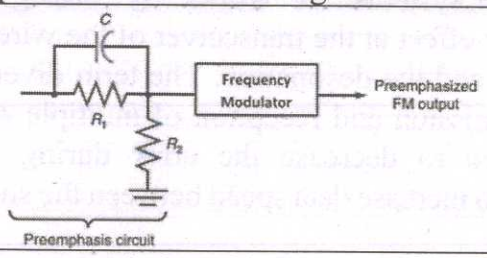
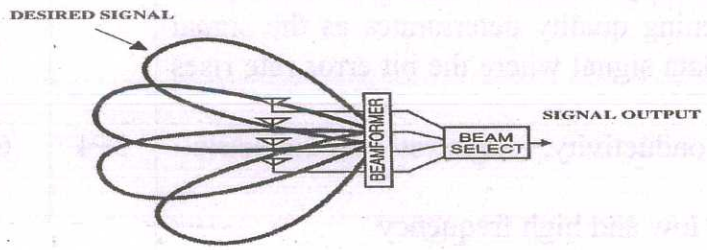
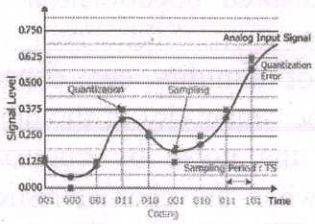
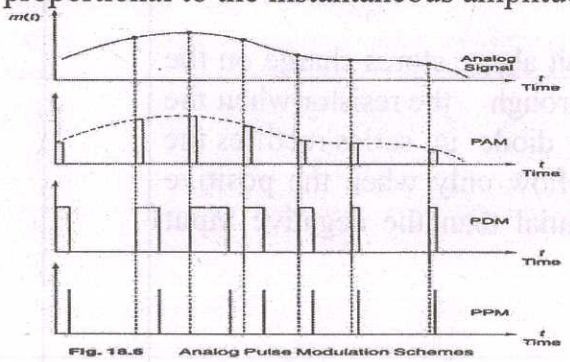
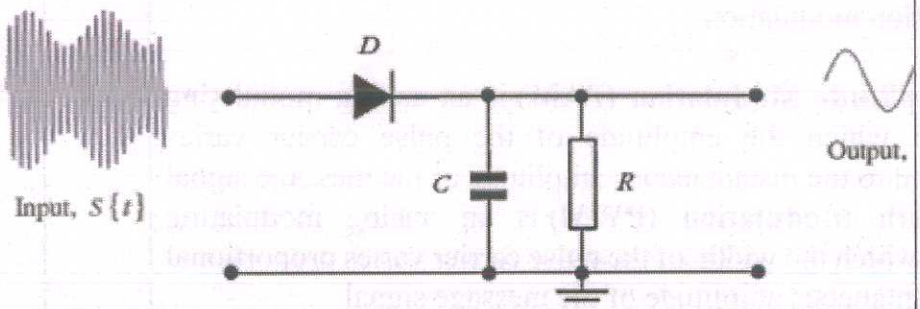
SCHEME OF EVALUATION
(Scoring Indicators)

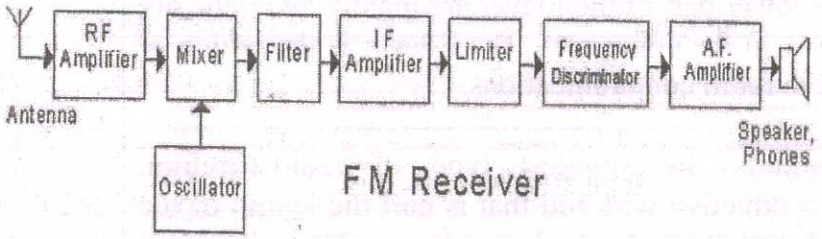
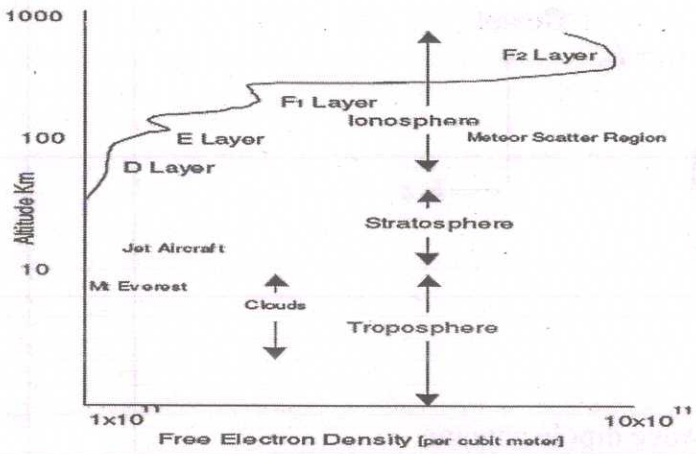
Revision:15
Course Code:3041
Course Title: COMMUNICATION ENGINEERING

