MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2005 Certified)

Winter – 15 EXAMINATIONS

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 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 judgment 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

(i) Define: 1) Analog Signal 2) Digital Signal

Ans: **(Any relevant correct definition - 1 mark each)**

Analog Signal: A signal whose amplitude can take on any value in a continuous range is known as an analog signal.

(OR)

A signal whose amplitude changes with respect to time is called as an analog signal.

Digital Signal: A signal whose amplitude can take on only a finite number of values is called as a digital signal.

(ii) State the importance of Modulation.

Ans: **(any two correct importance of modulation – 1 mark each)**

Importance of modulation:

1. The baseband voice signal cannot travel long distance in air since it get suppressed/attenuated after a short distance.
2. Therefore to transmit baseband signal over a long distance its frequency has to be increased to a great extent which can done by modulation. Hence range of communication increases.
3. Also by modulation multiplexing of signals and their transmission over a single channel is possible.
4. Modulation also helps in avoiding of mixing of different signals when transmitted together in a single channel.

(iii) Write the intermediate frequency value used for:

1) AM 2) FM

Ans**: (each correct answer – 1 mark)**

Intermediate frequency of AM = 455 kHz

Intermediate frequency of FM = 10.7 MHz

(iv) Write any two drawbacks of TRF radio receiver.

Ans: **(any two correct drawbacks – 1 mark each)**

Drawbacks of TRF Receiver:

1. Instability due to oscillatory nature of RF amplifier.
2. Variation in bandwidth over tuning range.
3. Insufficient selectivity at high frequencies
4. Poor adjacent channel rejection capability.

(v) State merits of delayed AGC as compared with simple AGC.

Ans: **(any two relevant merits – 1 mark each)**

Merits of Delayed AGC:

1. No reduction in gain for weak signals.
2. Reduction in gain only for strong signals.
3. Delayed AGC is adjustable

(vi) Define:

1) Characteristics impedance **1 mark**
2) Standing wave ratio **1 mark**

Ans:

Characteristic Impedance: Characteristics of impedance of transmission line Zo is the impedance measured at the input of this line when its length is infinite.

Standing Wave Ratio: The standing wave ratio (SWR) is the ratio of max voltage to min voltage.

OR

It is the ratio of maximum current to minimum current on a transmission line

$$SWR= \frac{V_{MAX}}{V_{MIN}} = \frac{I_{MAX}}{I_{MIN}}.`$$

(vii) Why are electromagnetic waves called transverse wave?

Ans: **(correct explanation – 2 marks)**

The electromagnetic waves are oscillations which propagate through free space.

In electromagnetic waves the direction of electric field, magnetic field & propagation are mutually perpendicular.

(viii) List the major causes of fading.

Ans: **(any two correct causes – 1 mark each)**

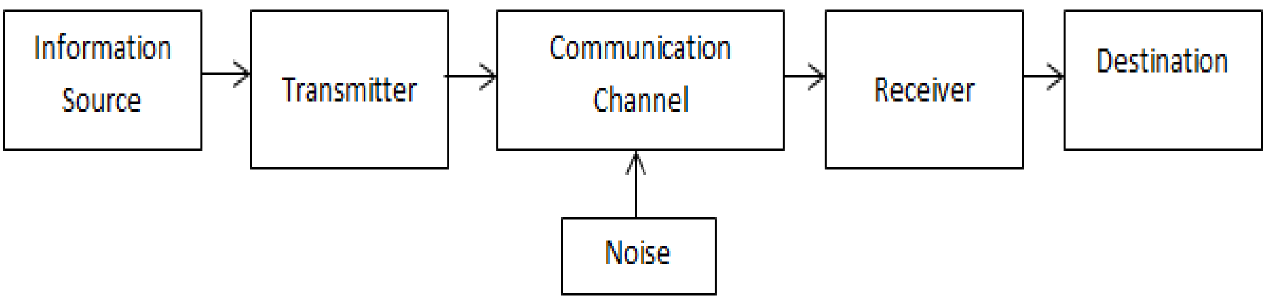
Major Causes of Fading:

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.

Q 1. b) Attempt any TWO of the following 8 marks

(i) Draw the block diagram of basic electronic communication system and label it. Explain the concept of channel.

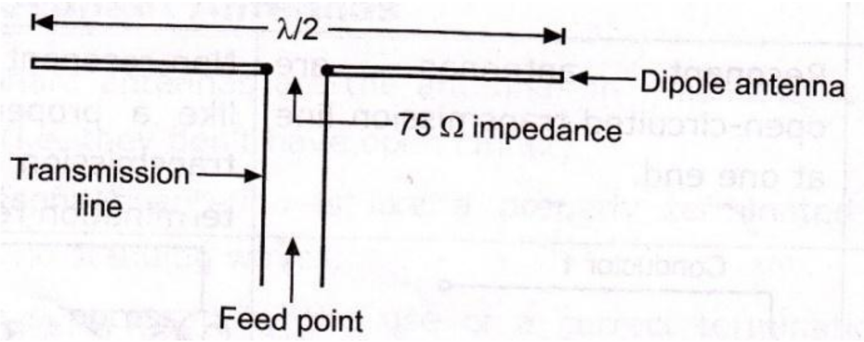
Ans: **(diagram – 2 marks, channel explanation – 2 marks)**



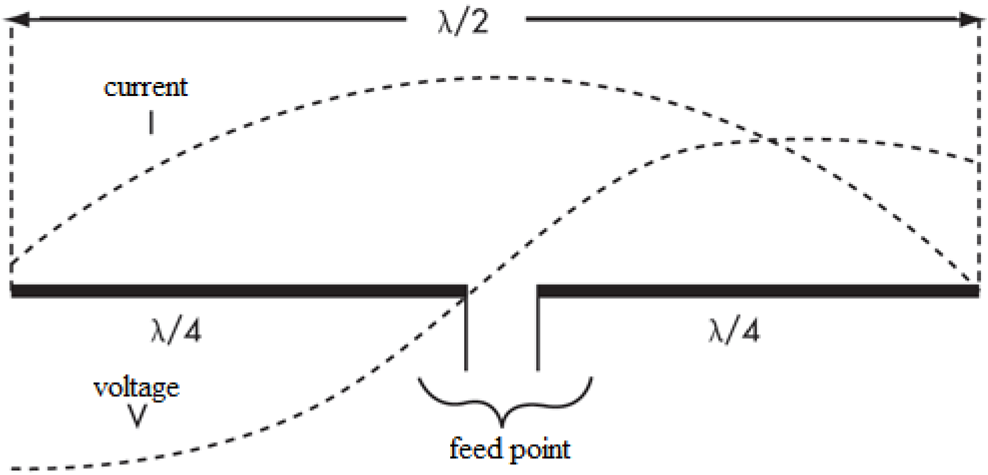
Channel: The communications channel is the physical medium that is used to send the signal from the transmitter to the receiver. In wireless transmission, the channel is usually the atmosphere (free space). In case of wired communication the channel may be a co-axial cable or optical fiber cable.

(ii) Draw the diagram of half-wave dipole antenna. Show the current and voltage distribution on it. Why is it called as 'Half Wave' dipole antenna?

Ans:



Half wave dipole antenna **(1 mark)**



Voltage and current distribution in half wave dipole antenna **(2 marks)**

The length of the dipole antenna is half wavelength i.e. λ / 2. Hence this dipole antenna is called as half wavelength dipole antenna. **(1 mark)**

(iii) Compare ground wave and space wave propagation on the basis of frequency range and method of wave propagation.

Ans: **(two correct points – 2 marks each)**

Note: polarize point not written also should be considered

Sr. No	Parameters	Ground Wave Propagation	Space Wave Propagation
1	Frequency Range	30 kHz to 3 MHz	Above 30 MHz
2	method of wave propagation	Surface Wave Propagation which waves vertically polarized	Line of Sight Propagation with waves horizontally polarized.

