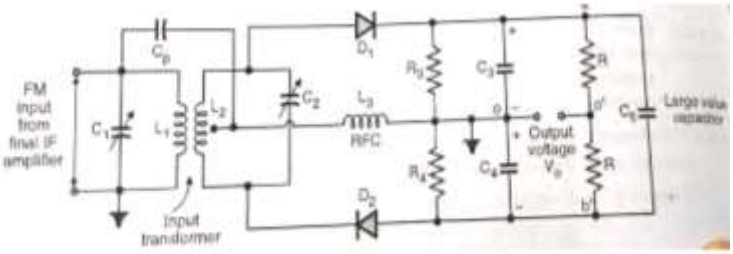
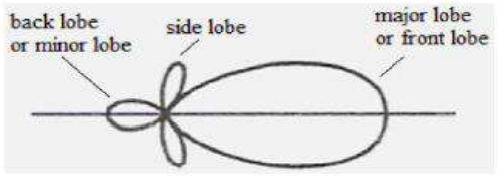
WINTER – 19EXAMINATION

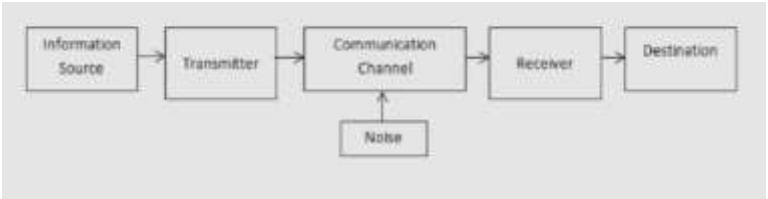
Subject Name: Principles of Electronic Communication **Model Answer** Subject Code: 22334

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

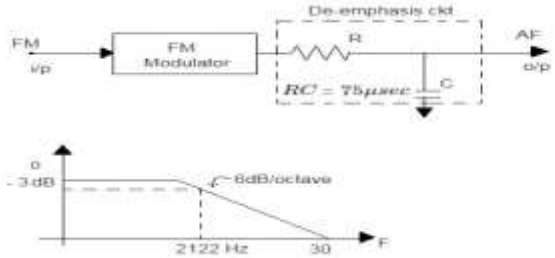
Q. No.	Sub Q. N.	Answer	Marking Scheme
Q.1		**Attempt any FIVE of the following:**	**10 M**
	a)	**Define the term signal to noise ratio.**	**2M**
	Ans:	**Signal to Noise ratio**: The ratio of the strength of an electrical or other signal carrying information to that of unwanted interference is called as signal to noise ratio. OR Signal to Noise Ratio is defined as the ratio of signal power to the noise power at the same point. S/N=Ps/Pn where,Ps=Signal Power Pn=Noise Power at the same point	**Definition: 2 marks**
	b)	**Define modulation index of FM.**	**2M**
	Ans:	**Modulation index** of FM is defined as the ratio of the frequency deviation to the **modulating** frequency. M.I.= ∇ / fm Where ∇- frequency deviation Fm- modulating frequency	**2M**
	c)	**Write Carson's rule to calculate BW of FM wave.**	**2M**
	Ans:	**Carson's Rule for FM bandwidth** B.W. = 2(Δf+fm) **Where:** Δf = deviation fm = modulating frequency	**rule 2M**
	d)	**Draw the labelled circuit dia. Of ratio detector.**	**2M**

	Ans:	 Fig Ratio detector circuit	**Ckt. Diagram: 2 marks**
	e)	**Write the IF value of** **(i) FM ratio recevier.** **(ii) MW band AM.**	**2M**
	Ans:	(i) 10.7 Mhz (ii) 455 Khz	**1 mark each**
	f)	**Define fading w.r.t. 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**
	g)	**Sketch the radiation pattern of Yagi-Uda antenna.**	**2M**
	Ans:	**Radiation pattern:-** 	**Pattern 2M**