Qst No	Scoring indicator	Split up score	Sub total	total
I.1	1. Linear polarization 2.circular polarization 3. Elliptical polarization (answer any two)	2	2	10
1.2	Modulation index is the ratio of the amplitude of the modulating signal to the amplitude of the carrier signal. m = Am/Ac	1+1	2	
1.3		2	2	
1.4	Automatic gain control (**AGC**), is a closed-loop feedback regulating circuit in an amplifier or chain of amplifiers, the purpose of which is to maintain a suitable signal amplitude at its output, despite variation of the signal amplitude at the input.	2	2	
1.5	The sensitivity of a FM radio receiver determines the weakest signals that can be successfully receiver. Whether it is an audio signal for which the listening quality deteriorates as the signal falls into the noise, or a data signal where the bit error rate rises and throughput falls	2	2	
B.1	1.Nature of the ground—conductivity, roughness and dielectric constant 2.Frequency of EM wave- low and high frequency The surface wave is also very dependent upon the nature of the ground over which the signal travels. Ground conductivity, terrain roughness and the dielectric constant all affect the signal attenuation. In addition to this the ground penetration varies, becoming greater at lower frequencies, and this means that it is not just the surface conductivity that is of interest. At the higher frequencies this is not of great importance, but at lower frequencies penetration means that ground strata down to 100 meters may have an effect.	2+4	6	30

	Despite all these variables, it is found that terrain with good conductivity gives the best result. Thus soil type and the moisture content are of importance. Salty sea water is the best, and rich agricultural, or marshy land is also good. Dry sandy terrain and city centers are by far the worst. This means sea paths are optimum, although even these are subject to variations due to the roughness of the sea, resulting on path losses being slightly dependent upon the weather. It should also be noted that in view of the fact that signal penetration has an effect, the water table may have an effect dependent upon the frequency in use			
B.2	Smart Antennas, also known as multiple antennas, adaptive array antennas, and so on is used to increase the efficiency in digital wireless communication systems. It works by taking the advantage of the diversity effect at the transceiver of the wireless system that is the source and the destination. The term diversity effect refers to the transmission and reception of multiple radio frequencies that are used to decrease the error during data communication and also to increase data speed between the source and the destination Advantages—1.high efficiency and high power for desired signal 2.Interference is suppressed Disadvantages:- High cost Large base station required Diversity is a big problem  	2+2+ 2.	6	
B.3	Sampling and quantization Sampling--converting a continuous wave of analog signal to discrete pieces or samples for recording digitally. The number of samples recorded per second is called sampling rate. Fs= 2 x fm(sampling theorem)	2+2+ 2+	6	

	Quantization:-Converting the captured sample values from possibly infinite number of levels to their closest defined levels.The quantized samples are fed to the input of an A-D converter. The circuit produces digital output based on the value of input sample which is then recorded for processing by a compute  			
B.4	Analog pulse modulation:- In this method carrier wave is a continuous stream of pulse is used. Types:- Pulse amplitude modulation Pulse width modulation Pulse position modulation **Pulse Amplitude Modulation (PAM)** is an analog modulating scheme in which the amplitude of the pulse carrier varies proportional to the instantaneous amplitude of the message signal **Pulse width Modulation (PWM)** is an analog modulating scheme in which the width of the pulse carrier varies proportional to the instantaneous amplitude of the message signal **Pulse Position Modulation (PPM)** is an analog modulating scheme in which the position of the pulse carrier varies proportional to the instantaneous amplitude of the message signal  Fig. 18.6 Analog Pulse Modulation Schemes	2+2+2	6	

