



WINTER– 14 EXAMINATION

Subject Code: 17440

Model Answer

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.

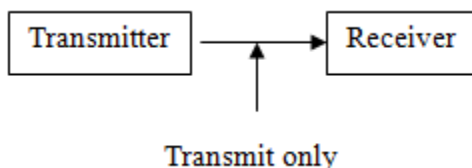
Q.1.A Attempt any SIX of the following

12 marks

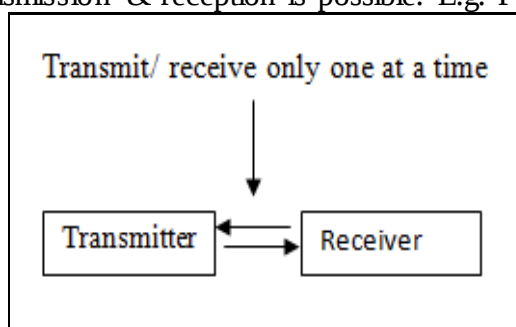
(a) Define Simplex and half duplex system with neat sketch.

Ans. **(Correct definition with neat sketch – 1 mark each)**

Simplex: - In these systems, the information is communicated only in one direction, called as simplex system e.g. TV broadcasting or radio.



Half Duplex: - These systems are bidirectional as they can transmit as well receive information but one at a time. No simultaneous transmission & reception is possible. E.g. Police Walkie-Talkie



(b) Define deviation ratio in FM. What is the maximum value of deviation ratio and modulating frequency?

Ans. **(Correct Definition – 1 mark, correct deviation value – 1 mark)**

The ratio of maximum frequency deviation to the maximum modulating signal frequency is called as **deviation ratio or maximum deviation ratio**.

Maximum value of deviation is limited to 75 kHz and of modulating frequency is limited to 15 KHz. Hence the maximum deviation ratio is limited to 5.

(c) List the types of Analog pulse modulation. Also state the need of pulse modulation.

Ans. **(Any two correct types – 1 mark, need of modulation – 1 mark)**

Types of Analog Pulse Modulation are:

1. Pulse Amplitude Modulation
2. Pulse Width Modulation
3. Pulse Position Modulation

Need of Pulse Modulation: (any two)

1. To transmit modulated signal with low loss.
2. To avoid interference with other communication.
3. To make receiving antennas quite small.
4. To multiplex multiple signals.
5. To increase channel allocations.
6. To have better noise immunity.



(d) What is the tuning range and IF value of (i) MW band AM and (ii) FM radio receiver?

Ans. **(Correct tuning range and IF value of both – 1 mark each)**

Tuning Range of:

MW AM band: 540 to 1640 KHz

FM Receiver: 88 to 108 MHz

Intermediate Frequency (IF) of:

MW AM band: 455 KHz.

FM Receiver: 10.7 MHz

(e) What is tracking? List its types.

Ans. **(Tracking – 1 mark, types – 1 mark)**

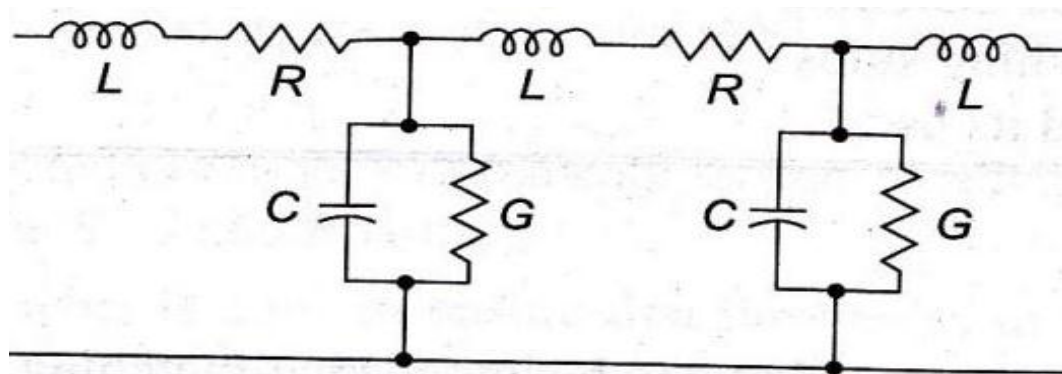
Tracking is a process in which the local oscillator frequency follows or tracks the signal frequency to have a correct frequency difference.

Types of Tracking:

1. Two Point Tracking
 - Padder Tracking
 - Trimmer Tracking
2. Three Point Tracking

(f) Draw general equivalent circuit of transmission line.

Ans. **(correct diagram – 2 marks)**



(g) What is fading? Write two reasons of Fading.

Ans. **(fading – 1 mark, any two relevant correct reasons – 1 mark)**

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.

Reasons for Fading: (any two)

1. Interference between waves that have travelled by slightly different paths.
2. Multipath Propagation
3. Variation in atmospheric conditions along the path of waves.
4. As the fading is a frequency selective process, the signal very close to each other in the frequency domain will fade to a different extent.



(h) What is electromagnetic polarization? List the types of polarization.

Ans. (**electromagnetic polarization – 1 mark, any two types – 1 mark**)

Electromagnetic Polarization:

The direction of electric field vector in relation to the direction of propagation is known as polarization. Thus, the direction of electric field specifies the polarization of the antenna.

If the electric field is parallel to the earth, then the electromagnetic waves are said to be horizontally polarized.

Types of Polarization: (ant two)

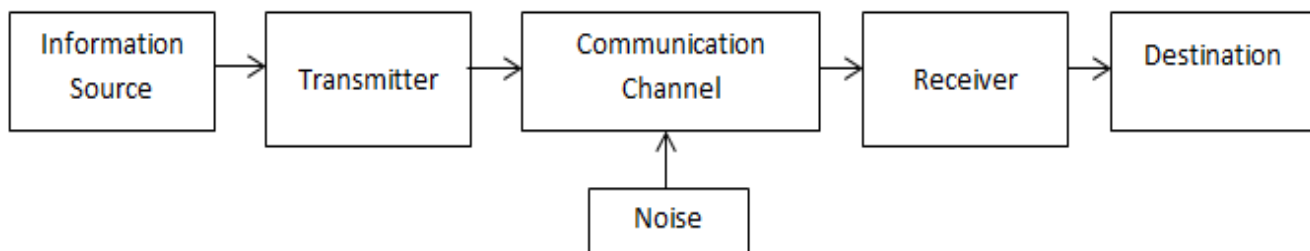
1. Linear Polarization
2. Elliptical Polarization
3. Circular Polarization

Q.1.B Attempt any TWO of the following

8 marks

(a) Draw the block diagram of communication system and state the function of each block.

Ans. (**diagram – 2 marks, explanation – 2 marks**)



Transducer: A transducer is usually required to convert the output of a source into an electrical signal that is suitable for transmission. For example, a microphone serves as the transducer that converts an acoustic speech signal into an electrical signal.

Transmitter: The transmitter converts the electrical signal into a form that is suitable for transmission through the physical channel or transmission medium. For example, in radio and TV broadcast, the transmitter must translate the information signal to be transmitted into the appropriate frequency range that matches the frequency allocation assigned to the transmitter.

There is some internal noise available inside the transmitter section due to the electronic circuits used which is called thermal noise due to heat dissipation and other noises etc.

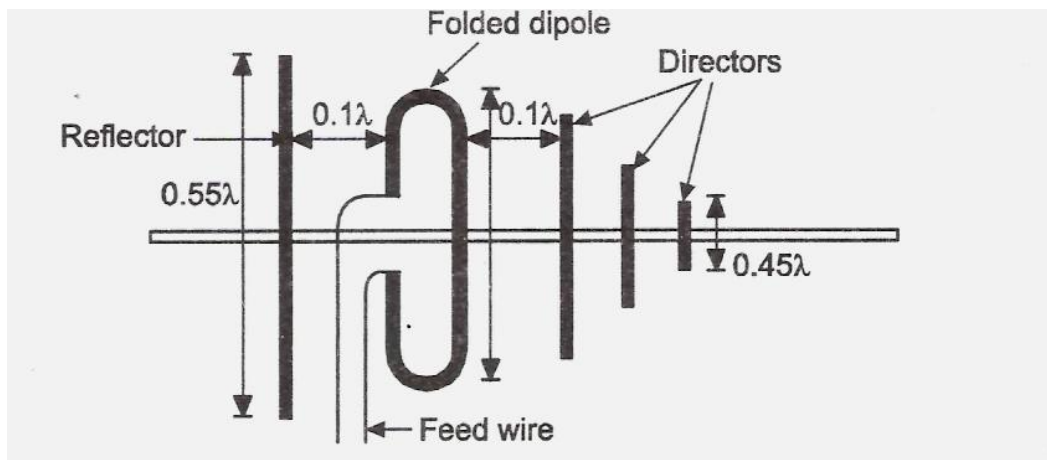
Channel: The communications channel is the physical medium that is used to send the signal from the transmitter to the receiver. In wireless transmission, the channel is usually the atmosphere (free space).

Receiver: The function of the receiver is to recover the message signal contained in the received signal. If the message signal is transmitted by carrier modulation, the receiver performs carrier demodulation in order to extract the message from the sinusoidal carrier. There is some internal noise available inside the receiver section due to the electronic circuits used which is called thermal noise due to heat dissipation and other noises etc.