Q 2. Attempt any FOUR of the following 16 marks

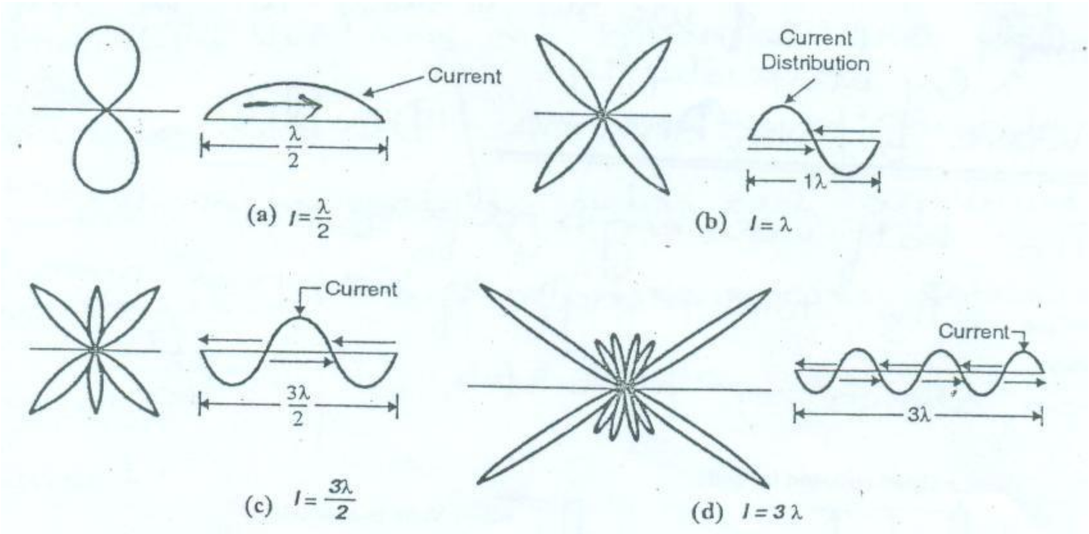
a) Draw the diagram of radiation pattern of the following resonant dipoles:

(i) $l = \frac{\lambda}{2}$ *(iii)* $l = 3\frac{\lambda}{2}$

(ii) $l = \lambda$ *(iv)* $l = 3\lambda$

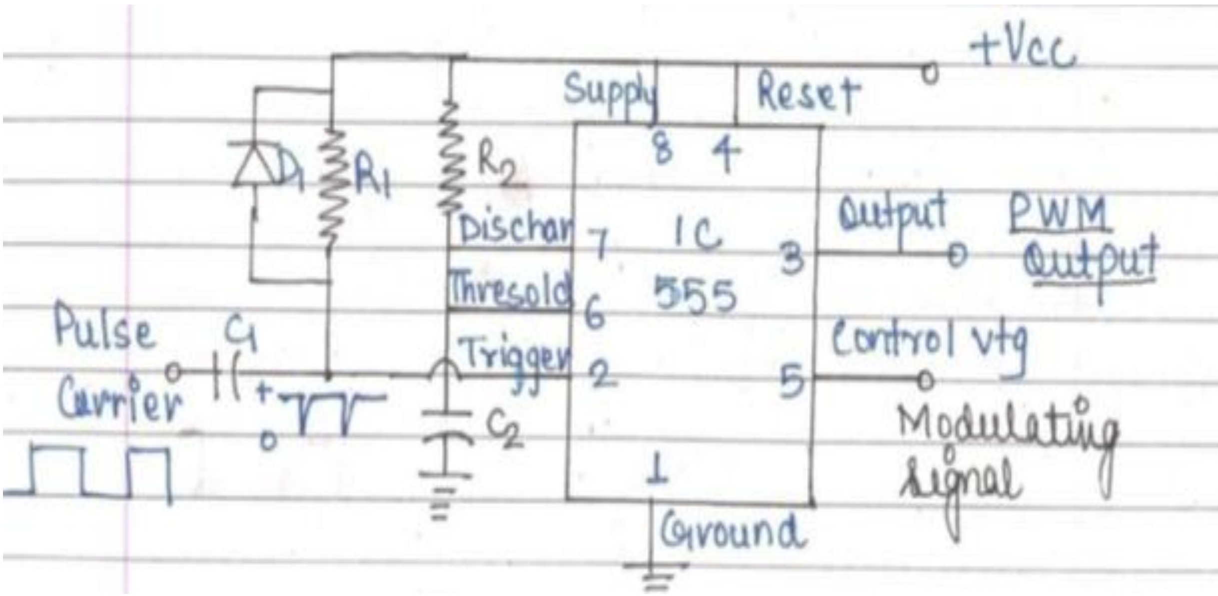
where *l* = length of dipole

Ans: **(each correct pattern – 1 mark)**



b) Draw the circuit diagram of PWM using IC 555. State its operation.

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



Operation:

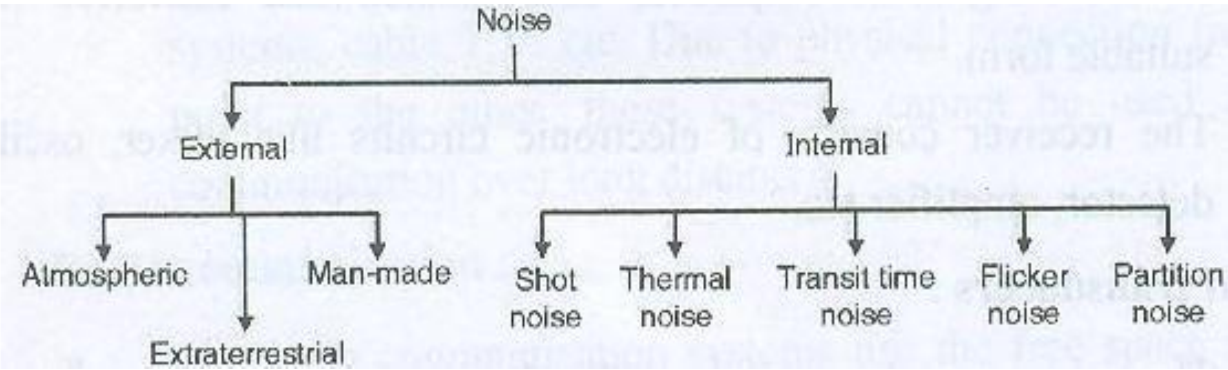
1. The timer IC555 is operated in Monostable mode.
2. The negative going carrier pulses are to the differentiator formed by R1 & C1. The differentiator produces sharp negative pulses which are applied to trigger input pin (2) of IC 555.
3. These triggering decides the starting instants (leading edge) of the PWM pulses. The PWM pulses go high at the instants of arrival of these triggering pulses.
4. The termination of the pulses is dependent upon,

- R2, C2 discharge time
- The modulating signal applied to control input pin (5)

5. The modulating signal applied to pin no (5) will vary the control voltage to IC 555 in accordance to the modulating voltage.
6. As this voltage increases, the capacitor C2 is allowed to charge through R2 up to a higher voltage & hence for a longer time (as R2 C2 time constant is fixed). The width of the corresponding output pulse will increase due to this action. As soon as VC2 is equal to the control voltage, the PWM pulse goes to zero.
7. Thus PWM signal is generated at the output pin (3) of IC555 as Monostable multivibrator.

c) List at least four types of noise. Explain any one of them.

Ans: **(Any four types list – 2 marks, any one explanation – 2 marks)**



Explanation of External Noise

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.

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 i5 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 through 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 (he duration of time that it takes for a current carrier such as a hole or current 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, possess no serious problem.

Transistor Thermal Noise

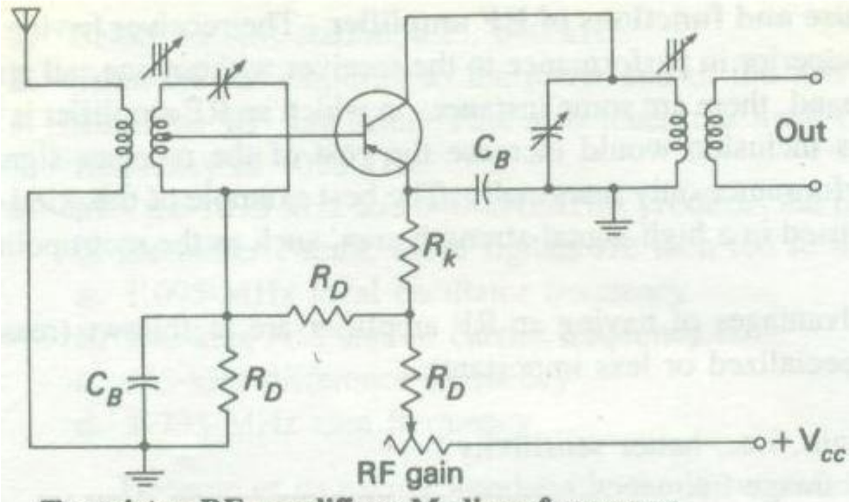
Within the transistor, thermal noise is caused by the emitter, base and collector internal resistances. Out of these three regions, the base region contributes maximum thermal noise.