B.5	**Signal-to-noise ratio:- It** is defined as the **ratio** of the power of a **signal** (meaningful information) to the power of background **noise** (unwanted **signal**) SNR = power of the signal / power of the noise Unit is decibel • All real measurements are disturbed by noise. This includes electronics noise but can also include external events that affect the measured phenomenon — wind, vibrations, gravitational attraction of the moon, variations of temperature, variations of humidity, etc., depending on what is measured and of the sensitivity of the device. It is often possible to reduce the noise by controlling the environment. Otherwise, when the characteristics of the noise are known and are different from the signals, it is possible to filter it or to process the signal • Improve the Selectivity of the device • Improve the sensitivity of the device • Control the environmental condition • Suitable filtering • Suitable modulation method	2 +4	6	
B.6	 An envelope detector is an electronic circuit that takes a (relatively) high-frequency amplitude modulated signal as input and provides an output which is the envelope of the original signal. Working:- the capacitor in the circuit above stores charge on the rising edge and releases it slowly through the resistor when the input signal amplitude 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 .	2 x 3	6	

B.7		6	6	
III.a	Unit .I  **D Layer:-** The region between about 75 and 95km above the Earth in which the (relatively weak) ionization is mainly responsible for absorption of high frequency radio waves **E Layer:-** The region between about 95 and 150km above the Earth that marks the height of the regular daytime E-layer. Other subdivisions, isolating separate layers of irregular occurrence within this region, are also labeled with an E prefix, such as the thick layer, E2, and a highly variable thin layer, Sporadic E. Ions in this region are mainly O2+. **F Layer:-** The region above about 150km in which the important reflecting layer, F2, is found. Other layers in this region are also described	Fig. 4 +2 +2	8	

	using the prefix F, such as a temperate-latitude regular stratification, F1, and a low-latitude, semi-regular stratification, F1.5. Ions in the lower part of the Flayer are mainly NO+ and are predominantly O+ in the upper part. The F-layer is the region of primary interest to radio communications.			15
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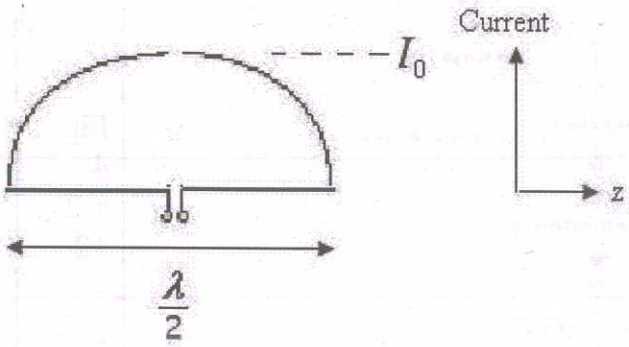
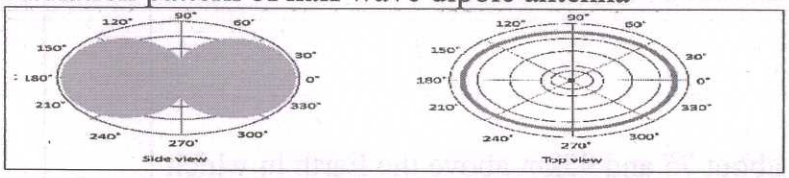
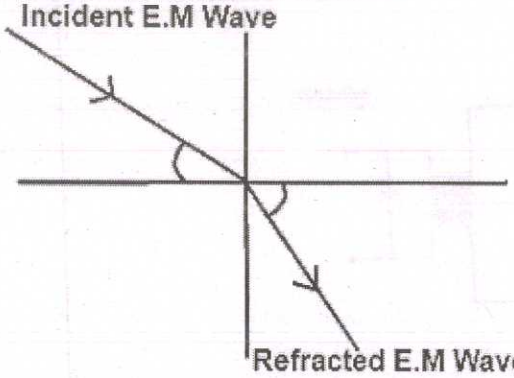
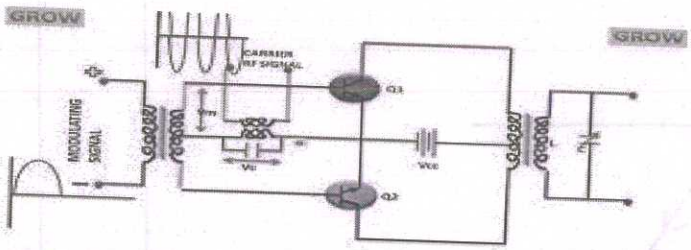
III.b	A **dipole antenna** is the simplest type of radio **antenna**, consisting of a conductive wire rod that is half the length of the maximum wavelength the **antenna** is to generate. This wire rod is split in the middle, and the two sections are separated by an insulator	2+2+3	7	
				