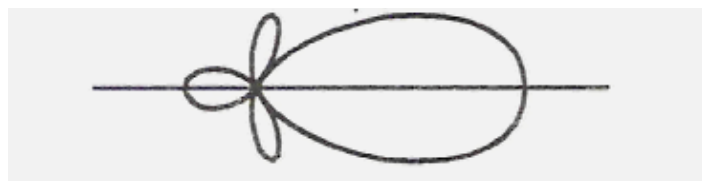
Output Transducer: The output transducer converts electrical signal into original form, e.g. Loudspeaker etc.

(b) Draw the construction of Yagi – Uda Antenna. Draw its Radiation Pattern and write two applications.

Ans. (construction – 2 marks, radiation pattern – 1 mark, any 2 applications – 1 mark)



Radiation Pattern



Applications:

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.

(c) A lossless transmission line for 100Ω characteristic impedance connects to 100 KHz generator and 140Ω load. Calculate reflection coefficient and VSWR.

Ans. (reflection coefficient – 2 marks, VSWR – 2 marks)

Given: Characteristic Impedance (Z_0) = 100Ω

Load Impedance (Z_L) = 140Ω

To find:

1. Reflection Coefficient (ρ) or (K) =?
2. VSWR =?

Solution:

$$\begin{aligned} \text{VSWR} &= \frac{Z_L}{Z_0} = \frac{140}{100} = 1.4 \\ &= \frac{Z_0}{Z_L} = \frac{100}{140} = 0.714 \end{aligned}$$

So select the VSWR whichever is larger.

Therefore, VSWR = 1.4

(2 marks)

$$VSWR = \frac{1+K}{1-K}$$

$$\text{Therefore, } K = \frac{VSWR-1}{VSWR+1} = \frac{1.4-1}{1.4+1} = 0.166$$

Therefore, $K = 0.166$ (2 marks)

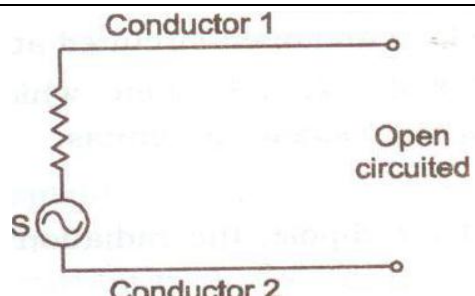
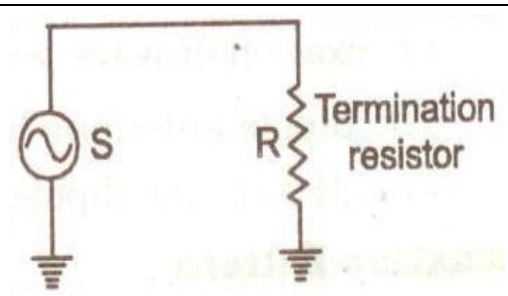
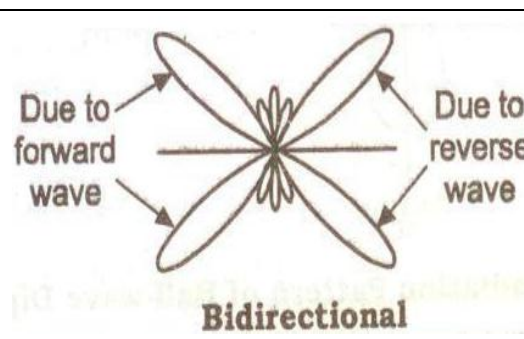
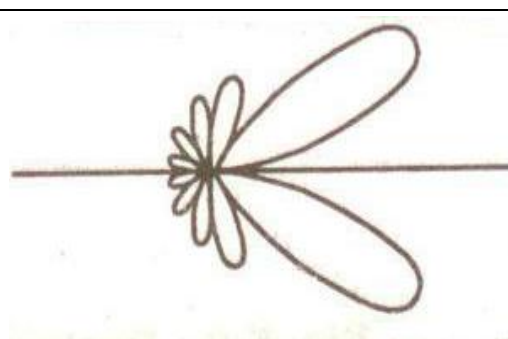
Q.2 Attempt any FOUR of the following

(16 marks)

(a) Compare resonant & non- resonant antenna on the basis of:

- | | |
|---------------|---------------------------|
| 1. Definition | 3. Reflection Coefficient |
| 2. Circuit | 4. Radiation Pattern |

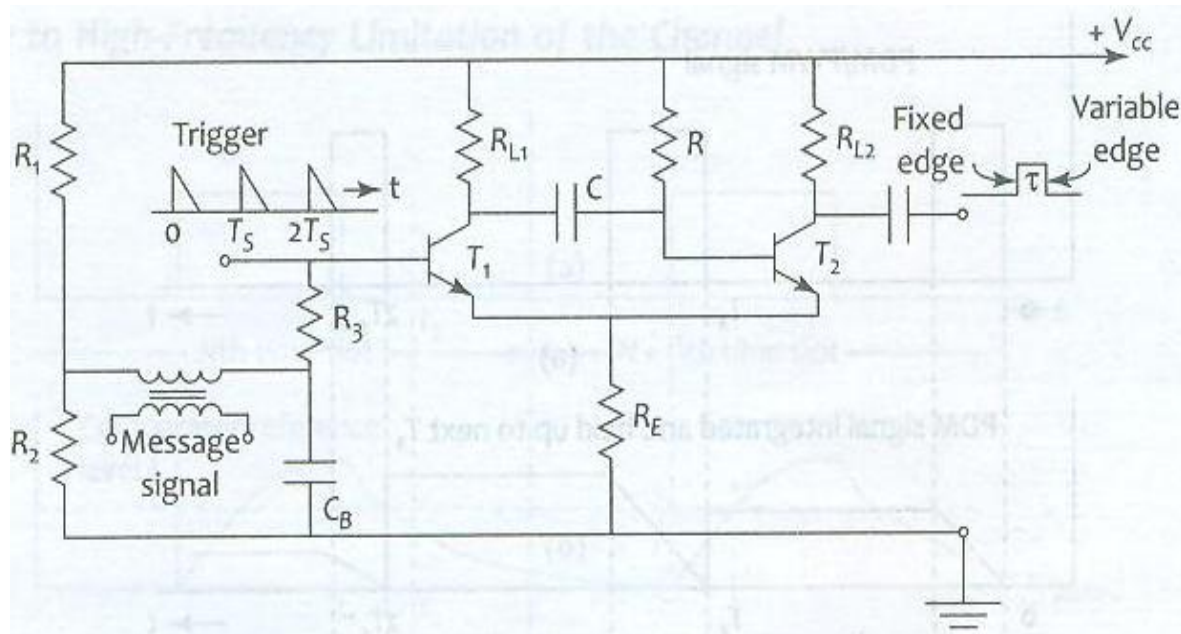
Ans. (Each correct point – 1 mark)

Sr. No	Parameter	Resonant Antenna	Non-resonant Antenna
1	Definition	Resonant antenna is open circuited transmission lines at one end.	Non-resonant antenna is a properly terminated transmission line with a terminating resistor.
2	Circuit		
3	Reflection Coefficient	Standing waves present. So, $K \leq 1$	Standing waves not present. So, $K = 0$
4	Radiation Pattern		

(b) Draw the transistorized circuit for generation of PWM and explain its working.

Ans. (circuit diagram – 2 marks, working – 2 marks)

Note: Any relevant circuit diagram and explanation should be considered.

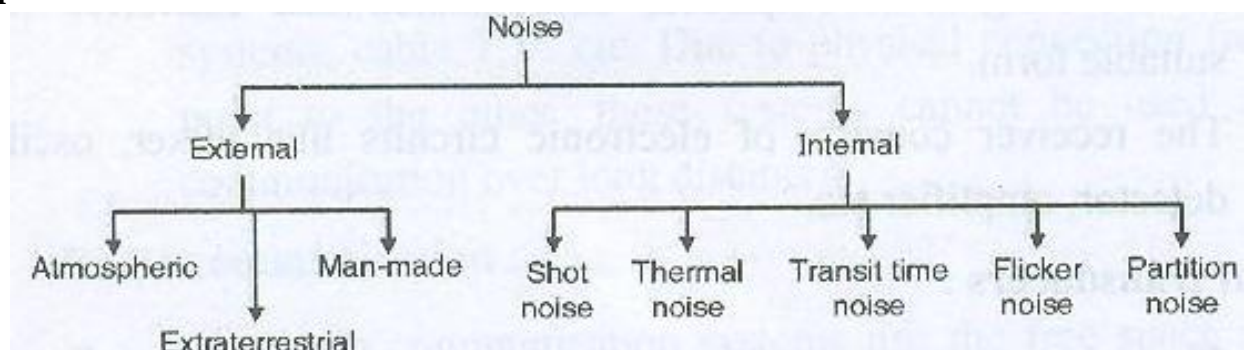


- The circuit diagram above shows the generation of PWM using transistor. This circuit is an emitter-coupled one shot or monostable multivibrator.
- In its stable state, transistor T1 is in cutoff condition and T2 in conducting state.
- However, when a trigger pulse of sufficient amplitude is applied to the base of T1, it suddenly goes into conduction and T2 is temporarily cutoff.
- The duration τ of the pulse that results at the collector of T2 is linearly related to the bias applied to the base of T1.
- Thus, τ is linearly related to the amplitude of the message signal at the instant at which the trigger pulse is applied and since the trigger pulses are applied at regular intervals of T_s , we get PWM signal at the collector of T2.