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.

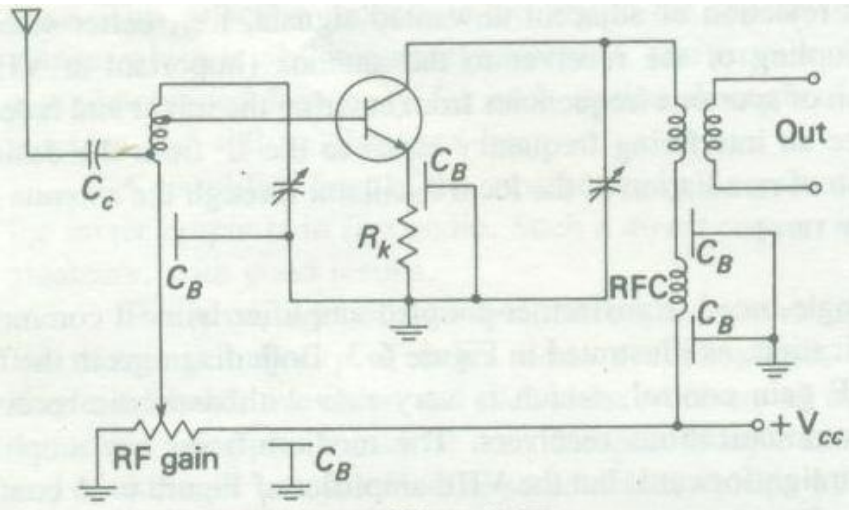
d) Draw the circuit diagram of transistorized RF amplifier. List any two characteristics of RF amplifier.

Ans: **(any relevant circuit diagram – 2 marks, any two correct characteristics – 2 marks)**



Transistor RF amplifiers Medium-frequency

(OR)



Transistor RF amplifiers VHF

The Characteristics of RF Amplifier are (2 points-2 marks)

1. Improved image frequency rejection
2. Improved signal to noise ratio
3. It selects the wanted frequency and rejects the unwanted frequencies.
4. Amplifier improves quality of receiver output.
5. Better coupling of receiver to the antenna.
6. Prevention in the reradiation of the local oscillator through the antenna of the receiver.

e) Describe the following transmission losses:

(i) Radiation losses (ii) Losses due to conductor heating

Ans: **(each correct description – 2 marks)**

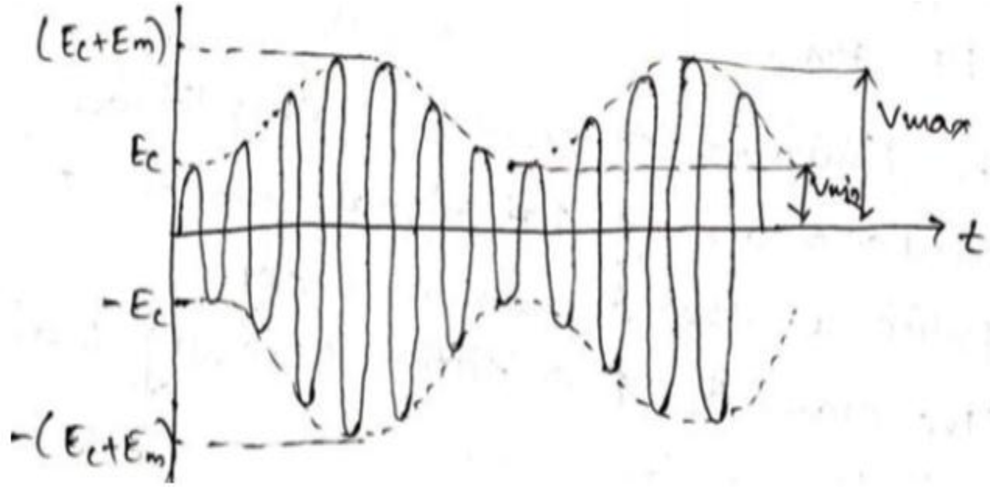
Radiation losses arise because; a transmission line may act as an antenna if the separation of the conductors is an appreciable fraction of a wavelength. It occurs more in parallel wire lines than in coaxial lines. Radiation losses are normally measures than calculated. They increase with frequency. They are reduced by proper shielding of the cable.

Conductor heating or I^2R loss is proportional to current and therefore inversely proportional to characteristic impedance. It also increases with frequency because of the skin effect. At higher frequencies, the current flowing through a conductor tends to concentrate more at the surface rather than at the core. This is called as skin effect. Skin effect reduces the equivalent cross sectional area of the conductor and hence increases the resistance R. In order to reduce the conductor loss, the length of the transmission lines should be shortened or use the wires of larger diameter.

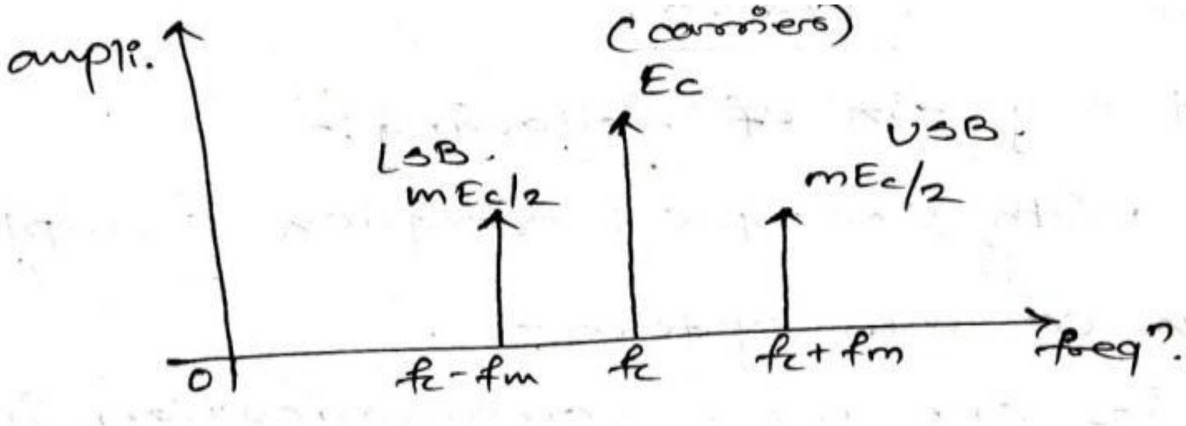
f) Draw the AM signal representation in:

(i) Time domain (ii) Frequency domain

Ans: **(each correct representation – 2 marks)**



AM in Time Domain



AM in Frequency Domain

Q 3. Attempt any four of the following: 16 marks

a) Compare amplitude modulation with frequency modulation with reference to:

i) definition iii) bandwidth
ii) modulation index iv) 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	Modulation Index	m = $\frac{V_m}{V_c}$	$M_f = \frac{\delta_m}{f_{m(\max)}}$
3	Bandwidth	BW = 2 f_m	BW = 2 (δ + $f_{m\,(max)}$)
4	Application **(any relevant point to be considered)**	Video transmission in TV receivers etc.	Sound transmission in TV receivers etc.

b) In broadcast super heterodyne receiver having loaded Q of antenna coupling of 100, if intermediate frequency of 455 kHz, calculate image frequency and its rejection ratio at 1000 kHz.

