1) The Answer 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 Answer 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 with example: Simplex & Duplex

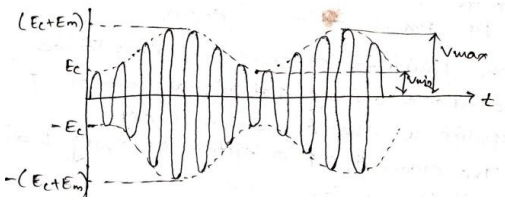
Ans: - (2 M)

Simplex communication System:-
It is one way communication in which information is communicated in only one direction. **(½ M)**
Eg. TV broadcasting, radio broadcasting, telemetry, remote control **(1 ½ M)**
Duplex Communication System:-
It is a two way communication which can transmit as well as receives information. Simultaneously or non simultaneously.
Eg. Walky talky, telephone, mobile, Radar, FAX, Pager **(1 ½ M)**

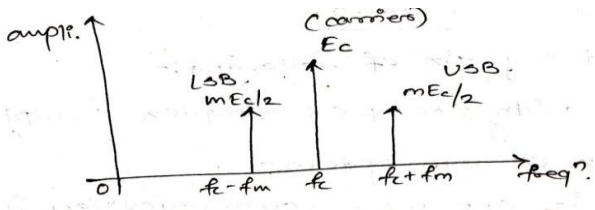
ii) Represent AM wave in time domain & frequency domain

Ans :- (2M)

AM in Time domain (1 M)



AM in frequency domain (1 M)



iii) Define pulse modulation & state its types.

Ans:- **(2 M)**

Pulse modulation is a technique in which continuous waveforms are sampled at regular intervals.

i.e. carrier is a train of discrete pulses. **(1 M)**

Types:-

i) Analog Pulse modulation **(½ M)**

- **PAM**
- **PWM**
- **PPM**

ii) Digital Pulse Modulation **(½ M)**

- **PCM**
- **DM**
- **ADM**

iv) State the function of limiter ckt. used in FM Receiver.

Ans: - **(2 M)**

The limiters remove any amplitude variations on the FM signal, before it applied to the demodulator ckt. The class A If amplifier generally used as limiter circuit.

v) State 2 advantages & disadvantages of balanced slope detector

Ans :- **(2 M)**

Advantages :- **(Any 2 ½ + ½ M)**

i) It is more efficient than simple slope detector.

ii) It is linear.

Disadvantages: - **(½ M Each)**

i) Amplitude limiting is not provided.

ii) Difficult to tune 3 tuned circuits to 3 different frequencies.

vi) What is single stub transmission line?

Ans:- **(2 M)**

It is the length of transmission line or wave guide that is connected at one end only. The free end of the stub is either left open circuit or short circuit.

vii) Why electromagnetic waves are said transverse waves?

Ans:- **(2 M)**

The electromagnetic waves are oscillations which propagate through free space.

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

Since the oscillations are perpendicular to direction of propagations of waves they are said to be transverse waves.

viii) Define plane of polarization.

Ans:- **(2 M)**

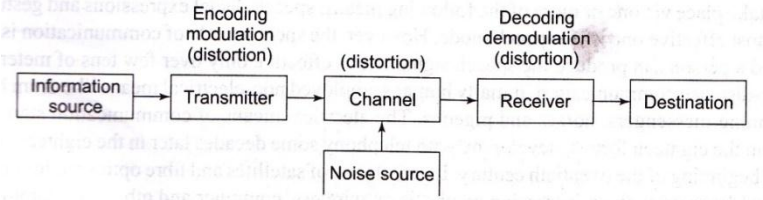
It is the plane in which the direction of the electric vector in the electromagnetic wave radiated by the transmitting antenna.

Eg. Horizontal plane of polarization, vertical plane of polarization.

b) Attempt any 2 of following. **(8 M)**

i) Draw & explain block diagram of communication system.

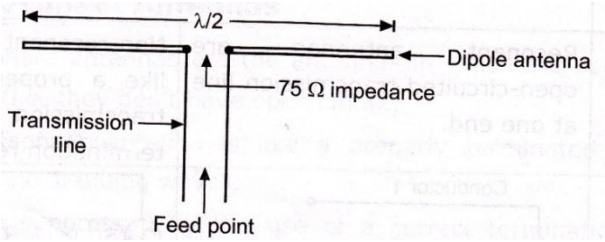
Ans :- **(Diagram – 2M, Explanation- 2 M)**



i) Input signal: - The information can be in the form of sound, picture or data coming from computer.
ii) Input transducer: - it converts original information into equivalent electrical signal.
iii) Transmitter: - it converts electric equivalent into suitable form. It increases the power level of signal so that it can cover long distance.
iv) Communication Channel: - it is the medium used for transmission of electromagnetic e.g. from one place to another.. it can be wire or optical fibre or free space.
v) Noise: - It is unwanted signal which gets added in transmitting signal.
vi) Receiver: - the received signal is demodulated & converted back to suitable form.
vii) Output transducer: - It converts electrical signal into original form.