(c) State and explain the types of noise in communication system.

Ans. (list – 1 mark, any 3 types explanation – 1 mark each)

Types of Noise:





Explanation of External Noise

Atmospheric Noise

Atmospheric noise or static is caused by lightning 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.

Extraterrestrial Noise

There are numerous types of extraterrestrial noise or space noises depending on their sources. However, these may be put into following two subgroups.

1. Solar noise
2. Cosmic noise

Solar Noise

This is the electrical noise emanating from the sun. Under quite conditions, there is a steady radiation of noise from the sun. This results because sun is a large body at a very high temperature (exceeding 6000°C on the surface), and radiates electrical energy in the form of noise over a very wide frequency spectrum including the spectrum used for radio communication. The intensity produced by the sun varies with time. In fact, the sun has a repeating 11-Year noise cycle. During the peak of the cycle, the sun produces some amount of noise that causes tremendous radio signal interference, making many frequencies unusable for communications. During other years, the noise is at a minimum level.

Cosmic noise

Distant stars are also suns and have high temperatures. These stars, therefore, radiate noise in the same way as our sun. The noise received from these distant stars is thermal noise (or black body noise) and is distributing almost uniformly over the entire sky. We also receive noise from the center of our own galaxy (The Milky Way) from other distant galaxies and from other virtual point sources such as quasars and pulsars.

Man-Made Noise (Industrial Noise)

By man-made noise or industrial- noise is meant the electrical noise produced by such sources as automobiles and aircraft ignition, electrical motors and switch gears, leakage from high voltage lines, fluorescent lights, and numerous other heavy electrical machines. Such noises are produced by the arc discharge taking place during operation of these machines. Such man-made noise is most intensive in industrial and densely populated areas. Man-made noise in such areas far exceeds all other sources of noise in the frequency range extending from about 1 MHz to 600 MHz

Explanation of Internal Noise

Thermal Noise

Conductors contain a large number of "free" electrons and "ions" strongly bound by molecular forces. The ions vibrate randomly about their normal (average) positions, however, this vibration being a



function of the temperature. Continuous collisions between the electrons and the vibrating ions take place. Thus there is a continuous transfer of energy between the ions and electrons. This is the source of resistance in a conductor. The movement of free electrons constitutes a current which is purely random in nature and over a long time averages zero. There is a random motion of the electrons which give rise to noise voltage called thermal noise.

Thus noise generated in any resistance due to random motion of electrons is called thermal noise or white or Johnson noise.

Shot Noise

The most common type of noise is referred to as shot noise which is produced by the random arrival of electrons or holes at the output element, at the plate in a tube, or at the collector or drain in a transistor. Shot noise is also produced by the random movement of electrons or holes across a PN junction. Even though current flow is established by external bias voltages, there will still be some random movement of electrons or holes due to discontinuities in the device. An example of such a discontinuity is the contact between the copper lead and the semiconductor materials. The interface between the two creates a discontinuity that causes random movement of the current carriers.

Transit Time Noise

Another kind of noise that occurs in transistors is called transit time noise.

Transit time is the duration of time that it takes for a current carrier such as a hole or electron to move from the input to the output.

The devices themselves are very tiny, so the distances involved are minimal. Yet the time it takes for the current carriers to move even a short distance is finite. At low frequencies this time is negligible. But when the frequency of operation is high and the signal being processed is the magnitude as the transit time, then problem can occur. The transit time shows up as a kind of random noise within the device, and this is directly proportional to the frequency of operation.

Flicker Noise

Flicker noise or modulation noise is the one appearing in transistors operating at low audio frequencies. Flicker noise is proportional to the emitter current and junction temperature. However, this noise is inversely proportional to the frequency. Hence it may be neglected at frequencies above about 500 Hz and it, therefore, poses no serious problem.

Transistor Thermal Noise

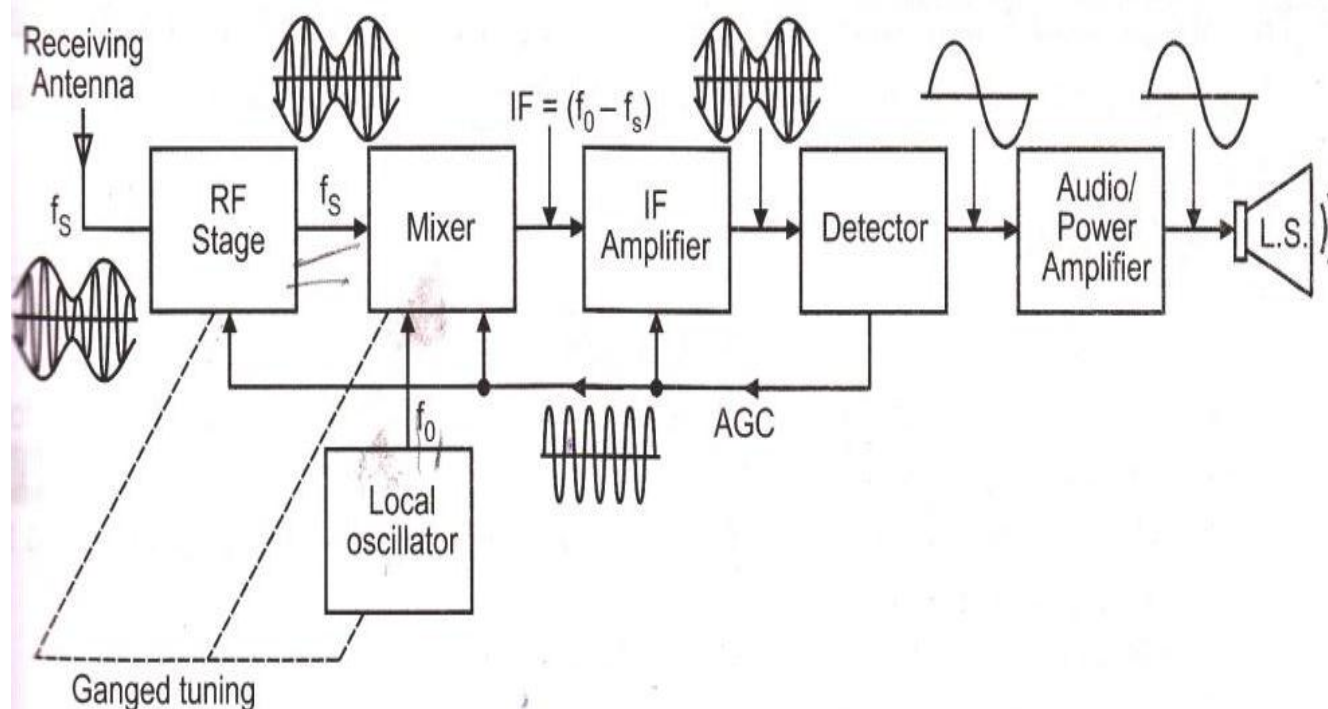
Within the transistor, thermal noise is caused by the emitter, base and collector internal resistances. Out of these three regions, the base region contributes maximum thermal noise.

Partition Noise

Partition noise occurs whenever current has to divide between two or more paths, and results from the random fluctuations in the division. It would be expected, therefore, that a diode would be less noisy than a transistor (all other factors being equal) If the third electrode draws current (i.e., the base current). It is for this reason that the inputs of microwave receivers are often taken directly to diode mixers.

(d) Draw the block diagram of AM super heterodyne radio receiver and state the function of each block.

Ans. (block diagram – 2 marks, explanation – 2 marks)



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 f_s and the local oscillator f_o , and are mixed to produce intermediate frequency signal IF which is given as:

$$IF = f_o - f_s$$

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.

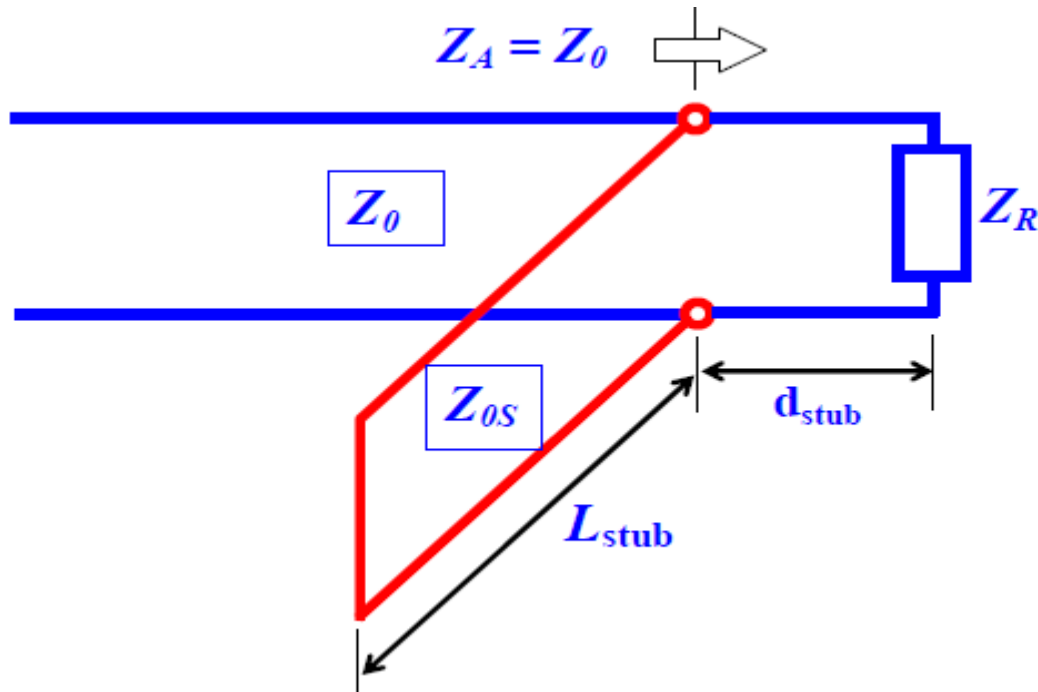
Detector- Amplified signal is detected by the detector to get original modulating signal. The detector also provides control signals to control the gain of IF and RF stage called as AGC.