Q.2		**Attempt any THREE of the following:**	**12 M**
	a)	**Draw the basic block diagram of Electronic communication system. State the function of transmitter.**	**4M**
	Ans:	**Block diagram:**  • **Transmitter** The function of the transmitter is to process the electrical signal from different aspects. For example in radio broadcasting the electrical signal obtained from sound signal, is processed to restrict its range of audio frequencies (up to 5 kHz in amplitude modulation radio broadcast) and is often amplified. In wire telephony, no real processing is needed. However, in long-distance radio communication, signal amplification is necessary before modulation. Modulation is the main function of the transmitter. In modulation, the message signal is	**Block diagram: 2 Marks,** **Function: 2 Marks**

	superimposed upon the high-frequency carrier signal. In short, we can say that inside the transmitter, signal processing such as restriction of range of audio frequencies, amplification and modulation of signal are achieved. All these processing of the message signal are done just to ease the transmission of the signal through the channel.	
b)	**A 10kW carrier is amplitude modulated by two sine to a depth of 0.5 & 0.6 respectively. Calculate total power of modulated carrier.**	**4M**
Ans :	$P_c = 10\ kW = 10,000\ W$ $m_1 = 0.5$ $m_2 = 0.6$ $P_{t_1} = P_c\left(1 + \frac{m_1^2}{2}\right)$ $= 10,000\left(1 + \frac{(0.5)^2}{2}\right)$ $= 11,250\ watt$ $\boxed{P_{t_1} = 11,250\ watt}$ $P_{t_2} = P_c\left(1 + \frac{m_2^2}{2}\right)$ $= 10,000\left(1 + \frac{(0.6)^2}{2}\right)$ $= 10,000\left(1 + \frac{0.36}{2}\right)$ $= 11,800\ watt$ $\boxed{P_{t_2} = 11,800\ watt}$ $P_t = P_{t_1} + P_{t_2}$ $= 11,250 + 11,800$ $= 23,050\ W$ $\boxed{\text{Total power} = 23.05\ kW}$	**Calculation of Pt1- 1.5 Marks,** **Pt2- 1.5 Marks, Pt- 1 Marks**
c)	**Compare AM & FM w.r.t. following points.** **(i) Definition** **(ii) Modulation index** **(iii)Bandwidth** **(iv)Application**	**4M**
Ans :		**4 Points 4M**

SR. NO	PARAMETER	AM	FM
1	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.
2	Modulation Index	$m = \frac{V_m}{V_c}$	$Mf = \frac{\delta_m}{f_{m(max)}}$
3	Bandwidth	BW = 2 fm	BW = 2 (δ+ fm (max))
4	Application (any relevant point to be considered)	Video transmission in TV receivers etc.	Sound transmission in TV receivers etc.

d)	**Explain the concept of De-emphasis with neat diagram.**	**4M**
Ans :		**diagram 2M ,Explanation 2M**

- In the De-emphasis circuit, by reducing the amplitude level of the received high frequency signal by the same amount as the increase in pre-emphasis is termed as De-emphasis.
- The pre-emphasis process is done at the transmitter side, while the de-emphasis process is done at the receiver side.
- Thus a high frequency modulating signal is emphasized or boosted in amplitude in transmitter before modulation. To compensate for this boost, the high frequencies are attenuated or de-emphasized in the receiver after the demodulation has been performed. Due to pre-emphasis and de-emphasis, the S/N ratio at the output of receiver is maintained constant.
- The de-emphasis process ensures that the high frequencies are returned to their original relative level before amplification.
- Pre-emphasis circuit is a high pass filter or differentiator which allows high frequencies to pass, whereas de-emphasis circuit is a low pass filter or integrator which allows only low frequencies to pass.