Ans:-

Given:-Q=100

Intermediate frequency = IF= 455 KHz

Incoming signal Frequency Fs=100 KHz

Calculate:-

1) fsi –Image frequency
2) Image frequency Rejection ratio

1) fsi is given as-

fsi= Fs+ 2 IF = 1000 x 10^3+ 2 (455 x 10^3)

= 1910 KHz **(2 mks)**

2) Rejection ratio is given by

α = $\sqrt{1+Q^2\rho^2}$

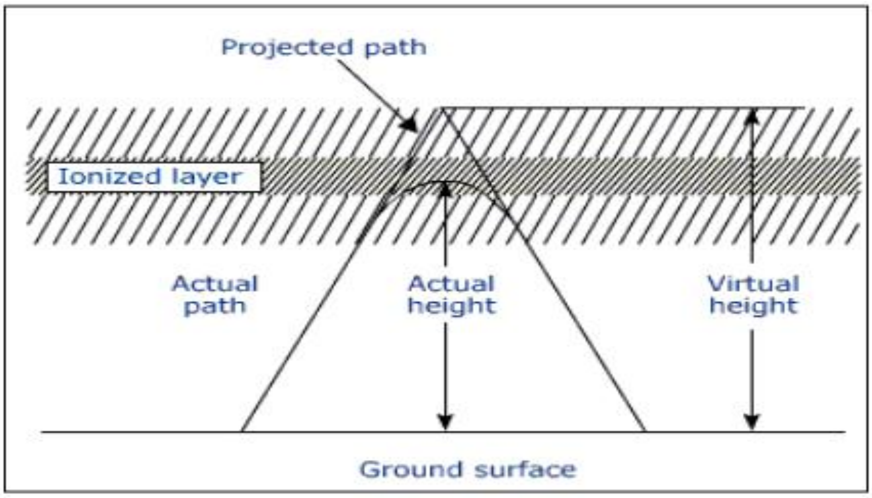
Where Q is the loaded Q of tuned circuit or antenna coupling

$$\rho = \frac{fsi}{fs} - \frac{fs}{fsi} = \frac{1910}{1000} - \frac{1000}{1910} = 1.386$$

Therefore, α = $\sqrt{1+Q^2\rho^2}$ = $\sqrt{1+100^2\ X\ 1.386^2}$ = 138.6 **(2 mks)**

c) Describe the term virtual height with the help of diagram showing ionized layer and the path of wave.

Ans:- **(Diagram- 2 mks, Explanation- 2mks)**



Virtual height: - It is the height above the earth's surface from which a refracted wave appears to have been reflected. It is also defined as the maximum height that the hypothetical reflected wave would have reached. As shown in the figure above, the projected path defines the virtual height.

d) A lossless transmission line has a shunt capacitance of 100 pf/m and a series inductance of 4µH/m. Calculate its characteristic impedance. What will be the value of series inductance if shunt capacitance is changed to 69 pf/m for same characteristic impedance?

Ans:- Shunt capacitance C= 100 pF/m

Series inductance L =4 µH/m

For lossless line, characteristics impedance is given as

$$Zo = \sqrt{\frac{L}{C}} = \sqrt{\frac{4*10-6}{100*10-12}}$$

$= 200\ \Omega$ **(2 mks)**

For same value of Zo, given new value of shunt capacitance of 69 Pf/m, value of series inductance is calculated as-

$$Zo = \sqrt{\frac{L}{C}}$$

$$200 = \sqrt{\frac{L}{69*10-12}}$$

$L= (200)^2 \text{ x } 69 \text{ x } 10^{-12}$

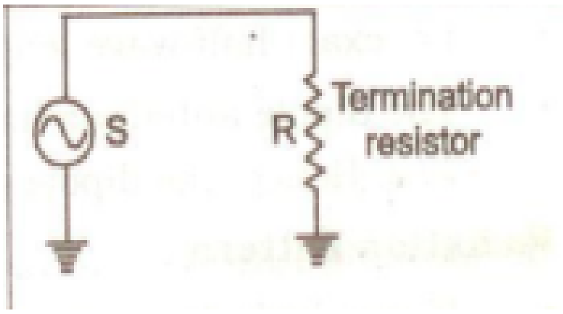
$= 2.76$ µH/m **(2 mks)**

e) Describe non-resonant antenna with the help of its radiation pattern.

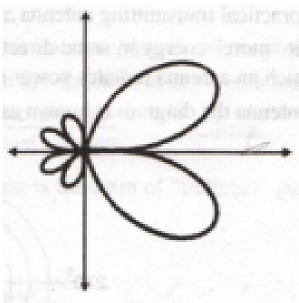
Ans **:- (diagram- 2 mks, description – 1 mks, radiation pattern – 1 mks)**

Non resonance antenna-The antennae whose lengths are not multiples of λ/2.They are like a properly terminated transmission line by correct termination resistor. So they don't have standing waves present. And hence have only forward waves and no reflections.

Diagram



Radiation pattern



f) Define pre-emphasis. Why is it used? Sketch a typical pre emphasis circuit.

Ans:-

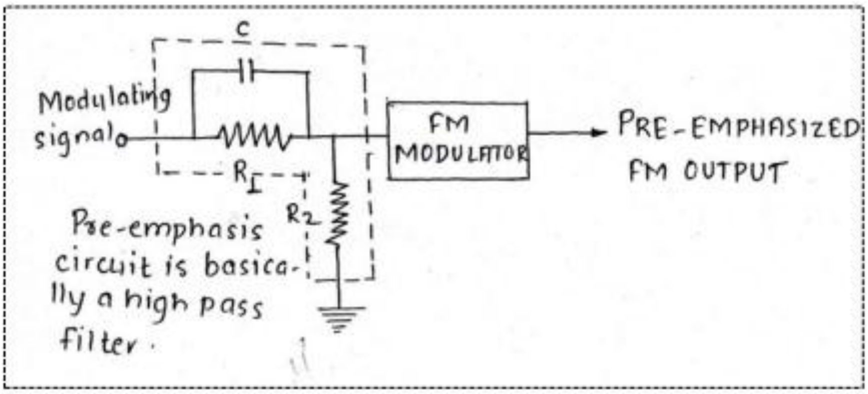
Definition- (1 mks)

The artificial boosting of higher modulating frequencies to reduce the effect of noise is called as pre-emphasis.

Need:- (1 mks)

- 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 (mf).
- This can be done by increasing the deviation and can be increased by increasing the amplitude of modulating signal at higher frequencies.

Circuit diagram (2 mks)



Q4. Attempt any FOUR of the following 16 marks

a) Draw a basic circuit of basic reactance modulator and describe its operation.

Ans:- **(Circuit diagram- 2 mks, explanation- 2mks)**

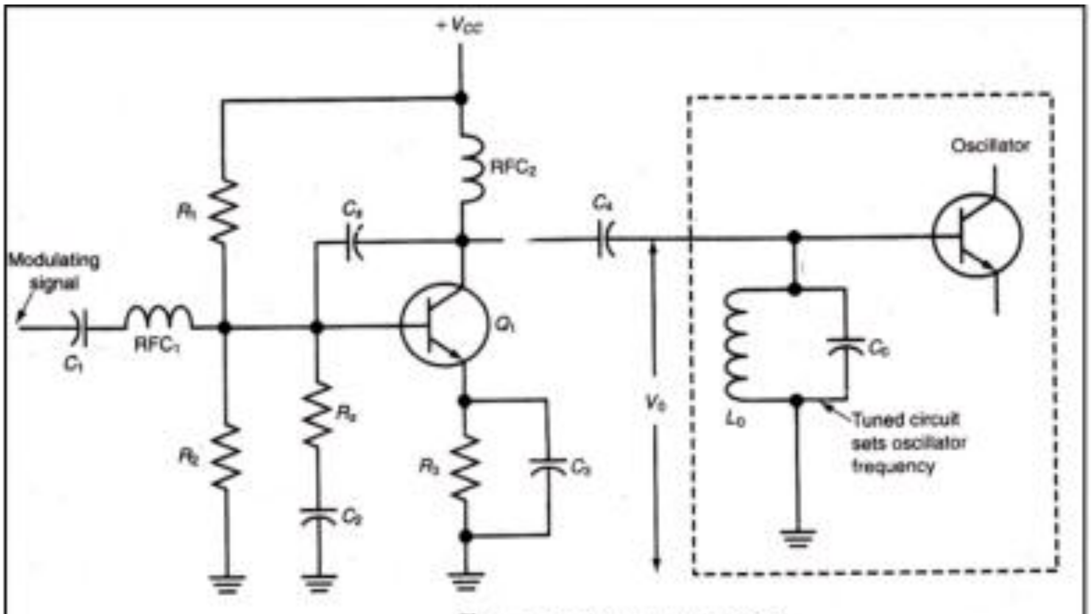


Fig. A reactance modulator.