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.

(e) What is stub? Draw and explain single stub matching.

Ans. (stub – 1 mark, single stub diagram – 2 marks, explanation – 1 mark)

Stub is the piece of short circuited TL which is used to tune out the reactance of the load when connected across the TL as close as possible.



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



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(f) Differentiate between AM & FM on the basis of:

- | | |
|---------------|---------------------|
| 1. Definition | 3. Modulation Index |
| 2. Bandwidth | 4. Application |

Ans. (Each correct point – 1 mark)

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	Bandwidth	$BW = 2 f_m$	$BW = 2 (\delta + f_{m(max)})$
3	Modulation Index	$m = \frac{V_m}{V_c}$	$M_f = \frac{\delta_m}{f_{m(max)}}$
4	Application (any relevant point to be considered)	Video transmission in TV receivers etc.	Sound transmission in TV receivers etc.

Q.3. Attempt any four from the following:

(16 marks)

(a) A frequency modulated signal is represented by voltage equation as
 $e_{FM} = 10 \sin (6 \times 10^8 t + 5 \sin 1250 t)$. Find out:-

- | | |
|-------------------------|-----------------------|
| 1. Carrier frequency | 3. Modulation index |
| 2. Modulating frequency | 4. Maximum deviation. |

ANS: - (1 mark each for proper answer)

Given equation: $e_{FM} = 10 \sin (6 \times 10^8 t + 5 \sin 1250 t)$

Now consider equation

$$e_{FM} = A \sin (\omega_c t + m_f \sin \omega_m t)$$

Compare this equation with the given equation

$$m_f = 5$$

1. Carrier frequency:

$$\omega_c = 6 \times 10^8 \text{ rad/sec}$$

$$2\pi f_c = 6 \times 10^8$$

$$f_c = 6 \times 10^8 / 2\pi = 95.5 \text{ MHz}$$

$$f_c = 95.5 \text{ MHz}$$

2. Modulating frequency:

$$\omega_m = 1250 \text{ rad/sec}$$

$$2\pi f_m = 1250$$

$$f_m = 1250 / 2\pi = 199 \text{ Hz}$$

$$f_m = 199 \text{ Hz}$$

3. Modulating index:

$$m_f = 5$$

4. Maximum deviation:

$$mf = \delta / f_m$$

$$\delta = mf \times f_m$$

$$= 5 \times \omega_m / 2 \pi$$

$$= 5 \times 1250 / 2 \pi = 995 \text{ Hz}$$

$$\delta = 995 \text{ Hz}$$

(b) Define intermediate frequency (IF). why local oscillator frequency (f_0) is made greater than signal frequency (F_s) in radio receiver?

ANS. (Any relevant correct explanation to be considered)

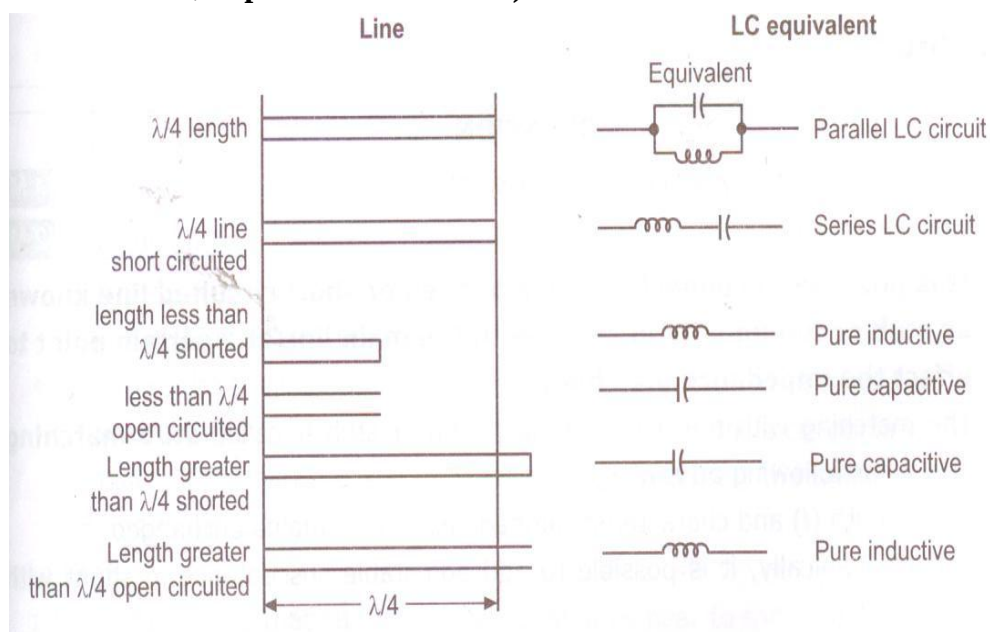
The intermediate frequency (IF) of a receiving system is usually a compromise, since there are reasons why it should be neither low, nor high, nor in a certain range between these two. (1 mark)

Reason for LO frequency to be greater than signal frequency (3 marks)

- The local oscillator frequency (f_0) is made greater than signal frequency (F_s) in radio receiver:
- Local oscillator frequency range is 995 KHz to 2105 KHz for MW band.
 $F_{\max}/F_{\min} = 2105/995 = 2.2$
- If local oscillator has been designed to be below signal frequency, the range would be 85 to 1195 KHz and frequency ratio is,
 $F_{\max}/F_{\min} = 1195/85 = 14.0$
- The normal tunable capacitance ratio is,
 $C_{\max}/C_{\min} = 10$
- 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.

(c) Explain with sketch properties of transmission lines for various lengths.

ANS: (diagram – 2 marks, explanation – 2 marks)





- We know that piece of transmission line $\pi/4$ long and short circuited at far end behaves exactly like a parallel; tuned circuit.
- If the frequency of operation is reduced, then there is reduction in shunt inductive reactance and increase in shunt capacitance reactance.
- Inductive current predominates and thus the impedance of circuit is purely inductive.
- Now same piece at the new frequency is less than $\pi/4$ long, since how the wavelength is greater and length of line is unchanged.
- Thus, we have important property that a short circuited line less than $\pi/4$ long appears as a pure capacitance.

(d) How quarter wave transformer is used for impedance matching? Explain.

ANS. (4 marks for any relevant proper answer)

- In all applications of transmission line, it is required that the load be matched to line.
- This requires the tuning of the unwanted load reactance and the transformation of resulting impedance to the required value.
- Ordinary RF transformers may be used to middle of the VHF range but their performance is not good at higher frequencies than this.
- The Quarter-wave line provides good opportunities for impedance transformation up to highest frequencies and it is compatible with transmission line.
- If Z_0 is varied, the impedance seen at the input to the $\pi/4$ transformer will also vary accordingly so that load may be matched to characteristic impedance of the main line.

(e) A half-wave dipole antenna is capable of radiating 1 KW and has a 2.15 dB gain over an isotropic antenna. How much power must be delivered to the isotropic antenna to match the field strength of directional antenna?

