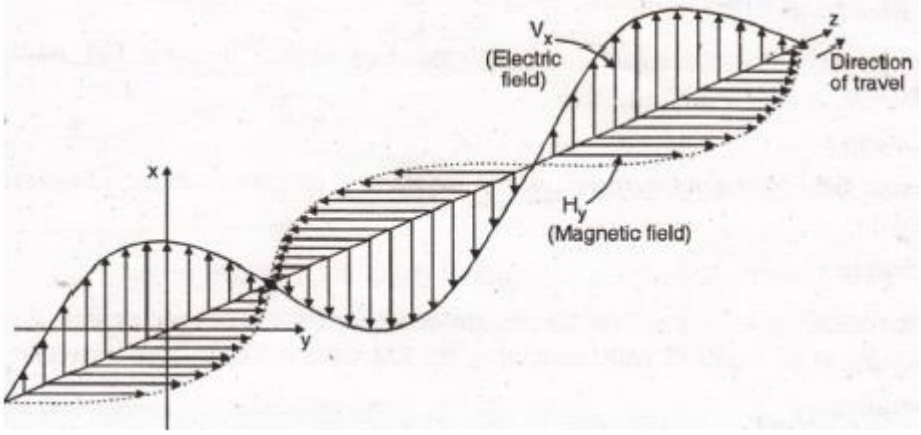
more strongly.

- There is no reduction in gain for weak signals.
- The problem of reducing the receiver gain for weak signal is avoided .the delayed AGC is not used in low cost radio receiver.
- It is used in high quality receiver like communication receiver.

Q.4	**A)**	**Attempt any THREE :**	**12-Total Marks**
	a)	**Define the following terms:** **1) Virtual height** **2) Actual height** **3) Critical frequency.** **4) Maximum usable frequency.**	**4M**
	Ans:	**1)Virtual height:-**The incident and refracted rays follow paths that are exactly the same as they have been if reflection had taken place from a surface located at a greater height, called Virtual height of this layer **2) Actual height:-**The actual height of the wave in the ionized layer is a curve and is due to refraction of wave. The height from this curve to earth surface is called actual height. **3) 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 F2 layer is between 5 to 12 MHz. 4) **Maximum usable frequency**: The limiting frequency when the angle of incidence is other than the normal is known as maximum unstable frequency. MUF= fc secθ	**Each correct definition carries 1 mark**
	b)	**Compare narrow band FM with wide band FM (fourpoints).**	**4M**
	Ans:		**1 mark for each correct point**

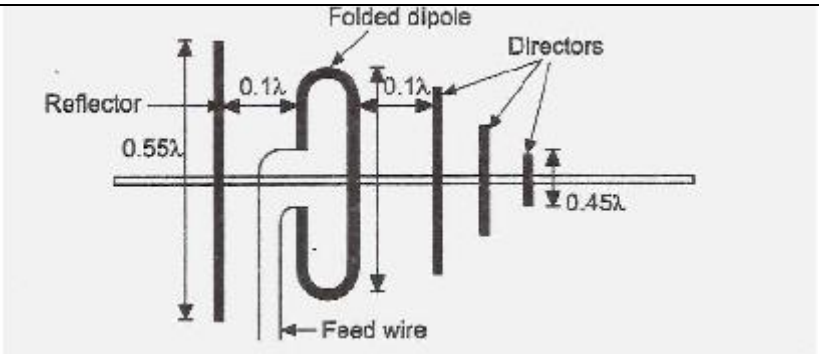
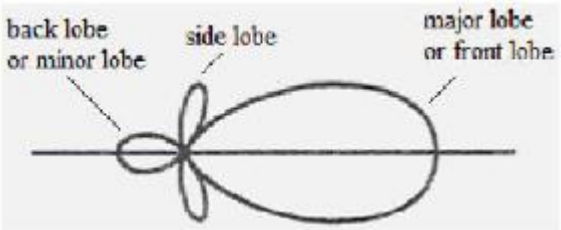
Narrow band FM	**Wide band FM**
1 .Modulation Index is less than or slightly greater than 1.	1. Modulation Index is greater than 1.
2.Maximum deviation is 5 KHz.	2. Maximum deviation is 75 KHz.
3.Range of modulating frequency is 30 Hz to 3KHz	3. Range of modulating frequency is 30 Hz to 15KHz
4. Bandwidth is small approximately same as that of AM.	4. Bandwidth is large about 15 times higher than bandwidth of Narrow band FM.
5.Application:-FM mobile communication like police wireless, ambulance etc.	5. Application:-Entertainment broadcasting.