Q.3 **Attempt any THREE of the following:** **12 M**

a) **Compare narrow band FM with wide-band FM w.r.t. following points.**
(i) Modulation index
(ii) Maximum deviation
(iii)Range of modulating frequency
(iv)Application **4M**

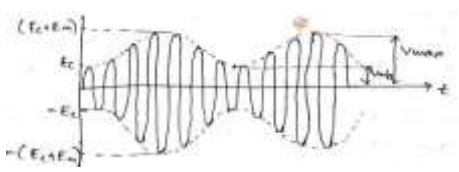
Ans :

Sr. No	Parameters	Narrow band FM	Wide band FM
1	**Modulation index**	Less than or slightly greater than 1	Greater than 1
2	**Maximum deviation**	5 KHz	75 KHz
3	**Range of modulating frequency**	30Hz to 3 KHz	30Hz to 15 KHz
4	**Application**	FM mobile communication like police wireless, ambulance etc.	Entertainment broadcasting can be used for high quality music transmission

1M for each correct point

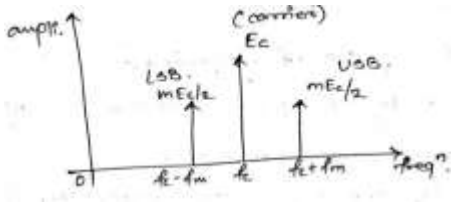
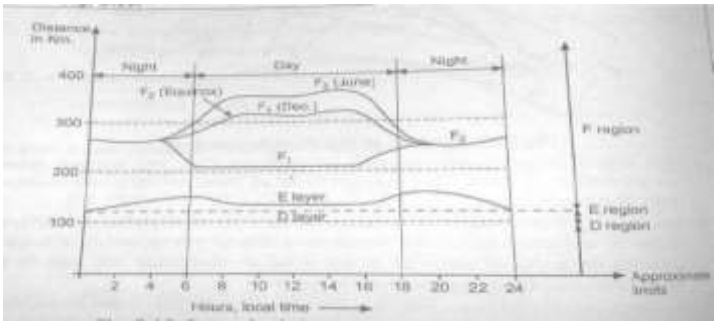
b) **Sketch AM signal in (1)Time domain (2)Frequency domain.** **4M**

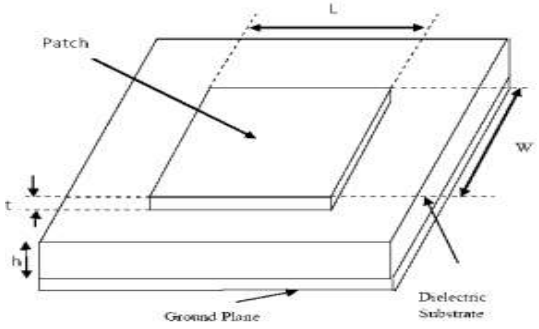
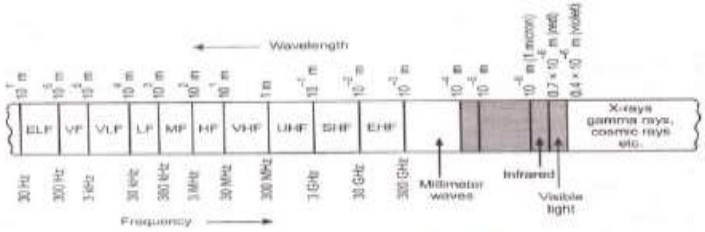
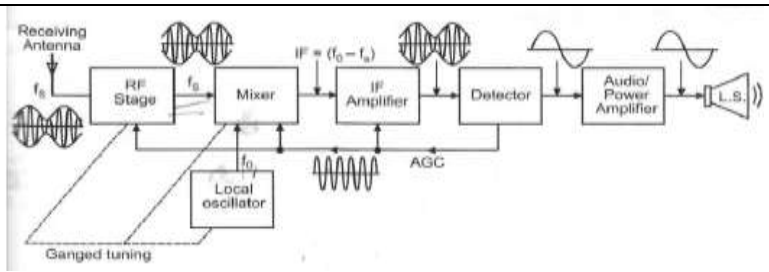
Ans : **AM in Time domain**