ANS: -

Given data- A (dB) = 2.15 dB, $P_1 = 1 \text{ Kw}$

Solution- $A \text{ (dB)} = 10 \log_{10} (P_2/P_1)$

$$2.15 = 10 \log_{10} (P_2/1000)$$

$$0.215 = \log_{10} (P_2/1000)$$

$$100.215 = P_2/1000$$

$$1.64 = P_2/1000$$

$$P_2 = 1.64 \times 1000$$

$$P_2 = 1640 \text{ watt}$$

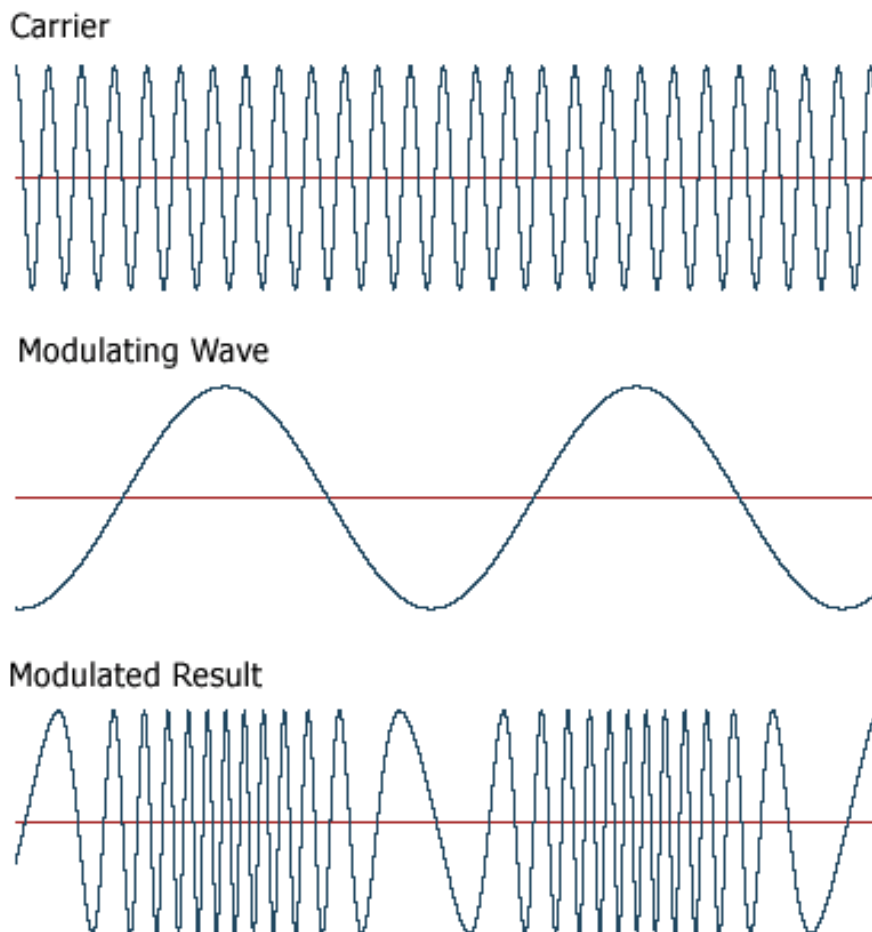
Delivered power = 1640 watt

(4 marks)

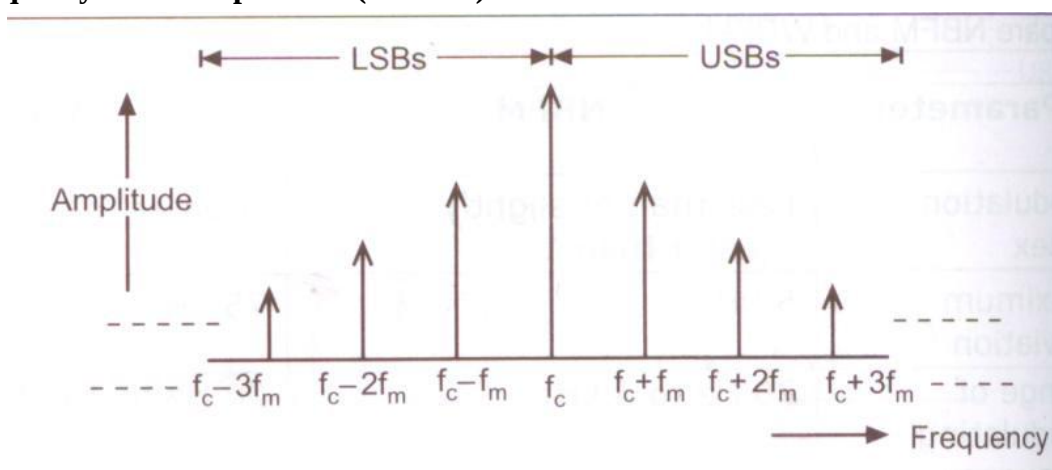
(f) Represent the FM in time domain and frequency domain with neat labeling.

ANS:

FM in time domain spectrum (2 marks)



FM in frequency domain spectrum (2 marks)



Q 4. Attempt any four of the following:

(16 marks)

(a) What is Pre-emphasis and De-emphasis? Draw the circuit of Pre-emphasis. State where both the circuits are used.

ANS:-

Pre-emphasis (1 mark)

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

Used:-Pre-emphasis is used FM Transmitter as a high pass filter.

(½ marks)

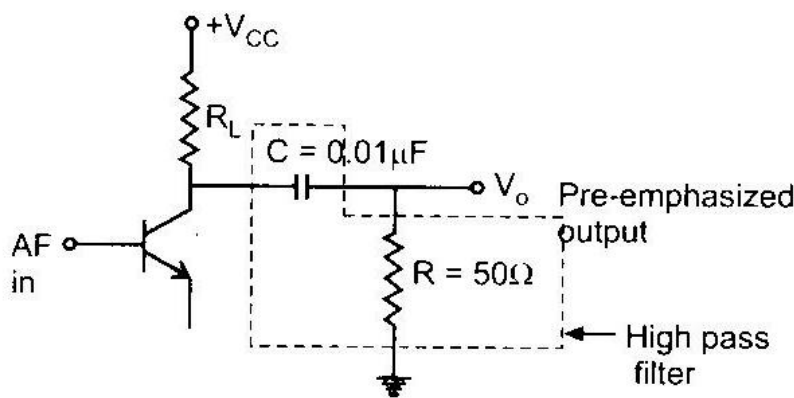
De-emphasis (1 mark)

The artificial boosting of higher modulating frequencies in the process of pre-emphasis is nullified at receiver by process called de-emphasis.

Used:-It is used in FM receiver.

(½ marks)

Circuit of Pre-emphasis (1 mark)



(b) A 10 kW carrier is amplitude modulated by two sine waves to a depth of modulation 0.5 and 0.6 respectively. Calculate total power content of the modulated carrier.

ANS:- (each formula 1 mark, proper answer – 1 mark each)

Given: $P_c = 10 \text{ Kw} = 10,000 \text{ w}$

$M_1 = 0.5$

$M_2 = 0.6$

To find: Total Power (P_t)

Solution:

Total modulation Index (M_a) is given as,

$$M_a = \sqrt{M_1^2 + M_2^2} = \sqrt{0.5^2 + 0.6^2} = \sqrt{0.61} = 0.78. \quad (2 \text{ marks})$$

$$P_t = P_c \left(1 + \frac{M_a^2}{2} \right) = 10 \left(1 + \frac{0.78^2}{2} \right) = 13.05 \text{ kW} \quad (2 \text{ marks})$$

(c) For a transmission line, if R is the reflection co-efficient what will be its value:

- (i) if there is no reflected voltage?
- (ii) If reflected and incident voltages are same?
- (iii) If reflected voltage = 10V and incident voltage = 20V?
- (iv) If reflected voltage = 2V and incident voltage = 2V?

ANS: - (1 mark each proper answer)

Solution:

Reflection Coefficient $R = \frac{E_r}{E_i}$

1. If $E_r = 0$

Then, $R = \frac{0}{E_i} = 0$

$R = 0$

2. If $E_r = E_i$

Then, $R = \frac{E_i}{E_i} = 1$

$R = 1$

3. If Reflected voltage $E_r = 10V$, Incident voltage $E_i = 20V$

Then, $R = \frac{E_r}{E_i} = \frac{10}{20} = 0.5$

$R = 0.5$

4. If Reflected voltage $E_r = 2V$, Incident voltage $E_i = 2V$

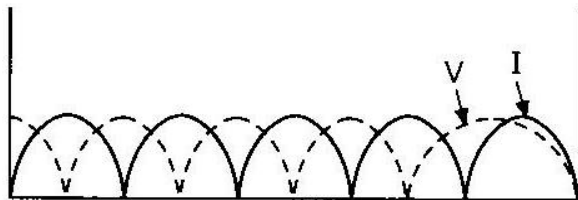
Then, $R = \frac{E_r}{E_i} = \frac{2}{2} = 1$

$R = 1$

(d) Draw voltage and current standing waves of a transmission line terminated in an open circuit. State four characteristics of transmission line.

ANS:

Voltage and current standing waves of a transmission line terminated in an open circuit-



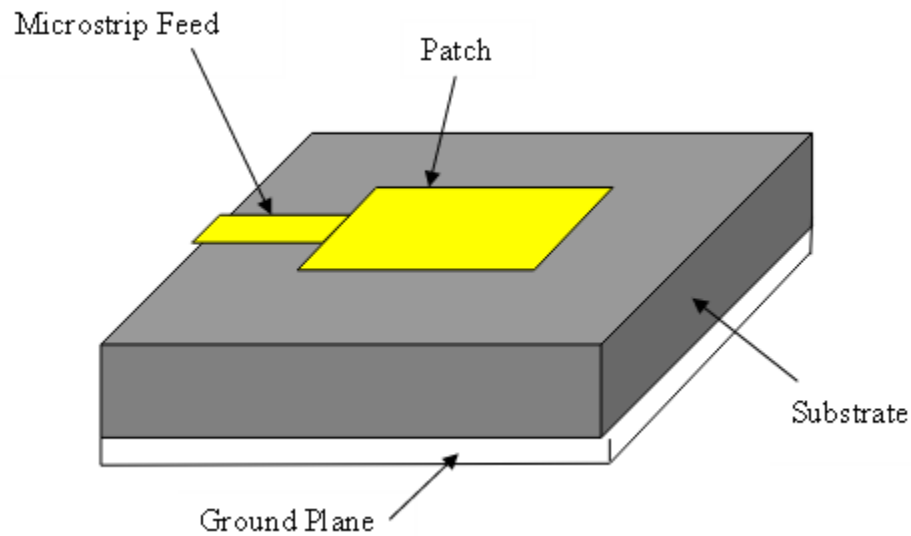
(2 marks)

Characteristics of transmission lines are :- (2 marks)