	Radiation pattern of half wave dipole antenna 			
	.application:- television receiving antenna & radio receiver			
	OR			
IV.a	When electromagnetic radiation travels through the atmosphere, it may be absorbed or scattered by the constituent particles of the atmosphere. Molecular absorption converts the radiation energy into excitation energy of the molecules. Scattering redistributes the energy of the incident beam to all directions. The overall effect is the removal of energy from the incident radiation.	2+2+2+2	8	15

	Scattering:- **Scattering** is the process by which a particle in the path of an **electromagnetic wave** continuously removes energy from the incident **wave** and re-radiates the energy into the total solid angle centred at the particle Absorption:- Electromagnetic radiation travels in wave packets known as **photons** that consist of propagating electric and magnetic fields. These photons undergo **absorption** when they transfer energy to atoms within a substance they are striking instead of transmitting through or reflecting off of it. Refraction:- Reflection is the abrupt change in the direction of propagation of a wave that strikes the boundary between two different media. At least some part of the incoming wave remains in the same medium Reflection:-When a radio wave or in fact any electromagnetic wave encounters a change in medium, some or all of it may propagate into the new medium and the remainder is reflected. The part that enters the new medium is called the transmitted wave and the other the reflected wave  			
IV.b	**Properties of EM wave:-** • These waves travel at the speed of light. • These waves do not require any medium for propagation. • Electromagnetic waves travel in a transverse form. • Electromagnetic waves are not deflected by electric or magnetic field. • These waves can be polarized. • Electromagnetic Waves undergo interference and diffraction.	7	7	

Unit. II

V.a	Balanced modulator – **Principle of operation:** • The principle of operation of a balanced modulator states that if two signals at different frequencies are passed through a "nonlinear resistance" then at the output we get an AM signal with suppressed carrier. • The device having a nonlinear resistance can be diode or a JFET or even a bipolar transistor. Types of balanced modulator: The suppression of carrier can be done using the following balanced modulators: • Using the diode ring modulator or lattice modulator. • Using the FET balanced modulator.  Working- few sentence	2+4+2	8	15
V.b	Carrier Signal: $\cos(2\pi f_c t)$ or $\cos(\omega_c t)$ Modulating Message Signal: $m(t)$: $\cos(2\pi f_m t)$ or $\cos(\omega_m t)$ The AM Signal: $s_{AM}(t)=[A_c+m(t)]\cos(2\pi f_c t)$ $S_{AM}(t) = (1 + k\cos\omega_m t)\cos\omega_c t$	4+3	7	

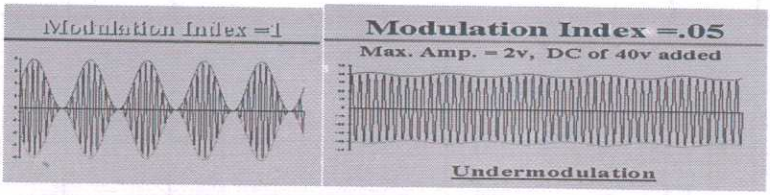
$$S_{AM}(t) = \cos\omega_c t + k\cos\omega_m t\cos\omega_c t$$