2M-time domain ,

2M-frequency domain

		AM in frequency domain 	
	c)	**Explain why reception for high frequency band is better during night time.**	**4M**
	Ans :	In sky wave propagation, the transmitted signal travels into the upper atmosphere where it is bent or reflected back to earth. This bending or reflection of signal takes place due to the presence of a layer called as ionosphere in the upper atmosphere. There are four main ionospheric layers F2, F1, D, E in the descending order. At night the F1 and F2 layers combine to form one layer and the lower two layers D and E disappears. As the lower layers are absent, the absorption of the signal does not take place, which was taking place during the day time. This improves the strength of the reflected signal and hence the reception for high frequency band is better during night time. 	**2M- explaination** **2M – Diagram**
	d)	**Explain structure of rectangular microstrip patch antenna with its radiation pattern.**	**4M**
	Ans :	In telecommunication, a microstrip antenna (also known as a printed antenna) usually means an antenna fabricated using microstrip techniques on a printed circuit board (PCB).It is a kind of internal antenna. They are mostly used at microwave frequencies. An individual microstrip antenna consists of a patchofmetal foil of various shapes (a patch antenna) on the surface of a PCB (printed circuit board), with a metal foil ground plane on the other side of the board. Most microstrip antennas consist of multiple patches in a two-dimensional array. The antenna is usually connected to the transmitter or receiver through foil microstrip transmission lines. The radio frequency current is applied (or in receiving antennas the received signal is produced) between the antenna and ground plane. Microstrip antennas have become very popular in recent decades due to their thin planar profile which can be incorporated into the surfaces of consumer products, aircraft and missiles; their ease of fabrication using printed circuit techniques; the ease of integrating the antenna on the same board with the rest of the circuit, and the possibility of adding active devices such as microwave integrated circuits to the antenna itself to make active antennas. The most commonly employed microstrip antenna is a rectangular patch which looks like a truncated microstrip transmission line. It is approximately of one-half wavelength long. When air is used as the dielectric substrate, the length of the rectangular microstrip antenna is approximately one-half of a free-space wavelength. As the antenna is loaded with a	**2M- explaination**

		dielectric as its substrate, the length of the antenna decreases as the relative dielectric constant of the substrate increases. The resonant length of the antenna is slightly shorter because of the extended electric "fringing fields" which increase the electrical length of the antenna slightly. An early model of the microstrip antenna is a section of microstrip transmission line with equivalent loads on either end to represent the radiation loss.  	**2M- Diagram**
Q.4		**Attempt any THREE of the following:**	**12 M**
	a)	**Explain Electromagnetic spectrum.**	**4M**
	Ans :	The information signal should be first converted into an electromagnetic signal before transmission because the wireless transmission takes place using electromagnetic waves. The electromagnetic waves are oscillations which propagate through free space. The electromagnetic wave consists of both electric and magnetic fields. The electromagnetic waves can travel a long distance through space. In electromagnetic waves, the direction of electric field, magnetic field & propagation are mutually perpendicular. Since the oscillations are perpendicular to direction of propagations of waves they are said to be transverse waves. The frequency of electromagnetic signals ranges from few Hertz to several GHz. This entire range of frequency of EM waves is called EM spectrum.  	**2M explanation** **2M- diagram**
	b)	**Draw the block diagram of AM. Super heterodyne ratio receiver and state the function of each block**	**4M**
	Ans :	 AM super heterodyne receiver works on the principle of super heterodyning. In the super heterodyne receiver, the incoming signal voltage is combined with a Signal generated in the receiver. The local oscillator voltage is normally converted into a signal of a low fixed frequency with the help of mixer.	**diagram – 2M,** **explanation – 2M**

The signal at this intermediate frequency contains the same modulation as the original carrier and it is now amplified and detected to reproduce the original modulating signal.

Functions of each block-

Receiving antenna- AM receiver operates in the frequency range of 540 KHz to 1640 KHz.

RF stage- 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

Ganged Tuning- To maintain a constant difference between the local oscillator and RF signal frequency, gang capacitors are used.

IF stage- The IF signal is amplified by the IF amplifier with enough gain.

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.