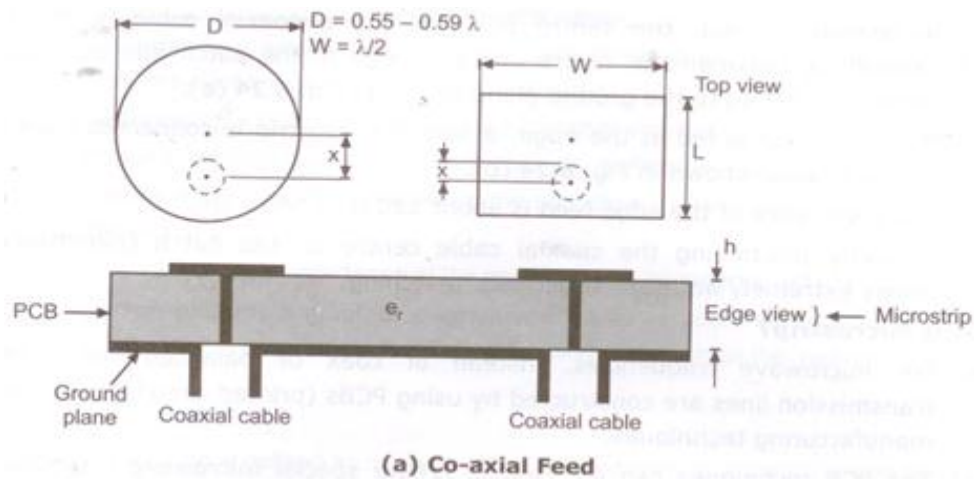
- 1. Series resistance R in Ω /unit length
- 2. Series inductance L in H/unit length
- 3. Shunt capacitance C in F/unit length
- 4. Shunt admittance G in mho/unit length

(e) Explain with neat sketch Micro strip patch antenna (any one).

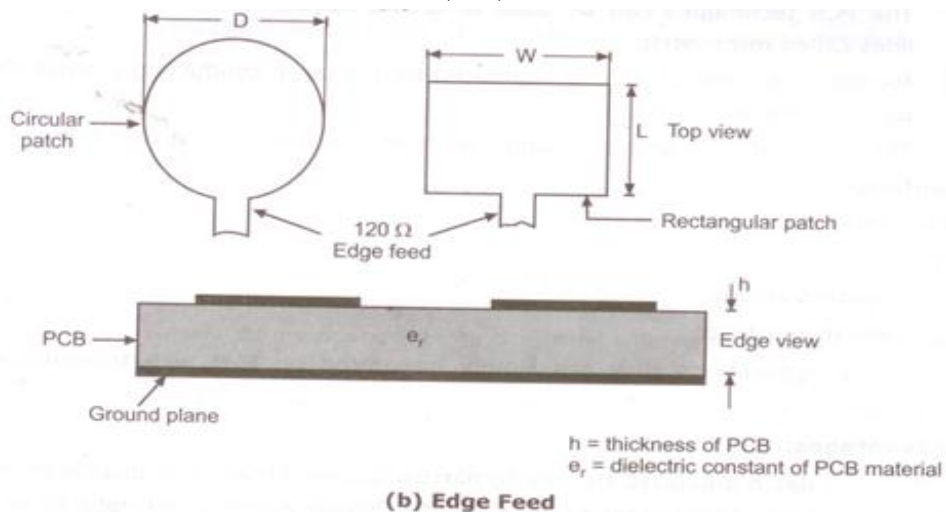
ANS: (any one diagram - 2 marks, explanation 2 marks)



(OR)



(OR)



- Patch antennas are made with Micro strip on PCBs
- The antenna is a circular or rectangular area of copper separated from the ground plane on the bottom of the board by a thickness of the PCBs insulating material shown in figure
- The width of the rectangular antenna is approximately 1 half wavelength ,the diameter of the circular antenna is 0.55 to 0.59 wavelength
- In both the antennas the exact dimensions depends upon the dielectric constant and the thickness of PCB material the most commonly used PCB material for patch antennas is a Teflon fibre glass combination the feed method for patch antennas can be of two types:

-Coaxial or

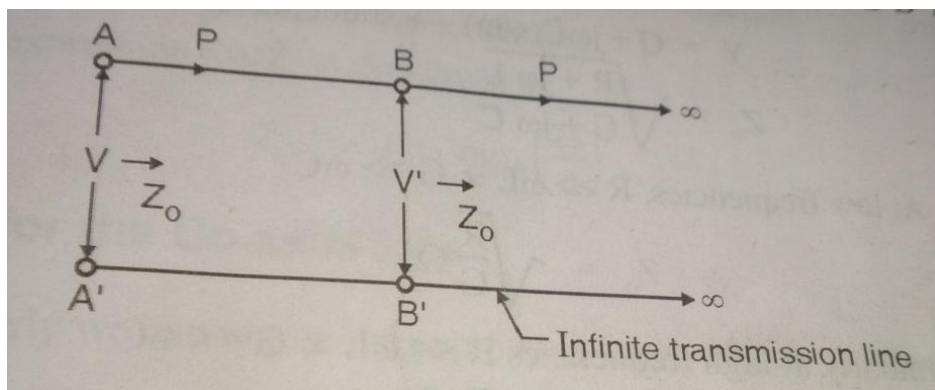
-Edge

- In coaxial method, the center conductor of a coaxial cable is attached somewhere between the center and the edge of the patch and the coaxial shield is attached to the ground plane as shown in figure.
- If the antenna is fed at the edge, a lent of Micro strip is connected from the source to edge as shown. The impedance of the edge feed is about 120Ω at the edge.
- Correctly positioning the coaxial cable center on the patch allows extremely accurate impedance matching.

(f) Derive the equation for characteristics impedance of transmission line at low frequency and high frequency.

ANS:

Characteristics impedance- Characteristic impedance of a transmission line, Z_0 is the impedance measured at the input of this line when its length is infinite. (1/2 marks)



(1/2 marks)

Explanation (3 marks)

Z_0 will be measured at the input of transmission line if the output is terminated in Z_0 . Under these conditions, z_0 is considered purely resistive. From filter theory, the characteristic of an iterative circuit consisting of series and shunt elements is given by,

$$Z_0 = \sqrt{\frac{Z}{Y}}$$

Where, Z_0 = Characteristic impedance.



Z = series impedance per section

$$= R + j\omega L \text{ (}\Omega/\text{M)}$$

Y = Shunt admittance per section

$$= G + j\omega C \text{ (s/m)}$$

Therefore,

$$Z_0 = \sqrt{\frac{R + j\omega L}{G + j\omega C}}$$

This equation shows the characteristics impedance of transmission line may be complex.

At Radio Frequency (OR at high frequency):

The resistive components are ignored.

$$\omega L \gg R, \omega C \gg G$$

$$\text{Therefore, } Z_0 = \sqrt{\frac{j\omega L}{j\omega C}} = \sqrt{\frac{L}{C}}$$

Where L is measured in H/m and f/m .

At low frequency:

$$R \gg \omega L, G \gg \omega C$$

$$\text{Therefore, } Z_0 = \sqrt{\frac{R}{G}}$$

Q 5. Attempt any four from the following:

(16 marks)

(a) In FM, if, maximum deviation is 75 KHz and the maximum modulating frequency is 10 KHz, calculate the deviation ratio and bandwidth of FM.

ANS:

$$\text{Given data- } \delta_{\max} = 75 \text{ KHz}$$

$$f_{m(\max)} = 10 \text{ KHz}$$

$$\text{Deviation ratio} = \delta_{\max} / f_{m(\max)}$$

$$= 75 \text{ KHz} / 10 \text{ KHz} = 7.5$$

(2 marks)

$$\text{BW} = 2(\delta_{\max} + f_{m(\max)})$$

$$= 2 \times (75 + 10) \text{ KHz}$$

$$= 170 \text{ KHz}$$

(2 marks)

(b) State the functions of RF section used in AM radio receiver. State any four advantages of RF amplifier.

ANS:

A radio receiver always has a RF section because

(2 points-2 marks)

1. It is a tunable circuit connected to the antenna terminals.
2. It selects the wanted frequency and rejects the unwanted frequencies.
3. Amplifier improves quality of receiver output.
4. Better coupling of receiver to the antenna.
5. Prevention in the reradiation of the local oscillator through the antenna of the receiver.

Advantages:

(2 advantages- 2 marks)

1. Greater gain i.e. better sensitivity
2. Improved image frequency rejection
3. Improved signal to noise ratio
4. Better selectivity

(c) The parameters of transmission line are $R=65 \Omega/\text{Km}$, $L=1.6 \text{ mH/Km}$, $C=0.1 \mu\text{F/Km}$, $G=2.25 \mu\text{S/Km}$. Calculate characteristics impedance.