Explanation-

- A reactance modulator is illustrated in figure. It is basically a standard common-emitter class A amplifier. Resistors R1 and R2 from a voltage divider to bias the transistor into the linear region. R3 is an emitter bias resistor.
- The oscillator signal from the RC phase-shift circuit made up of Cs and Rs.
- The value of Cs is chosen so that its reactance at the oscillator frequency is about 10 or more times of the value of Rs. if the reactance is much greater than the resistance, the circuit will appear predominantly capacitive; therefore the current through the capacitor and Rs will lead the applied voltage by about 90◦.
- Since the collector current is in phase with the base current, which in turn is in phase with the base voltage, the collector current in Q1 leads the oscillator voltage V0 by 90 ◦. Of course, any circuit whose current leads its applied voltage by 90◦ looks capacitive to the source voltage.
- The modulating signal is applied to the modulator circuit through C1 and RFC1. The RFC helps keep the RF signal from the oscillator out of the audio circuit from the modulating signal usually comes. The audio modulating signal will vary the base voltage and current of Q1 according to the intelligence to be transmitted.
- The collector current will also vary in proportion. As the collector current amplitude varies, the phase shift angle changes with respect to the oscillator, voltage, which is interpreted by the oscillator as a change in the capacitance. So as the modulating signal changes, the effective capacitance of the circuit varies and the oscillator frequency is varied accordingly.
- An increase in capacitance lowers the frequency, whereas a lower capacitance increases the frequency. The circuit produces direct frequency modulations.

b) A 400 watt carrier is amplitude modulated to a depth of 75% calculate the total power in AM wave.

Ans:- **(Formula – 1mks, correct answer- 3 mks)**

Given data-

Carrier power (Pc) = 400 watt

Modulation index (m) = 75%= 0.75

Pt=?

Solution

Total Transmitted Power (Pt) = Pc $\left[1 + \frac{m^2}{2}\right]$

$= 400 \text{ x } \left[1 + \frac{0.75^2}{2}\right]$

= 400 x [1.12812]

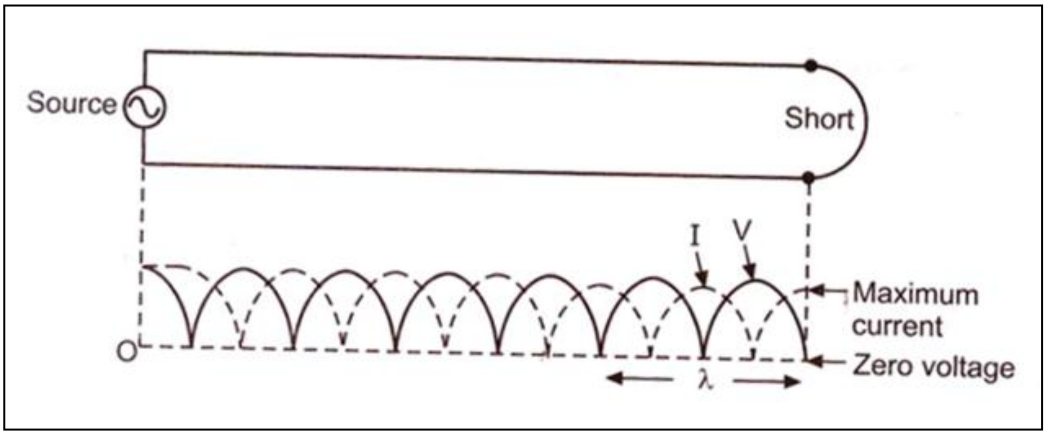
= 512.5 W

c) What is the value of SWR for short circuited transmission line? Describe the effect on transmitted wave in this case

Ans:- **(Value – 1mks, diagram – 2 mks, effect – 1 mks)**

For a short circuited transmission line, the value of SWR will be greater than 1(ideally infinite)

The waveform below the transmission line shows the voltage and current at each point on the line with short circuited end.



Effect:-

- We can measure these voltages and current at each point with the help of Multimeter.
- As shown the voltage is zero while the current is maximum because short circuit means zero impedance
- All the power is reflected back towards the source.
- The voltage and current variations distribute themselves according to the wavelength of the signal.
- The pattern repeats for every one-half wavelength.
- The voltage and current levels at the source will be dependent on the signal wavelength and actual line.
- So SWR= V max/Vmin

d) Describe the following effects of the environment on electromagnetic waves:
i) Reflection ii) Refraction

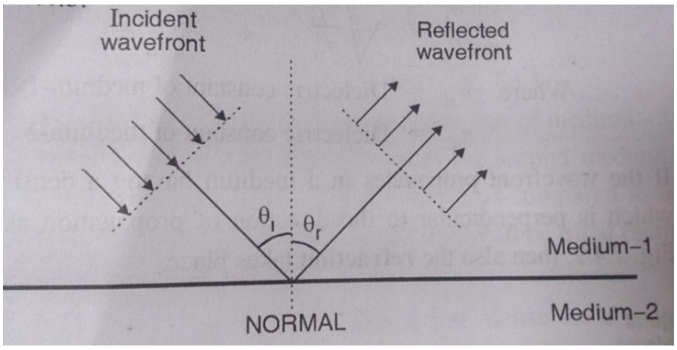
Ans:- **(Concept and figure- 1mks each)**

Reflection-

The effect can be thought of bouncing.

Reflection of electromagnetic wave will take place when it strikes a boundary of two media and some or all the incident power does not enter the second material.

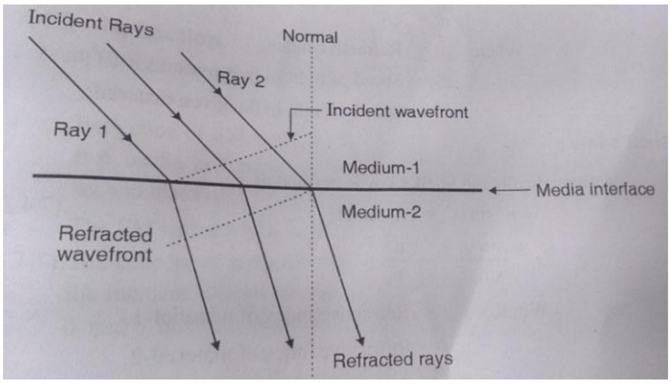
The EM Wave, which does not enter the second medium are reflected as shown in the figure below.



Refraction-

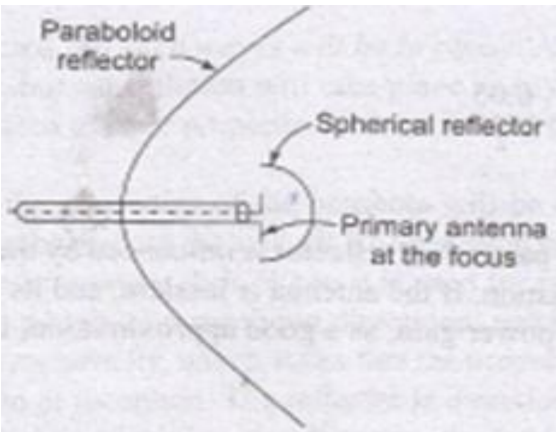
It is similar to bending. It is defined as the change in direction of a ray when it passes from one medium to the other with different velocities of propagation.

The refraction takes place when the two mediums have different densities. The principle of refraction is as shown in figure -



e) Describe the operating principle of dish antenna. Also draw its radiation pattern.