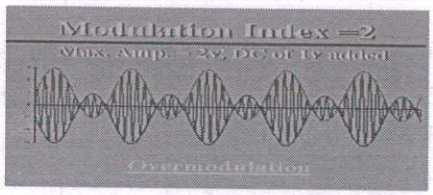
using : $\cos A\cos B = \frac{1}{2}[\cos(A-B)+\cos(A+B)]$

$$S_{AM}(t) = \cos\omega_c t + \frac{k}{2}\cos(\omega_c-\omega_m)t + \frac{k}{2}\cos(\omega_c+\omega_m)t$$

$$k = \frac{A_m}{A_c}$$ where k is called modulation index

Modulation index k is a measure of the extent to which a carrier voltage is varied by the modulating signal. When k=0 no modulation, when k=1 100% modulation, when k>1 over modulation



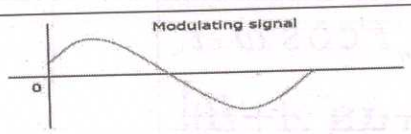


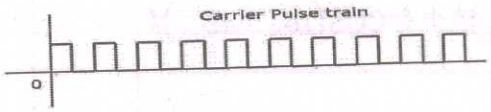
OR

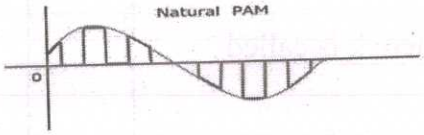
VI.a **Analog pulsemodulation** 2+4+2 8 15

- Pulse Amplitude Modulation
- Pulse Width Modulation
- Pulse Position Modulation

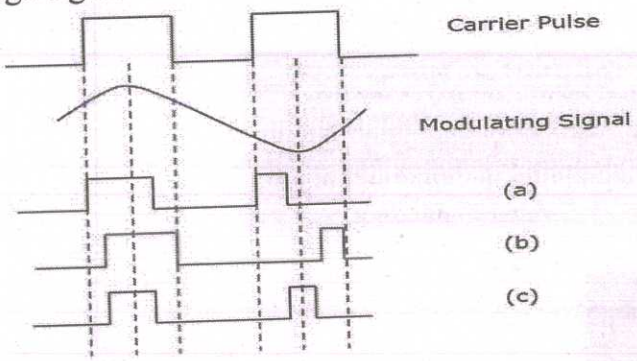
In **Pulse Amplitude Modulation (PAM)** technique, the amplitude of the pulse carrier varies, which is proportional to the instantaneous amplitude of the message signal.



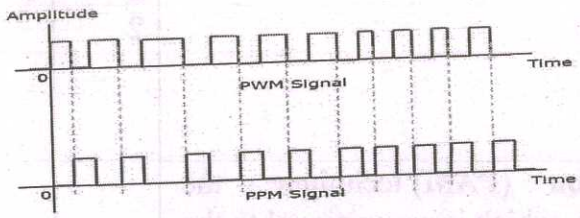




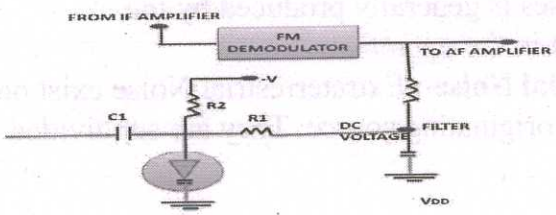
In **Pulse Width Modulation (PWM)** or Pulse Duration Modulation (PDM) or Pulse Time Modulation (PTM) technique, the width or the duration or the time of the pulse carrier varies, which is proportional to the instantaneous amplitude of the message signal

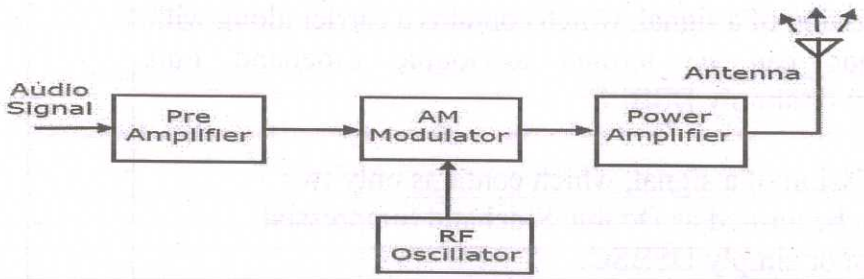


Pulse Position Modulation (PPM) is an analog modulation scheme in which, the amplitude and the width of the pulses are kept constant, while the position of each pulse, with reference to the position of a reference pulse varies according to the instantaneous sampled value of the message signal.