ANS:

Assume, $f = 800 \text{ Hz}$

$$\omega = 2\pi f$$

$$= 2\pi \times 800 = 5024 \text{ rad/sec.}$$

Series impedance:

$$Z = R + j\omega L$$

$$= 65 + j 5024 \times 1.6 \times 10^{-3}$$

$$= 65 + j8$$

$$Z = 65.48 \angle 7^\circ$$

Shunt impedance:

$$Y = G + j\omega C$$

$$= 2.25 \times 10^{-6} + j 5024 \times 0.1 \times 10^{-6}$$

$$= (2.25 + j 502.4) \times 10^{-6}$$

$$Y = 5 \times 10^{-4} \angle 89.7^\circ$$

$$\text{Characteristic impedance: } Z_0 = \sqrt{\frac{Z}{Y}}$$

$$= \sqrt{\frac{65.48 \angle 7^\circ}{5 \times 10^{-4} \angle 89.7^\circ}}$$

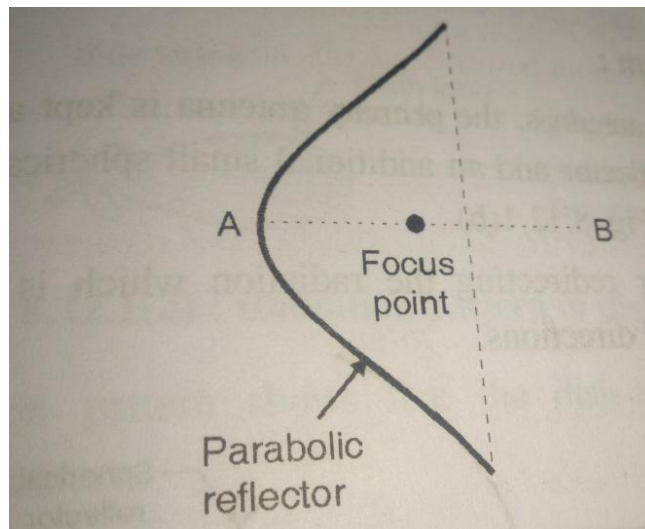
$$Z_0 = 374 \angle -41.35^\circ$$

(4 marks)

(d) Describe with sketch working principle of dish antenna. List its two advantages.

ANS: **Dish antenna**

(2marks)



Principle: - (1 mark)

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.

Advantages: (1marks for 2 points)

It provides sharper beam- width and higher front-to-back ratio, when trying to receive a weak signal.

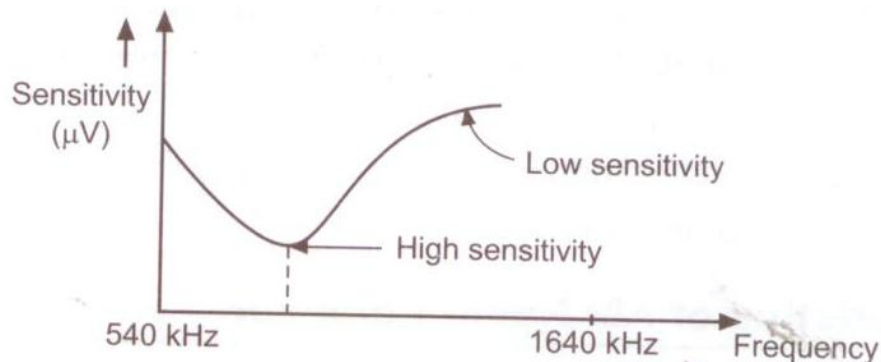
Dishes with larger diameter provide higher gain and lower beam width.

(e) Define sensitivity and selectivity. Draw the graph of sensitivity and selectivity for radio receiver.

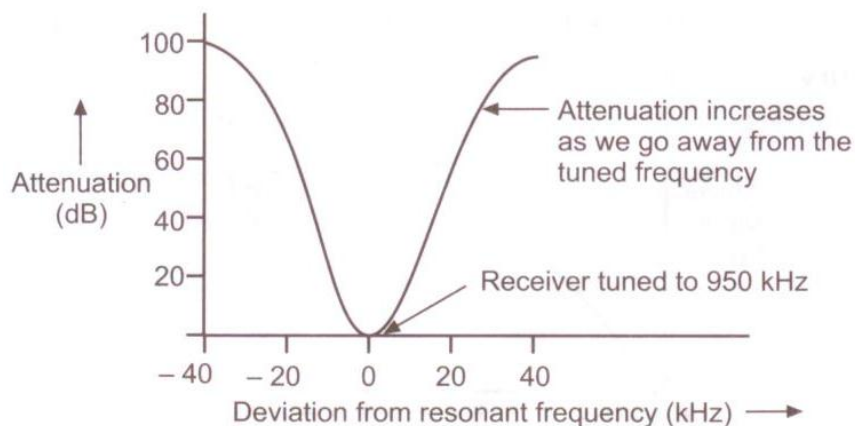
ANS:

Sensitivity-The ability to amplify weak signals is called sensitivity. The sensitivity is expressed in millivolt. **(1 marks)**

Sensitivity: (1 mark)



Selectivity: The ability of radio receiver to reject the unwanted signals. **(1mark)**



(1 marks)

(f) Derive the relation between reflection co-efficient (K) and VSWR(s).

ANS: (proper derivation 4 marks)

$$V_{\max} = |V_i| + |V_r|$$

$$V_{\min} = |V_i| - |V_r|$$

Where-

V_i = r.m.s. value of incident voltage

V_r = r.m.s. value of reflected voltage

By definition:

$$VSWR = \frac{|V_{\max}|}{|V_{\min}|} = \frac{|V_i| + |V_r|}{|V_i| - |V_r|} = \frac{V_i \left(1 + \frac{V_r}{V_i}\right)}{V_i \left(1 - \frac{V_r}{V_i}\right)} = \frac{1 + |k|}{1 - |k|}$$

Applying Componendo and Dividendo,

$$\frac{VSWR - 1}{VSWR + 1} = \frac{1 + |k| - 1 - |k|}{1 + |k| + 1 - |k|} = \frac{2|k|}{2} = |k|$$

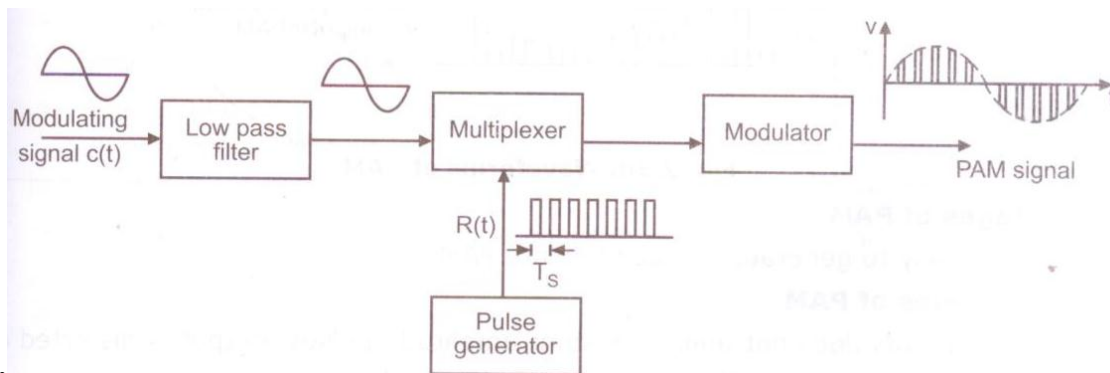
$$\text{Therefore, } |k| = \frac{VSWR - 1}{VSWR + 1} = \frac{S - 1}{S + 1}$$

Q 6. Attempt any four from the following:

(16 marks)

(a) Draw the block diagram for generation of PAM with waveform at each block. State two disadvantages and one application.

Ans:-



(2 marks)

Disadvantages: (2 points -1 mark)

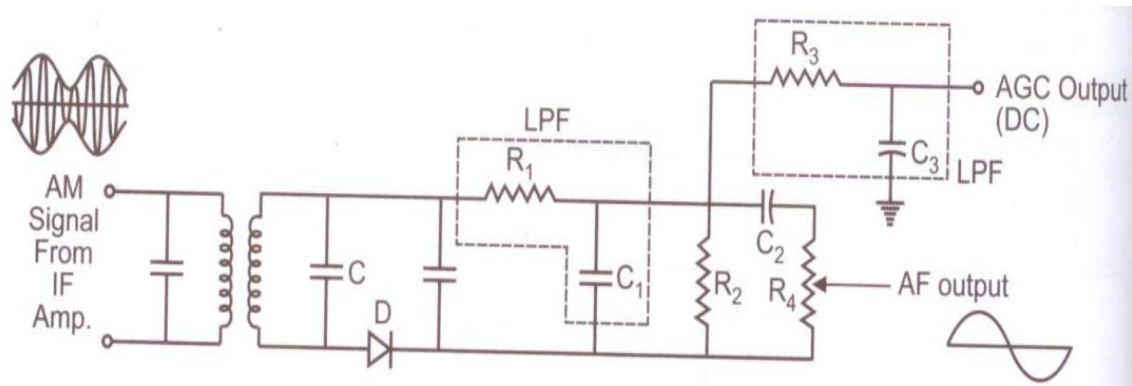
1. Since PAM does not utilize constant amplitude pulses, output is distorted due to additive noise so that it is infrequently used
2. Transmission bandwidth required is too large

Applications: (1 mark)

Used in radio telemetry for remote monitoring and sensing.

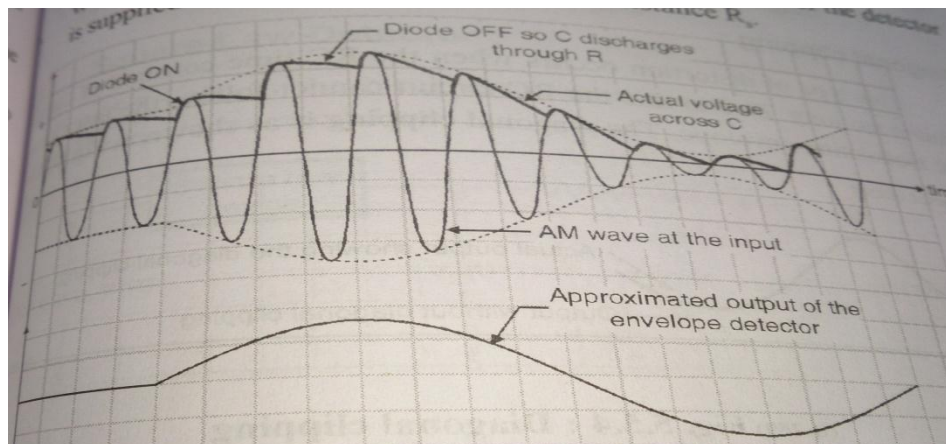
(b) Draw practical AM diode detector circuit. Sketch its input and output waveforms.