AGC- Automatic gain control controls the gain of RF and IF amplifiers to maintain a constant output level at the speaker even though the signal strength at the antenna varies.

c) In FM if max. Deviation is 75kHz and the max. Modulating frequency is 10 kHz. Calculate the deviation ratio and bandwidth of FM. — **4M**

Ans : — **2M- Deviation ratio, 2M- banwidth**

Given-: $\delta_{max=}$75 KHz

$f_{m=}$10KHz

i)Deviation Ratio=$\delta_{max}/f_{m(max)}$

=75KHz/10KHz

=7.5

Deviation Ratio=7.5

ii)Bandwidth=$2(\delta_{max}+f_{m(max))}$

$= 2x(75+10)KHz$

= 170 KHz

Bandwidth=170 KHz

d) Compare sky wave and space wave propagation w.r.t. following points.

(i) Frequency range

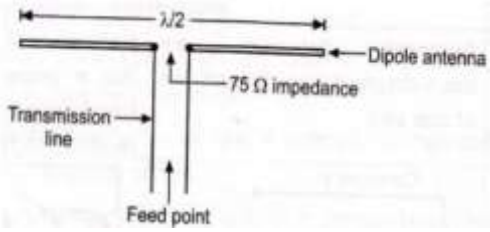
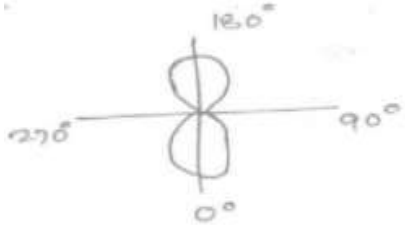
(ii) Effect of fading

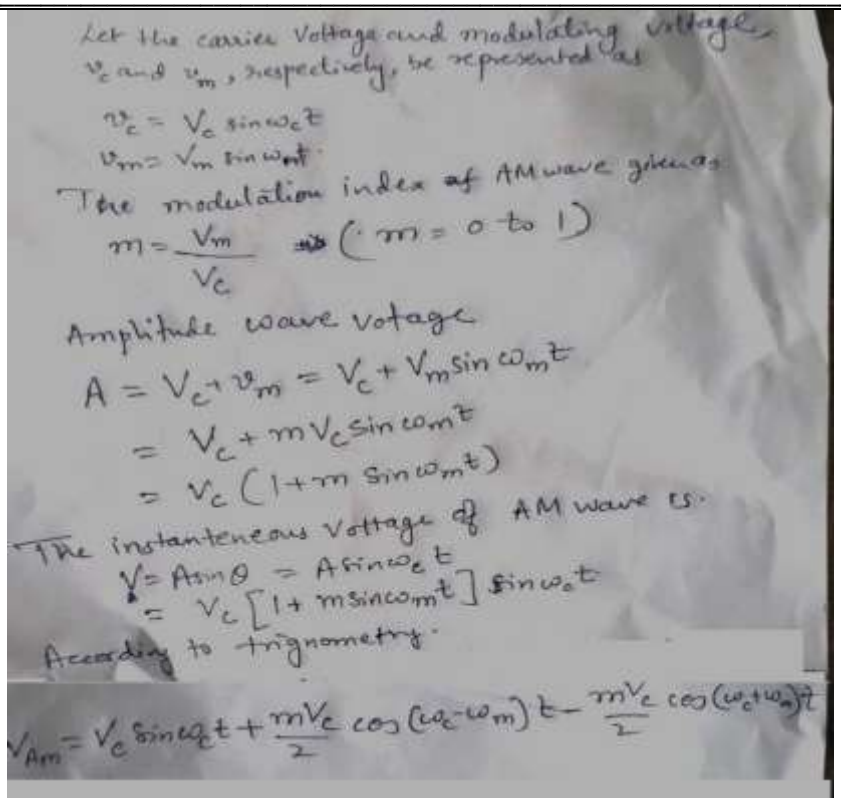
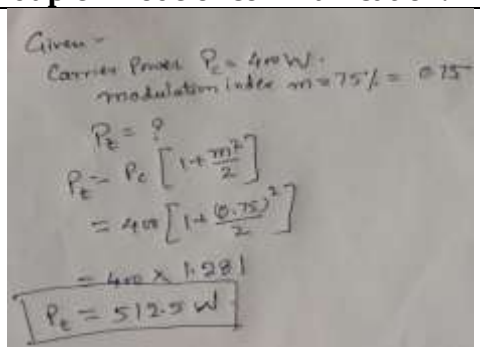
(iii)Polarization