VI.b	In the process of Amplitude Modulation, the modulated wave consists of the carrier wave and two sidebands. The modulated wave has the information only in the sidebands. **Sideband** is nothing but a band of frequencies, containing power, which are the lower and higher frequencies of the carrier frequency.	2+3+2	7	

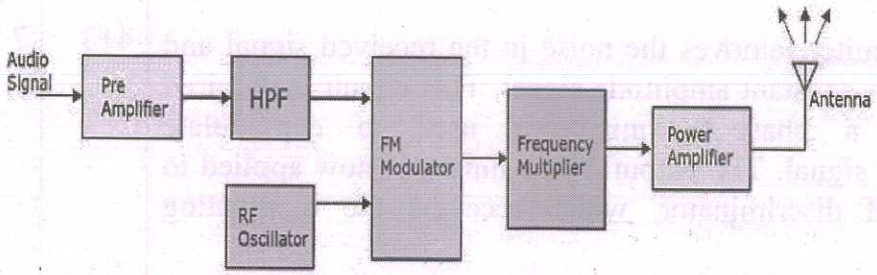
	The following methods are used for transmission 1. DSBFC;2. DSBSC ;3.SSBFC ;4.SSBSC ;5.VSB 1.The transmission of a signal, which contains a carrier along with two sidebands can be termed as Double Sideband Full Carrier system or simply DSBFC 2.The transmission of a signal, which contains only two sidebands can be termed as Double Sideband Suppressed Carrier system or simply DSBSC. 3.The transmission of a signal, which contains a carrier along with a single sideband can be termed as Single Sideband Full Carrier system or simply SSBFC. 4.The transmission of a signal, which contains a single sideband can be termed as Single Sideband Suppressed Carrier system or simply SSBSC. 5.The transmission of a signal, which contains a carrier along with upper sideband & small portion of lower side band can be termed as Vestigial Sideband system or simply VSB. Minimum power is used in SSBSC but in receiver side the signal extraction is very complicated so that VSB is suitable for power saving			
VII.a	**AFT:-**In radio equipment, Automatic Frequency Control (AFC), also called Automatic Fine Tuning (AFT), is a method or circuit to automatically keep a resonant circuit tuned to the frequency of an incoming radio signal. It is primarily used in radio receivers to keep the receiver tuned to the frequency of the desired station Fig below shows circuit diagram of AFC  Working in few sentence	3+2+2	7	15

VII.b	AM transmitter  The working of AM transmitter can be explained as follows. • The audio signal from the output of the microphone is sent to the pre-amplifier, which boosts the level of the modulating signal. • The RF oscillator generates the carrier signal. • Both the modulating and the carrier signal is sent to AM modulator. • Power amplifier is used to increase the power levels of AM wave. This wave is finally passed to the antenna to be transmitted.	4+4	8	
	OR			
VIII.a	Noise in communication systems – • **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 automobiles, aircraft, ignition of electric motors and switching gear. The main cause of Industrial noise is High voltage wires. These noises is generally produced by the discharge present in the operations. • **c) Extraterrestrial Noise :** Extraterrestrial Noise exist on the basis of their originating source. They are subdivided into **i)** Solar Noise **ii)** Cosmic Noise • **1) Shot Noise :** These Noise are generally arises in the active devices due to the random behavior of Charge	2+2+ 2+2	8	15

particles or carries. In case of electron tube, shot Noise is produces due to the random emission of electron form cathodes.