Ans:-



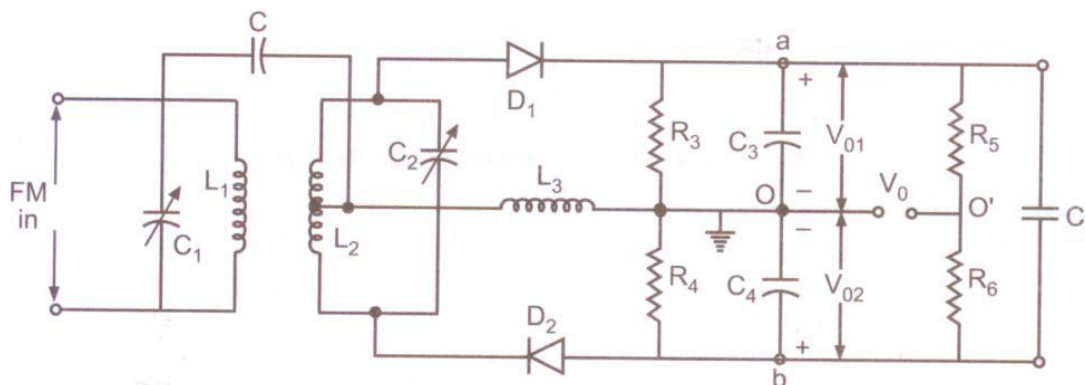
(2 marks)

Input and output waveforms- (2 marks)



(c) Draw circuit of Ratio detector circuit. Why Limiter stage is not used before Ratio detector?

ANS:

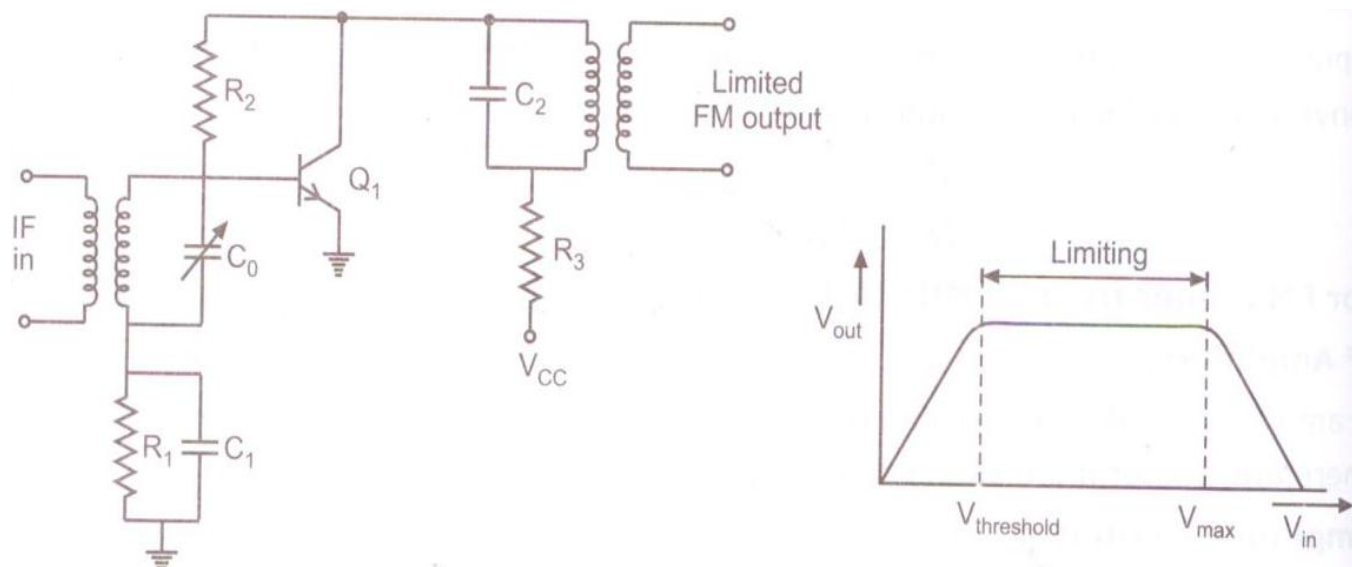


(2 marks)

The ratio detector itself consists of limiter stage due to large capacitor C5 .Hence, limiter stage is not used in ratio detector. (2 marks)

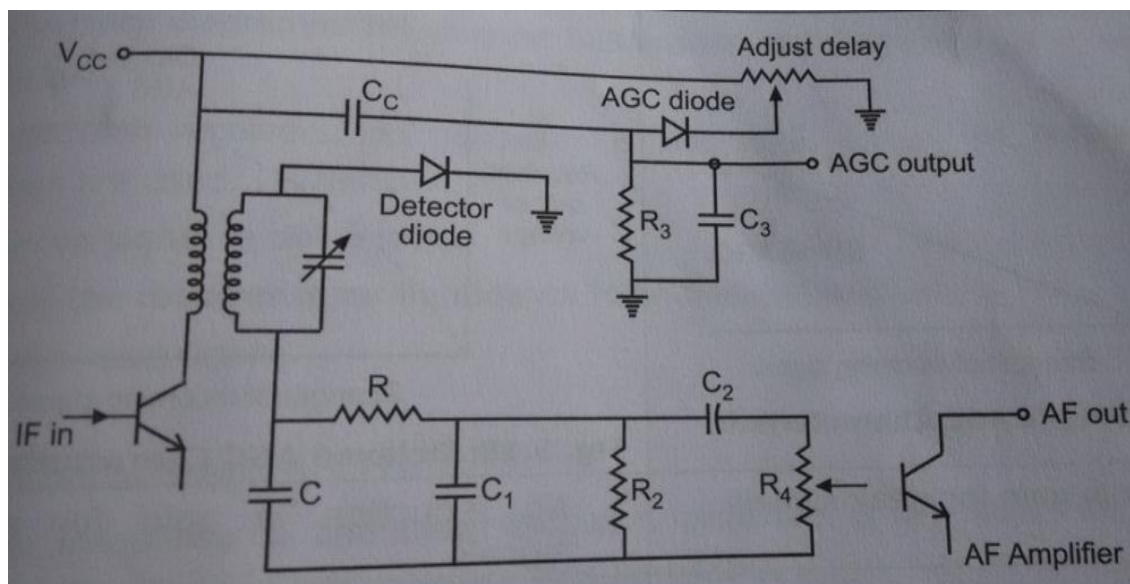
(c) Draw transistorized circuit of amplitude limiter used in FM receiver.

Ans:- (Any relevant Correct diagram - 4 marks)



(e) Draw delayed AGC circuit. State its two advantages and applications.

Ans:- (Diagram – 2 marks)



Advantages (2 points – 1mark)

1. No reduction in gain for weak signals.
2. Reduction in gain only for strong signals.

Application: (1 mark)

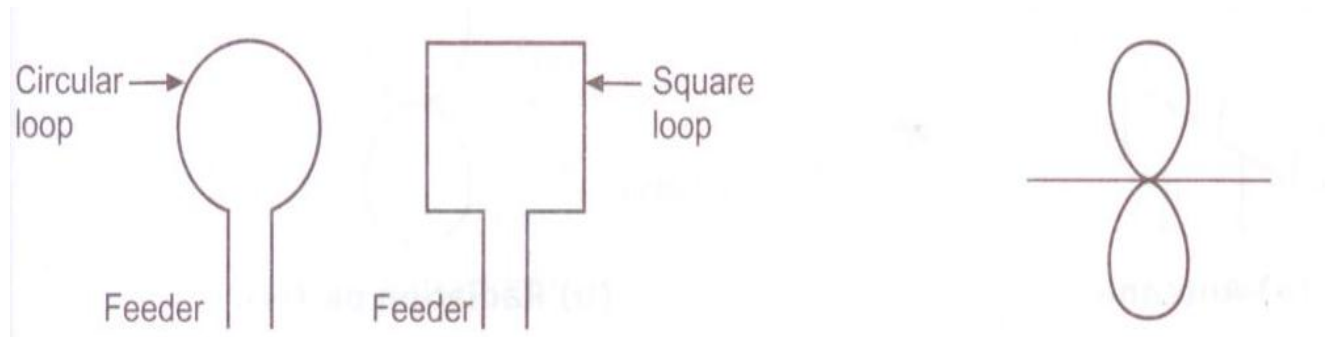
Delayed AGC is used in high quality receivers like communication receiver.

(f) Explain Loop antenna with sketch. Draw its radiation pattern. State its advantages and applications.

Ans:

Loop antenna-The single turn coil carrying RF current through it having length less than the wavelength. **(1 mark)**

Diagram – 1 mark



Advantages- (2 advantages – 1mark)

1. highly directive
2. Small size

Applications: (2 applications - 1 mark)

1. For direction finding
2. In portable receivers
3. In navigation