Ans:**-(diagram – 2 mks, explanation- 1mks, radiation pattern-1 mks)**



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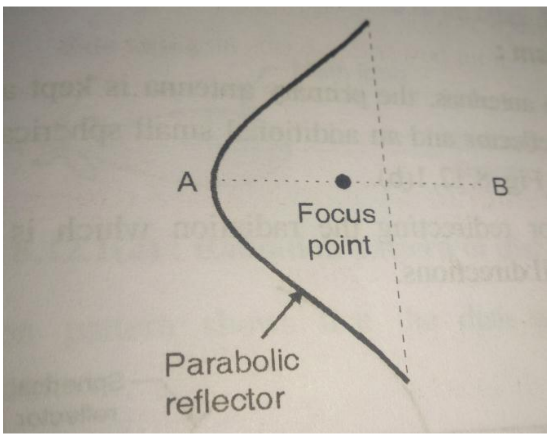
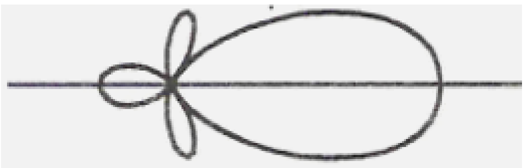


Principle: - (1 mark)

- 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.

Radiation Pattern: (1 mark)

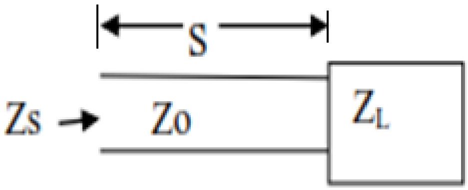


f) Describe impedance inversion property of quarter wavelength transmission line.

Ans:- **(diagram- 2mks, description- 2 mks)**

Impedance inversion property-

Consider the figure shown below where the load impedance ZL connected to a piece of transmission line of length s, having characteristics impedance Z0



When the length s is exactly a quarter wavelength line (odd no. of quarter wavelength) and the line is lossless, then the impedance Zs, when looking towards the load is given by-

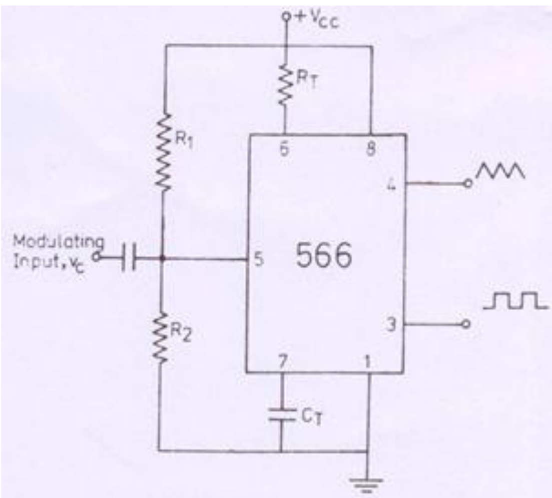
$$Zs=Zo^2/ ZL$$

This relation is called reflective impedance means quarter wavelength reflects the opposite of its load impedance- called as impedance inversion property. Here if ZL is inductive then Z will be capacitive and vice versa.

Q) 5 Attempt any FOUR of the following 16 marks

a) Describe the FM generation using IC566.

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

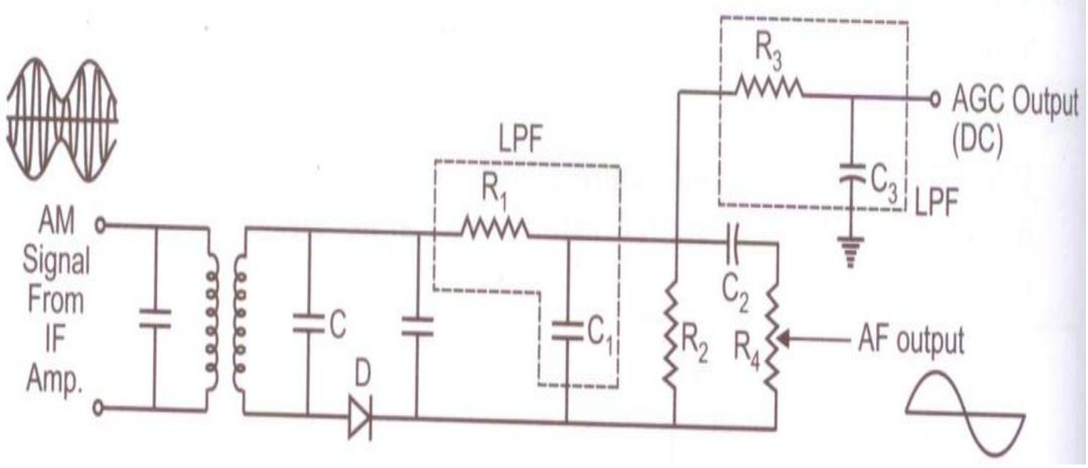


Explanation

- A common type of VCO available in IC form is NE/SE566. Referring to figure a timing capacitor C_t is linearly charged or discharged by a constant current source/sink.
- The amount of current can be controlled by charging the voltage V_c applying at the modulating input (pin 5) or by changing the timing resistor R_t external to IC chip.
- The voltage at pin 6 is held at the same voltage as pin5. Thus if the modulating voltage at pin 5 is increased the voltage at pin 6 also increases, resulting in less voltage across R_t and thereby decreasing the charging current.
- The output frequency of the VCO can be changed either by (i) Rt, (ii) Ct or (iii) The voltage V_c at the modulating input terminal pin 5. The voltage V_c can be varied by connecting a R_1R_2 circuit is shown in figure.
- The component R_t and C_t are first selected so that VCO output frequency lies in the centre of the operating frequency range.
- Now the modulating input voltage is usually varied from 0.75 V_{cc} to V_{cc} which can produce a frequency variation of about 10 to 1.

b) Draw the block diagram of practical diode detector. Describe how it is better than simple diode detector.

ANS: (Diagram 2M Description 2M)



It is better than simple diode detector since it overcomes the drawback of simple diode detector such as i) Negative peak clipping, ii) Positive peak clipping, iii) Diagonal peak clipping.

c) Describe the application of transmission line stub. Write the situation where single stub or double stub is used.

ANS: (2M for application and 2M for any one situation)

Transmission line are used for impedance matching and is used as series resonance circuit to eliminate interfacing RF signal.

Single stub: The source and load impedance get perfectly matched and maximum power is transfer to the load. The impedance of the line does not have to be very small.

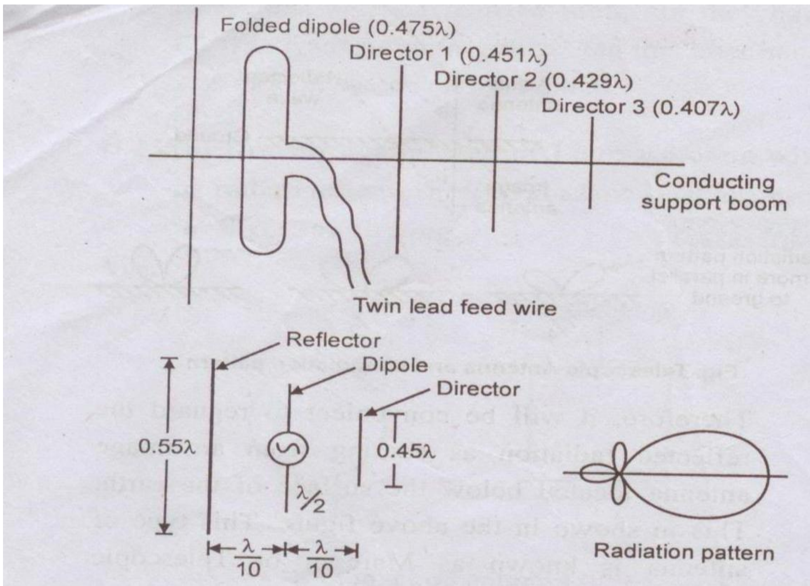
Single stub is useful for fixed frequency, so as frequency changes the location of the single stub.

It is used for single frequency.

Double stub: It generally employed that high frequency matching and at such high frequency in microwave range coaxial cables are used.

d) Draw the diagram of Yagi-Uda antenna. Describe it with reference to its radiation pattern.