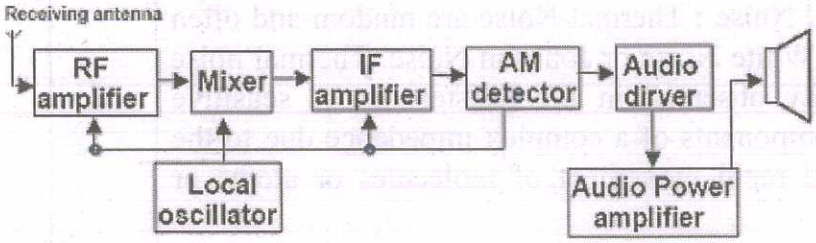
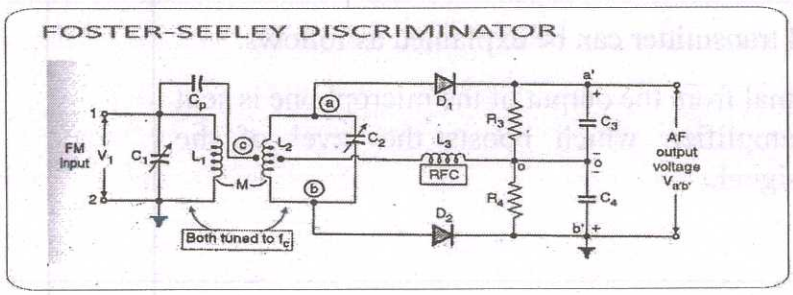
- **2) Partition Noise :** When a circuit is to divide in between two or more paths then the noise generated is known as Partition noise. The reason for the generation is random fluctuation in the division.
- **3) Low- Frequency Noise :** They are also known as FLICKER NOISE. These type of noise are 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 noise 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.

VIII.b **FM Transmitter** 4+3 7



The working of FM transmitter can be explained as follows.

- The audio signal from the output of the microphone is sent to the pre-amplifier, which boosts the level of the modulating signal.

	• This signal is then passed to high pass filter, which acts as a pre-emphasis network to filter out the noise and improve the signal to noise ratio. • This signal is further passed to the FM modulator circuit. • The oscillator circuit generates a high frequency carrier, which is sent to the modulator along with the modulating signal. • Several stages of frequency multiplier are used to increase the operating frequency. Even then, the power of the signal is not enough to transmit. Hence, a RF power amplifier is used at the end to increase the power of the modulated signal. This FM modulated output is finally passed to the antenna to be transmitted.			
IX.a	Super Heterodyne AM Receiver  Briefly explanation of each block	4 +4	8	15
IX.b	• The limiter removes the noise in the received signal and gives a constant amplitude signal. This circuit is required when a phase discriminator is used to demodulate an FM signal. The output of the limiter is now applied to the FM discriminator, which recovers the modulating signal  	4+3	7 7	

	OR			
X.a	RECEIVER CHARACTERISTICS *Sensitivity, noise, selectivity*, and *fidelity* are important receiver characteristics. These characteristics will be useful to you when performing receiver tests. They can help you to determine whether a receiver is working or not or in comparing one receiver to another. Characteristics of Receiver • Selectivity • Sensitivity • Stability • Noise • fidility 1.Slectivity:-It is a measure of a receiver's ability to separate received signals 2.Selectivity -it Is a measure of a receiver's ability to detect weak signals. Known as the signal to noise ratio measured in Decibels. (There are two types of noise.. Internal and External) The formula for determining the performance is: (SIGNAL + NOISE)/ NOISE 3. Stability is the resistance to frequency drift caused by temperature, voltage variations and proximity to the body. 4. Noise- All receivers generate a certain amount of noise, which you must take into account when measuring sensitivity. Receiver noise may originate from the atmosphere (lightning) or from internal components(transistors, tubes). Noise is the limiting factor of sensitivity. You will find sensitivity is the value of input carrier voltage (in microvolts) that must be applied from the signal generator to the receiver input to develop a specified output power **5. Fidelity** The **fidelity** of a **receiver** is its ability to accurately reproduce, in its output, the signal that appears at its input. You will usually find the broader the band passed by frequency selection circuits, the greater your **fidelity**.	2+2+4	8	15

X.b

Sl No	contents	AM Receiver	FM Receiver
1	modulation	AM	FM
2	Noise	Immune to noise	Noise free
3	Band width	low	high
4	power	All transmitted power is useful	Only side band power is useful
4	demodulation	Simple	complex
5	atmosphere	affected	Not affected
6	Frequency range	540-1600 KHz	88-108 MHz
7	Limiter and de emphasis	Not necessary	necessary
8	IF	455kHz	10.7MHz