(iv)Application — **4M**

Ans : — **1M for each correct point**

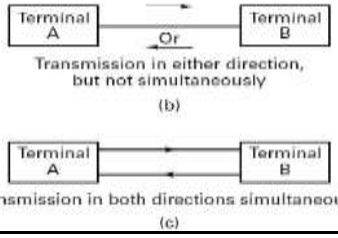
Sr. No	Parameters	Sky Wave Propagation	Space Wave Propagation
1	Frequency range	3 MHz to 30 MHz	Above 30 MHz
2	Effect of fading	Problem of fading is severe	Fading is not severe but shadow zones due to tall objects and ghost interference are serious problems.

		3	Polarization	Vertical	Line of Sight Propagation with waves horizontally Polarized	
		4	Application	RadioBroadcasting (SW Range)	Used for TV and FM broadcasting	
	e)	**Explain the working of half dipole antenna with its radiation pattern.**				**4M**
	Ans :	**Half wave dipole antenna diagram**  **Explanation:** 1. It is a resonant antenna 2. It is exact half wavelength (λ /2) long & open circuited at one end. 3. The dipole antennas have lengths λ /2 , λ , 3 λ /2 etc. which are all multiple of λ /2. Hence they are resonant. 4. In half wave dipole antennas the forward waves & reflected waves exist. Hence radiation pattern is bidirectional. **The radiation pattern of half wave dipole antenna is –**  				**Diagram -1M** **Explanation-2M** **Radiation pattern-1M**
Q.5		**Attempt any TWO of the following:**				**12 M**
	(a)	**Derive a mathematical expression for AM wave.**				**6M**