ANS: (any relevant Diagram with radiation pattern - 2M and description 2M)

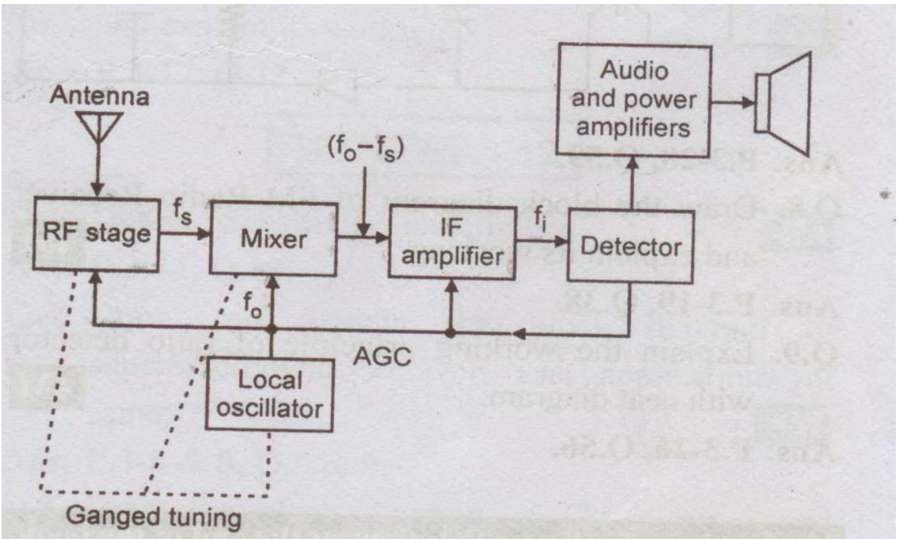


- This antenna is widely used with TV receivers for location within 40to 60 kms from the transmitters.
- It has folded dipole as a driven element with one reflector and one or more directors on parasitic elements. These elements are closed together as shown in the figure.
- This antenna provides a gain of 7db and is unidirectional as seen from its radiation pattern. To avoid pick up from any other side, the back lobe of radiation pattern can be reduced by bringing the radiators closer to each other.
- Yagi antenna has broadband response; therefore it is not necessary to use a separate antenna for each channel.
- The receiver antenna is mounted horizontally for maximum pickup from the transmitting antenna. The antenna elements are normally made out of 0.6 to 5 centimeter to 1.25 cm in diameter dimension pipes suitable length.

e) Draw block diagram of super heterodyne AM radio receiver, describe the principle of super het.

ANS: **(Diagram 2M Principle 2M)**

Diagram:

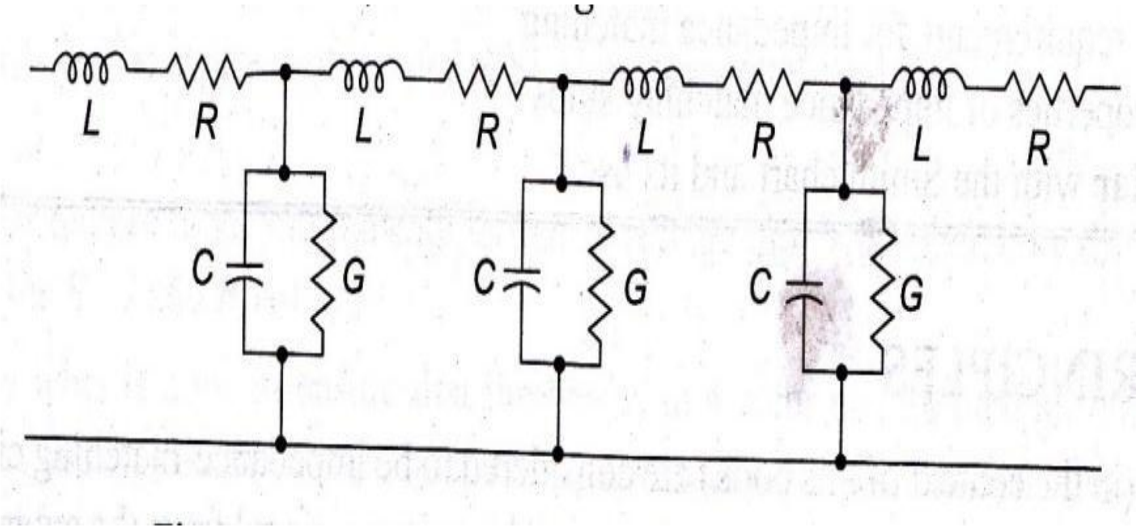


Principle of Super heterodyne

The principle of super heterodyne means mixing of input signal frequency with the local oscillator signal frequency to get constant intermediate frequency. The tuning of radio receiver is done through a local oscillator and accordingly the input signal is selected to get a intermediate frequency. In case of AM receiver the intermediate frequency is 455 kHz.

f) Draw and explain the general equivalent circuit of transmission line.

ANS: (Diagram 2M and explanation 2M)



- Transmission line is a medium of transmitting the signal over longer distances & so each conductor has a certain length diameter.
- Since each conductor has a certain length and diameter.
- It must have inductance and resistance. Since there are to wires close to each other there will be capacitance between them.
- These two wires are separated by a medium called a dielectric. These will be some current leakage through the dielectric as no dielectric is a perfect. Dielectric can be represented as shunt conductance.
- The quantities L, R, G, & C are measured per unit length.
- Transmission line parameters are constants:

These are two types of transmission line parameters:

1) Primary parameters: R, L, G, &C.
2) Secondary parameters: P & $Z_{o.}$
   Where, R= Resistance per unit length,
   L= Inductance per unit length,
   G= Conductance per unit length,
   C= capacitance per unit length.

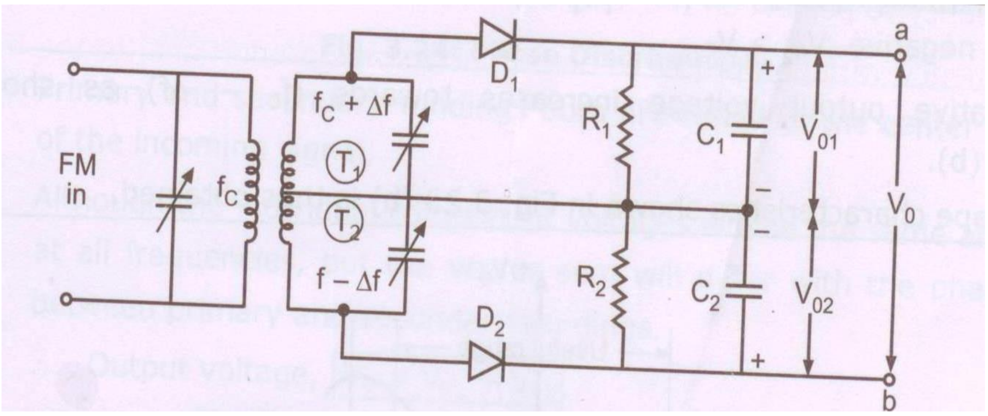
These parameters are distributed throughout the length of transmission line and are called as distributed parameters.

Q 6) Attempt ANY TWO of the following 16 marks

a. Draw the circuit diagram of balance slope detector and describe its working principle.

ANS**: (circuit Diagram 3marks and working principle 3marks, characteristics – 2marks)**

Diagram: (3 marks)



Working Principle: (3 marks)

- The difficulties arising in simple slope detector circuit are overcome balanced slope detector.
- The circuit uses two slope detectors, connected back to back to the opposite ends of center tapped transformer and hence fed 180^o out of phase.
- The circuit is divided in to three tuned circuits.
- Primary side tuned circuit is tuned to center frequency fc.
- Secondary side top of tuned circuit in tuned above If i.e. (fc +Δf) and bottom of tuned circuit is below IF i.e. (fc-Δf).
- Each tuned circuit is connected to diode detector and RC load.
- R_1C_1 and R_2C_2 are filtered to remove RF ripple.
- Final output voltage v_0 is

$$v_0 = v_{01} - v_{02}$$

Circuit Operation:

The circuit depends on range of frequencies

- For $f_{in} = f_c$:

  Voltage at T_1 = voltage at T_2

  Input voltage at D_1 = Input voltage at D_2

  $V_{01} = V_{02}$

  $V_0 = 0$

- $f_c < f_{in} < (f_c + \Delta f)$:

  Voltage induced in T_1 > voltage induced in T_2

  Input voltage at D_1 > Input voltage at D_2

  Output voltage V_{01} is positive as frequency increases towards ($f_c = \Delta f$)

  The positive output voltage increases as shown in figure.