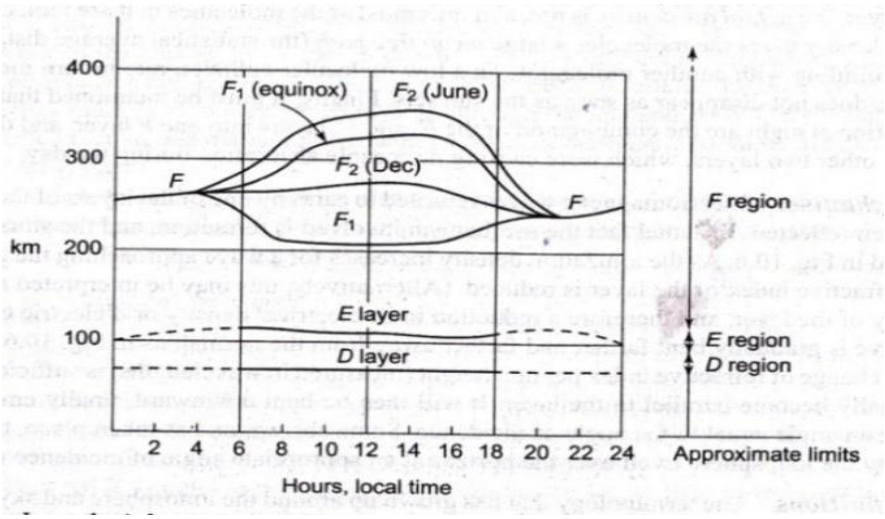
	c)	**Redraw the block diagram by identifying the blank blocks. Explain the role of blocks A and B.** 	**4M**
	Ans:	 **Role of block A and B** **Mixer-** Receives signal from RF stage Fs and the local oscillator Fo, and are mixed to produce intermediate frequency signal IF which is given as: IF=Fo-Fs. **Detector-**Amplified signal is detected by the detector to get original modulating signal. The detector also provides control signals to control the gain of IF and RF stage called as AGC.	**Labelling blocks A,B – 1 M each** **Role of A - 1M** **Role of B - 1M**
	d)	**Justify electromagnetic wave is said to be transverse wave.**	**4M**
	Ans:	**Transverse electromagnetic wave:-**	**2 marks-diagram,2 marks-justification**

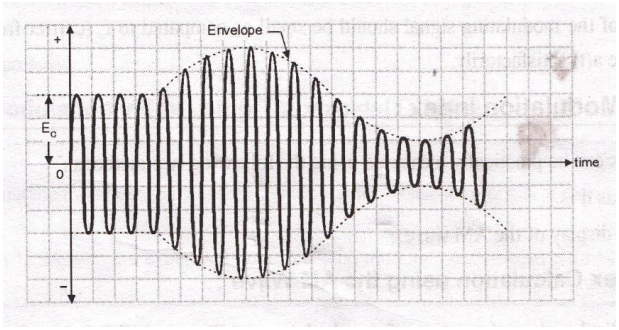


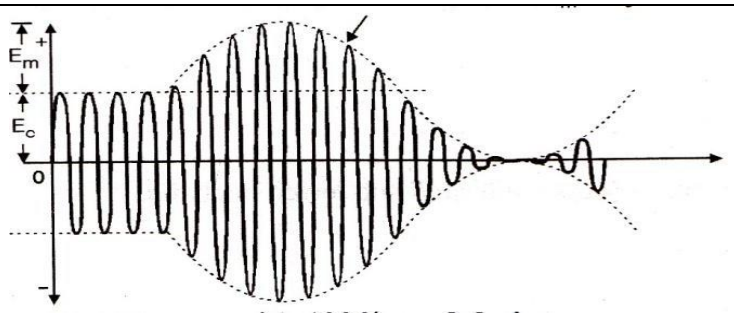
The electromagnetic waves are oscillations which propagate through free space. In electromagnetic waves the direction of electric field, magnetic field & propagation are mutually perpendicular.
Hence electromagnetic waves are called as transverse wave.