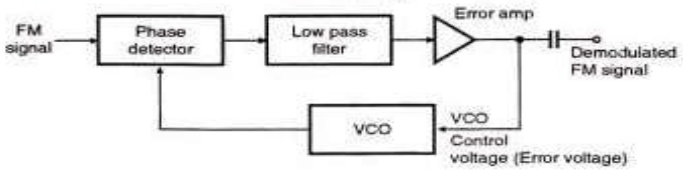
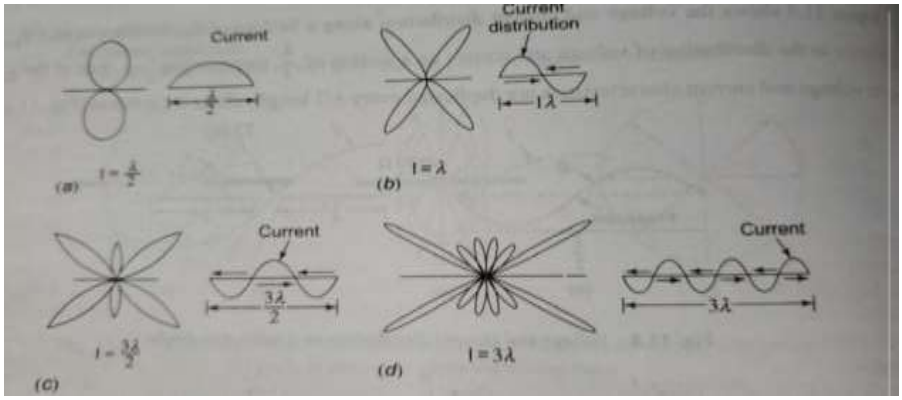
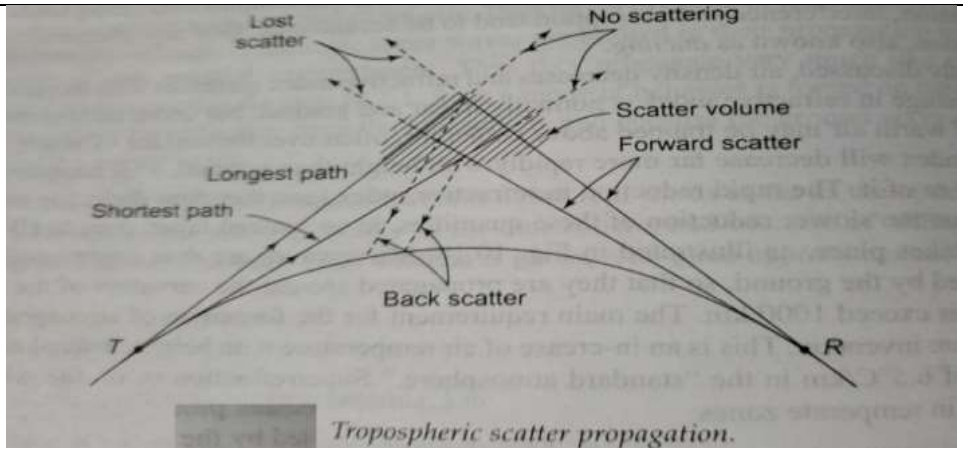
	Ans :		**6 M**
	(b)	**A 400 W carrier is amplitude modulated to a depth of 75%.Calculate the total power in AM wave.** **(i) Explain the types of noise in a communication system.** **(ii) Compare simplex and duplex mode of communication.**	**6M**
	Ans :	 **(i) Noise:** Noise is any spurious or undesired disturbances that mask the received signal in a communication system. **a) Atmospheric Noise:** Atmospheric Noise is also known as static noise which is the natural source of disturbance caused by lightning, discharge in thunderstorm and the natural disturbances occurring in the nature. **b) Industrial Noise: Sources** of Industrial noise are auto-mobiles, aircraft, ignition of electric motors and switching gear. **c) Extraterrestrial Noise: Extraterrestrial** Noise exist on the basis of their originating source. They are i) Solar Noise ii) Cosmic Noise **Internal Noise** are the type of Noise which are generated internally or within the Communication System or in the receiver. They are as follows: 1) Shot Noise : These Noise rises in the active devices due to the random behaviour of Charge particles or carries. In case of electron tube, shot Noise is produces due to the random emission of electron form cathodes.	**2M problem,2 M for noise,2M Compariso n any 2 points 2M**

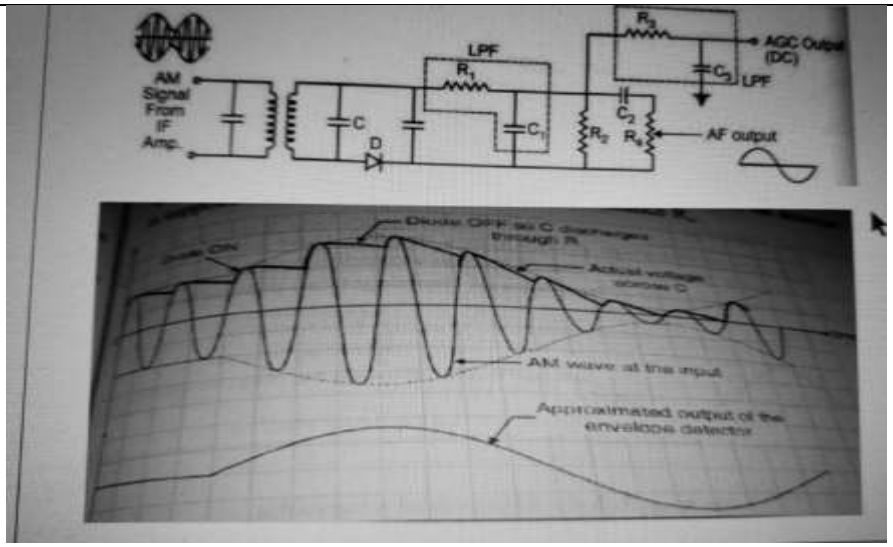
2) Partition Noise : When a circuit is to divide in between two or more paths then the noise generated is known as Partition noise. The reason for the generation is random fluctuation the division.
3) Low- Frequency Noise : They are also known as FLICKER NOISE. These type of noise are generally observed at a frequency range below few kHz. Power spectral density of these noise increases with the decrease in frequency. That why the name is given Low- Frequency Noise
. 4) High- Frequency Noise : These noises are also known TRANSIT- TIME Noise. They are observed in the semi-conductor devices when the transit time of a charge carrier while crossing a junction is compared with the time period of that signal.
5) Thermal Noise: Thermal Noise are random and often referred as White Noise or Johnson Noise. Thermal noises are generally observed in the resistor or the sensitive resistive components of a complex impedance due to the random and rapid movement of molecules or atoms or electrons. Dark current noise: When there is no optical power incident on the photodetector a small reverse leakage current still flows from the device terminals. This Dark current contributes to the total system noise and gives random fluctuations about the average particle flow of the photocurrent.
The Dark current noise is given by: where e is the charge on an electron Id is the dark current
Quantum noise: Discrete nature of electrons cause a signal disturbance called Quantum noise or Shot noise.It arises from the statistical nature of the production and collection of photoelectrons.