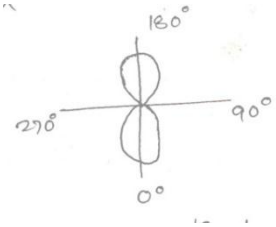
ii) Explain with neat diagram. Half wave dipole antenna

Ans :- **(2 M)**



Explanation: **(2 M)**

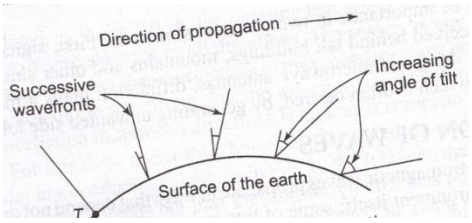
- It is a resonant antenna
- It is exact half wavelength (λ /2) long & open circuited at one end.
- The dipole antennas have lengths λ /2 , λ , 3 λ /2 etc. which are all multiple of λ /2. Hence they are resonant.
- The radiation pattern of half wave dipole antenna is -



- In half wave dipole antennas the forward waves & reflected waves exist. Hence radiation pattern is bidirectional.

iii) Describe 3 features of ground wave propagation along with neat sketch.

Ans :- **(2 M)**



Features: **(2 M)**

i) It consists of direct wave which travels near the ground from Transmitter to Receiver.
ii) The electromagnetic wave leaves the transmitting antenna & remains close to earth surface. The ground wave actually follows curvature of earth & hence travels beyond the horizon.
iii) The ground waves are vertically polarized.
iv) It is strongest at the low & medium frequency ranges. The ground wave is the path chosen by eq. when frequency in between 30 KHz & 3 MHz.

Q. 2. Attempt any 4 **(16 Marks)**

a) Draw & explain Horn Antenna.

Ans: - **(diagram – 2 M, explanation- 2 M)**

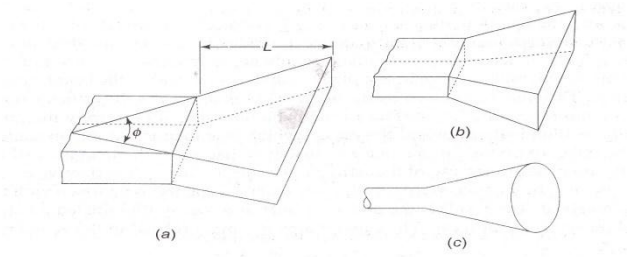


Fig. 11.32 *Horn antennas. (a) Sectoral; (b) pyramidal; (c) circular.*

- It is basically a waveguide terminated by horn.
- All the energy travelling forward in the waveguide is radiated effectively with addition of the Horn.
- 3 configurations of Horn antennas.

Sectoral	ii) Pyramidal	iii) Conical
↓	↓	↓
It flares out only in 1 direction	It flares out both direction	Termination of circular wave.

- [illegible] Horn antenna
  i [illegible] orn antenna

  It is a low noise antenna used in satellite tracking & communication stations.

  ii) Hog – Horn antenna:-

  The advantage of Hog- Horn antenna is that the Rx ing point does not move when antenna rotated about its axis.

Application:-

i) Used at microwave frequency.

ii) Used in satellite tracking.

b) Define Modulation & explain need of modulation.

Ans:- **(4 M)**

Modulation: - It is the process of superimposing low frequency information eq. on a high frequency carrier signal. **(1 M)**

Need of Modulation :- **(3 M)**

i) Reduction in ht. of antenna :-

$h = \frac{\lambda}{4}$

H = height of antenna

λ = wavelength

C= velocity of light

F = frequency

$$\lambda = \frac{c}{4f}$$

To transmit baseband eq. of f= 10 KHz. The ht. of antennae required is

$$\lambda = \frac{c}{4f}$$

$$\frac{3\ x\ 10^8}{4\ x\ 10x\ x\ 10^3} = 7.5\ km.$$

This ht. is not practicable to install. If suppose the eq. modulated to f= 1 MHz

$$h = \frac{\mathrm{c}}{4f}$$

$$= \frac{3\ x\ 10^8}{4\ x\ 1\ x\ 10^6} = 75\ m.$$

Thus, this proves that modulation technique reduces ht. of antenna.

ii) Avoids mixing of signal :-
If only baseband eq. are transmitted all eq. in the range of 20 Hz- 20 KHz. Thus all eq. mixed together & Rx can not separate them.
But modulation use different carrier frequency & separates each channel from one another.

iii) Increases range of
Baseband eq. are low frequency eq. it transmitted as it is can not travel long distance. If we use high frequency carrier then range of comm. Increases.

iv) Multiplexing is possible:-
Using modulation more than 1 eq. can be transmitted over same ch. simultaneously.

c) Draw & explain electromagnetic spectrum

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

The frequency of electromagnetic eq. ranges from few Hertz to several GHz. This entire range of frequency of EM waves is called EM spectrum.