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)

e)	**Sketch of Yagi-Uda antenna with its radiation pattern. Explain each element of Yagi-Uda antenna**	**4M**
Ans:	 **Radiation Pattern:-**  **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. . Yagi–Uda antennas consist of a single driven element connected to the transmitter or receiver with a transmission line, and additional parasitic elements so called reflector and one or more directors. The reflector is placed at the back of the folded dipole. Reflector reflects the unwanted signals. The director is placed in front of folded dipole which collects the wanted signals.	**1 mark-diagram,1 mark-radiation pattern,2 marks-explanation**

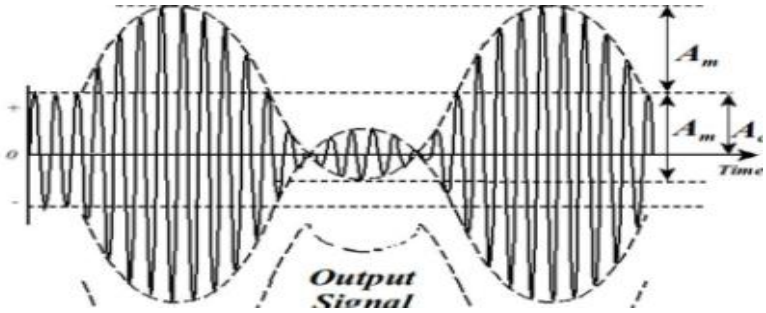
		The folded dipole with one or two directors and reflectors give high gain and beam width per unit area of array.	
Q.5		**Solve any TWO :**	**12-Total Marks**
	a)	**Explain ionospheric propagation with neat sketch. Explain two properties of layers of ionosphere.**	**6M**
	Ans:	**Diagram :**  **Explanation:** • The transmitted signal travels into the upper atmosphere where it is reflected back to earth due to the presence of layers called as ionosphere in the upper atmosphere. • The D layer is the lowest and it exist at a height of about 70 Km from the earth surface. • The E layer existing at an approximate height of 100 Km. The E layer also almost disappears at night due to recombination of ions and molecules. • The E layer is a thin layer of very high ionization density, sometimes making an appearance with the E layer. • The F_1 layer exist at a height of 180Km in daytime & combines with F_2 layer at night its daytime thickness is almost 20Km. The Ionosphere is the upper portion of the atmosphere. The ultra violet radiation from the sun will ionize the upper layer of the atmosphere. Due to ionization these part of the atmosphere becomes electrically charged. 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. **Properties of layers of ionosphere:-** 1. D Layer: It is lowest layer at a height of 70 kms with thickness 10 km. The	**Diagram 2M** **Explanation 2M** **Any Two Properties of layer -2 M**

		ionization density is maximum at noon and disappears at night. 2. E Layer: It is the next layer at a 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 a height of 180 kms with thickness 20 km. It provides more absorption for HF waves. 4. F2Layer: It is the next layer at a 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.	
	b)	**i) State the significance of modulation index in AM transmission.** **ii) Explain the effect of modulation index on AM wave with waveforms.**	**6M**
	Ans:	**Significance of modulation index in AM transmission** • It is used to determine the strength and quality of transmitted signal. • If the modulation index is small, then the amount of variation in the carrier amplitude is small. Thus, the audio signal transmitted will not be strong. • The greater the degree of modulation, die stronger and clearer will be the audio signal during reception. **Effect of modulation index on AM wave** **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.	**Significance 3M & three conditions 1M each**



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.



c) **Write the application of the following antennas:**

1) **Rectangular antenna**
2) **Dish antenna**
3) **Horn antenna**
4) **Loop antenna**
5) **Yagi-Uda antenna.**

6M

Ans:

(Note :AnyRelevent application gives the Marks.)

Applications:

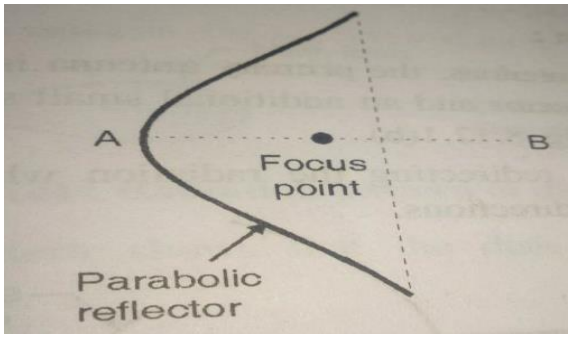
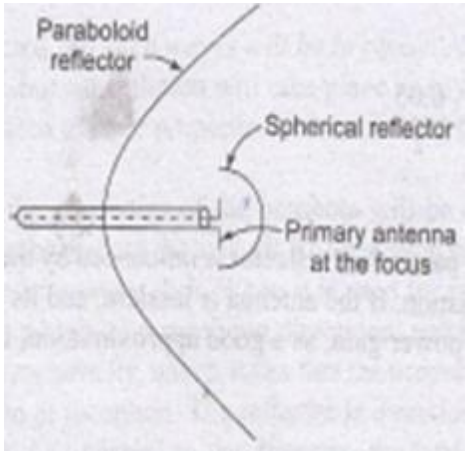
1.Rectangular antenna