(ii) comparision of Simplex and Duplex

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

	(c)	**(i) Write any one application of the following range.** **1. Radio frequency** **2. IR frequency** **3. Medium frequency**	**3M**
	Ans :	**Application of** **1. Radio Frequency-** Radar signals and communication **2. IR Frequency-** LED, Laser, TV remote, Used for directed links e.g. to connect different buildings via laser links. **3. Medium Frequency-** AM broadcasting.	**1M each**

		(ii) Draw and label PLL based FM detector.	**3M**
	Ans :	**FM Detection Using PLL :** A PLL can be used as FM demodulator as shown in Fig.  **Fig. PLL used as FM demodulator**	**3M diagram**
Q.6		**Attempt any TWO of the following:**	**12 M**
	(a)	**(i) List any two advantages of folded dipole antenna.** **(ii) Draw the radiation patterns of the following resonant dipole antenna.** **1. l=2 2. l= λ 3. l=3λ/2 4. i=3** **Where l is the length of dipole antenna.**	**6M**
	Ans :	**(i) Advantages of folded dipole:** 1. Higher input impedance 2. Greater bandwidth 3. Easy to construct 4. cost of construction is less **(ii)** 	**any 2 advantages 2M** **1 M for each= 4 M**
	(b)	**Explain Tropospheric scatter propagation with sketch.**	**6M**
	Ans :	 *Tropospheric scatter propagation.* As the name implies, troposcatter uses the troposphere as the region that affects the radio signals being transmitted, returning them to Earth so that they can be received by the distant receiver. Troposcatter relies on the fact that there are areas of slightly different dielectric	**3M sketch** **3 M explanation**

		constant in the atmosphere at an altitude of between 2 and 5 kilometers. Even dust in the atmosphere at these heights adds to the reflection of the signal. A transmitter launches a high power signal, most of which passes through the atmosphere into outer space. However a small amount is scattered when is passes through this area of the troposphere, and passes back to earth at a distant point. As might be expected, little of the signal is "scattered" back to Earth and as a result, path losses are very high. Additionally the angles through which signals can be reflected are normally small. The area within which the scattering takes place is called the scatter volume, and its size is dependent upon the gain of the antennas used at either end. In view of the fact that scattering takes place over a large volume, the received signal will have travelled over a vast number of individual paths, each with a slightly different path length. As they all take a slightly different time to reach the receiver, this has the effect of "blurring" the overall received signal and this makes high speed data transmissions difficult.	
	(c)	**i) Draw the practical AM diode detector circuit. Sketch its input and output waveforms.** **(ii) Define the terms:** **1. Skip distance** **2. Maximum usable frequency** **3. Virtual height**	**6M**
	Ans :	 **i) Practical AM diode detector** **1. Skip distance:-**Skip distance is defined as the shortest distance from a transmitter, measured along the surface of earth at which a sky wave of fixed frequency returns back to the earth. **2. 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. **3.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.	**diagram 1.5 marks** **wave forms 1.5marks** **1 Mark for each definition**