- $(f_c - \Delta f) < f_{in} < f_c$:

  Voltage induced in T_2> voltage induced in T_1

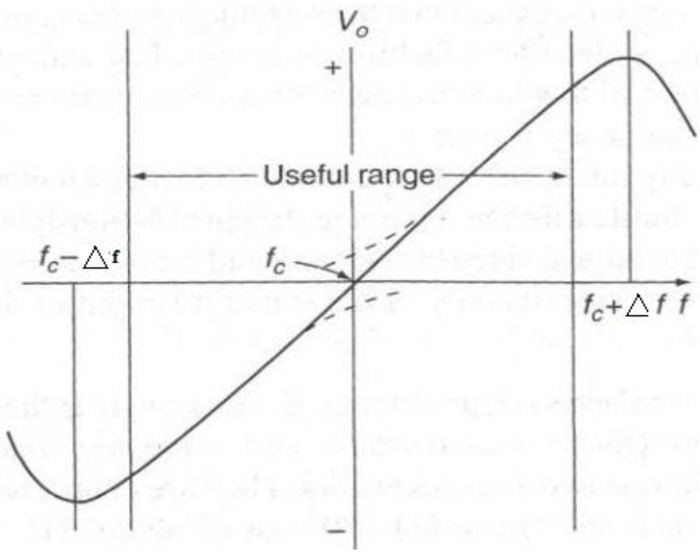
  Input voltage to D_1 > Input voltage to D_1

  V_0 is negative. $V_{02} > V_{01}$

The negative output voltage increases towards ($f_{c\,-}$ Δf) as shown in figure.

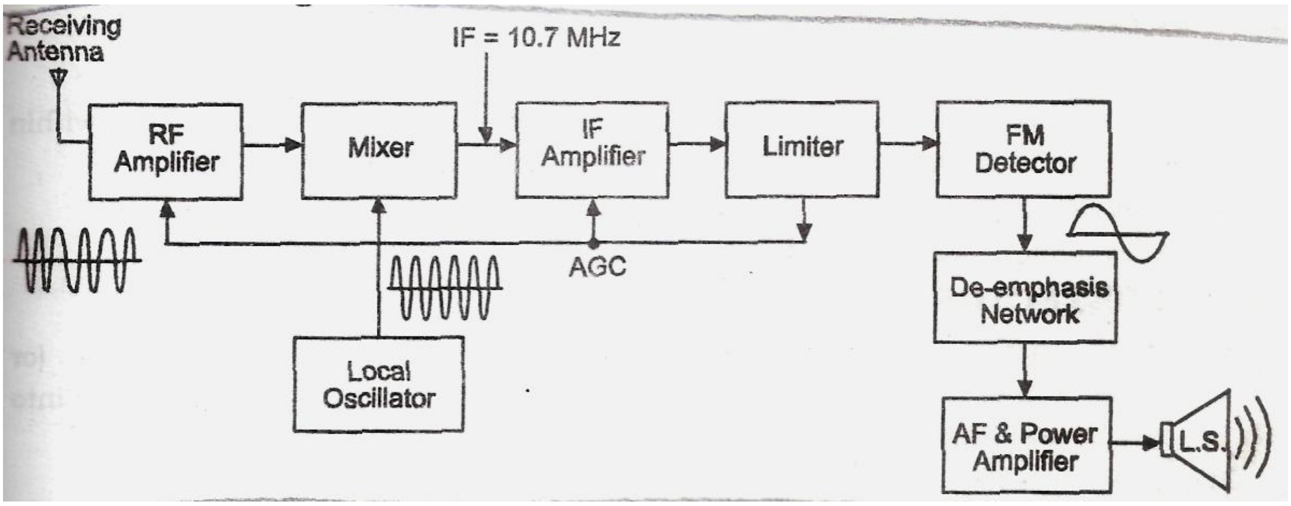
The s- shape characteristics shown in figure is thus obtained.

Characteristics: (2 marks)

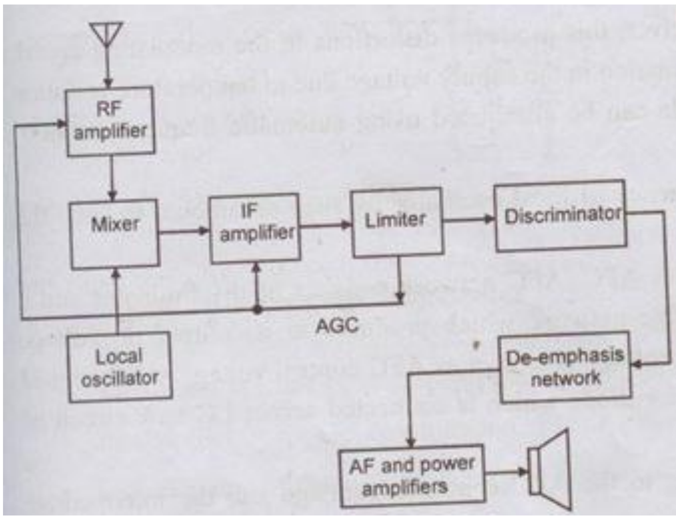


b. Draw the block diagram of FM super heterodyne radio receiver and state two function of each block.

ANS: **(Block diagram 4M and Function 4M)**



(OR)



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 f_s and local oscillator frequency f_o. At the output, it produces the difference frequency known as intermediate frequency f_i.

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 f_o is kept smaller than the signal frequency f_s by an amount equal to the intermediate frequency f_i ($f_i = f_s - f_o$).

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:

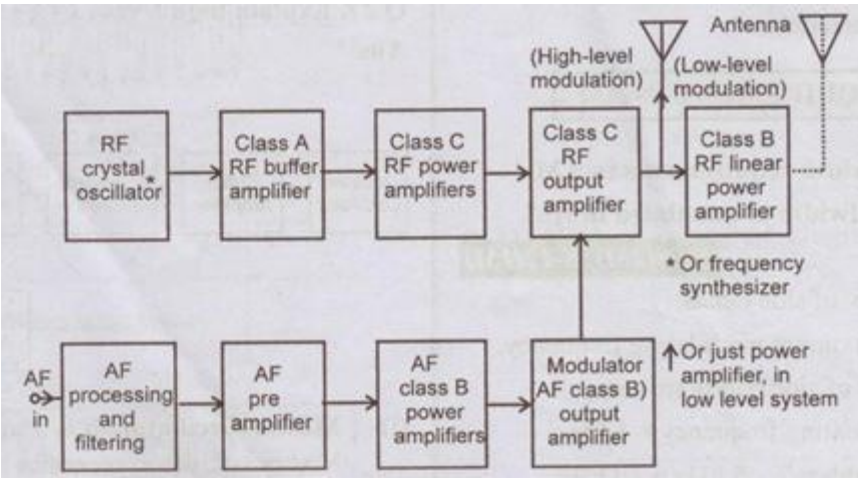
It separates modulating signal from frequency modulated carrier signal. Thus it produces audio signal at its output.

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. i) Draw the block diagram of AM transmitter.

ANS: **(Block diagram 4M)**



ii) What factors govern the selection of feed point of dipole antenna? How do current feed and voltage feed antenna differ?

ANS: **(factors – 2 Marks, current & voltage feed – 1 mark each)**

Following are the factors which govern the selection of feed point dipole array:

i) Antenna feed point impedance

ii) Current Feed (Low impedance feed)

iii) Voltage feed (High impedance feed)

Current feed:

i) The antenna is said to be current feed when excitation energy from the RF – generator is introduced to the antenna.

ii) The example is $\frac{1}{2}$ wave dipole antenna. In this case, the $\frac{1}{2}$ wave antenna is cut in two parts at midpoint and energy is fed by co- axial transmission line.

Voltage feed antenna:

i) When the excitation energy from the RF source is introduced at the point of maximum voltage, the antenna is sad to be voltage feed antenna.

ii) The example is the $\frac{1}{2}$ wave un-splitted antenna excited by a resonant R-F line.