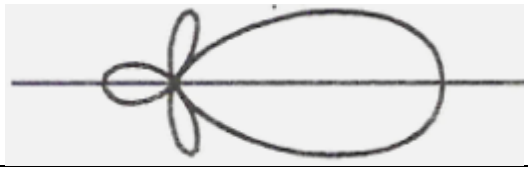
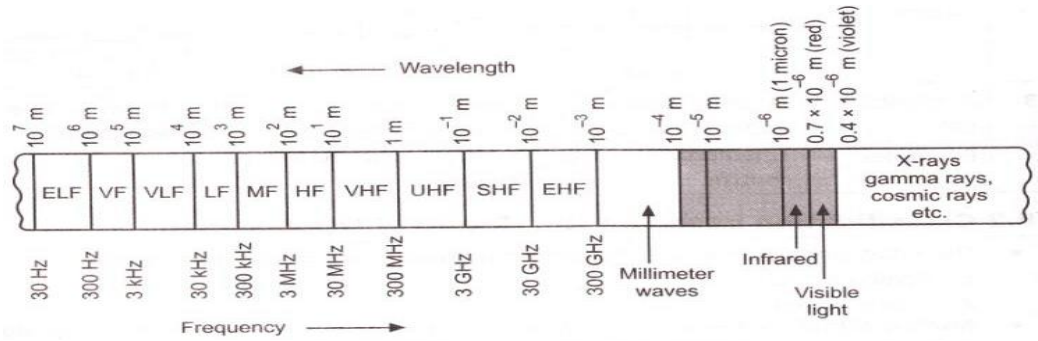
i)Used in Mobile and satellite communication
ii)Used in Global Positioning System
iii) Used for Radio Frequency Identification (RFID)
iv) Radar

Dish Antenna

i)Used in microwave relay links that carry telephone and television signals between nearby cities
ii) Used in wireless WAN/LAN links for data communications, satellite communications and spacecraft communication antennas.
iii) Used in radio telescopes.

6M

		Horn Antenna i) Used at microwave frequency. ii) Used in satellite tracking. **Loop Antenna** 1. For direction finding 2. In portable receivers 3. In navigation **Yagi-Uda antenna** 1. Yagi-Uda antenna is used in HF and VHF range as a TV receiving antenna. 2. Yagi-Uda antenna is used in conditional Access System (CAS) at the decryptor**.**	
Q.6		**Attempt any TWO:**	**12-Total Marks**
	a)	**Describe operating principle of dish antenna. Draw its constructional details and radiation**	**6M**
	Ans:	**Operating principle:** 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. **Dish antenna**  **Or** 	**(Operating Principle:2 M,Construction:2M,Radiation pattern:2M)**

		Radiation Pattern: 	
	b)	**i) Explain electromagnetic spectrum with neat diagram.** **ii) Explain atmospheric noise with example.**	**6M**
	Ans:	 **Explanation:-** • The electromagnetic spectrum is the range of frequencies of electromagnetic radiation and their respective wavelengths • The electromagnetic spectrum covers electromagnetic waves with frequencies ranging from below one hertz to above 10^{25} hertz • This frequency range is divided into separate bands, and the electromagnetic waves within each frequency band are called by different names; beginning at the low frequency (long wavelength) end of the spectrum these are: radio waves, microwaves, terahertz waves, infrared, visible light, ultraviolet, X-rays, and gamma rays at the high-frequency (short wavelength) end. **Ii) 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. **Example:** Lightning	**(Diagram-2M, Explanation-1M)** **Explainatio n:2M,Exam ple:1M)**
	c)	**A10kw carrier is amplitude modulated by two sine waves to a depth of 0.5and 0.6 respectively. Calculate total power of modulated wave.**	**6M**
	Ans:	Given: P_C =10kW, m_1=0.5, m_2=0.6 ,P_t=? $m_a = \sqrt{m_1^2 + m_2^2}$ $=\sqrt{0.5^2 + 0.6^2}$	**Formula-1m each Calculation of each- 2M**

		=0.78 $P_t = P_C(1+m_a^2/2)$ $=10(1+(0.78)^2/2)$ =13.05 kW	