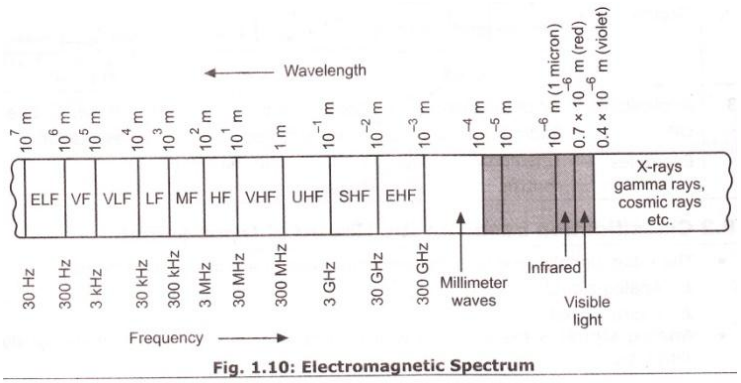


Fig. 1.10: Electromagnetic Spectrum

d) Draw & explain block dig. Of superheterodyne AM radio Rx.

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

Superheterodyne principle:

In super heterodyne Rx. The incoming eq. is mixed with o/p of local oscillator & converted into a eq. with lower fixed frequency called If

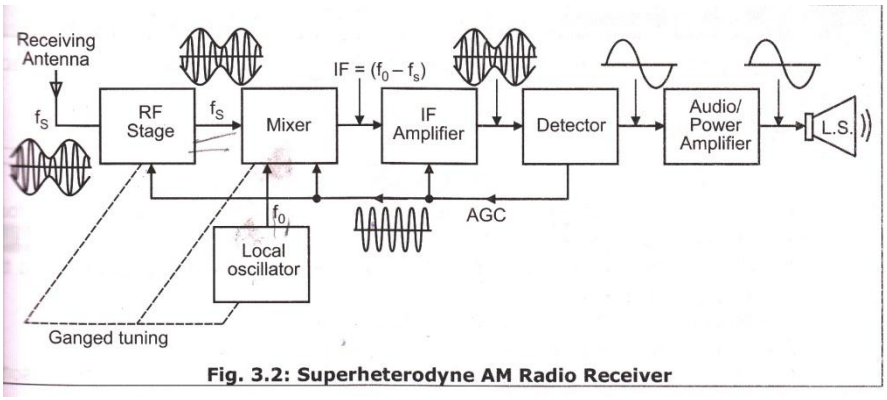


Fig. 3.2: Superheterodyne AM Radio Receiver

i) **RF stage :-** selects wanted eq. & reject all other eq. & reduce effect of noise.

ii) Mixer :-

The eq. from RF stage (fs) & local oscillator (fo) is mixed & produce the IF.

IF = fo - fs

iii) Changed tuning :-

To maintain constant difference between i.o. & RF eq. gang capa. are used.

iv) Detector :-

Amplified if eq. is detected by detector to get original modulating eq. it also provides control sqs. To control gain of IF & RF stage. It is Automatic gain control. (AGC)

e) Define characteristics impedance & explain how to calculate it

Ans:- **(4 M)**

Characteristics of impedance:-

Characteristics of impedance of transmission line Z0 is the impedance measured at the input of this line when its length is infinite. **(1 M)**

Calculation: - **(3 M)**

From filter theory the characteristics of an interactive ckt. Consists of series & shut elements given by,

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

Z_0 = characteristic impedance.

Z = series impedance $= R + j\omega L$ (Ω/m).

Y = shunt admittance $= G + j\omega C$ (℧/m).

At radio freq^{n}s,

$\omega L >> R$ & $\omega C >> G$.

$$\therefore Z_0 = \sqrt{\frac{j\omega L}{j\omega C}}.$$

$$\therefore Z_0 = \sqrt{\frac{L}{C}}.$$

L = H/m.
C = f/m.

At low freq^{n},

$R >> \omega L$ & $G >> \omega C$.

$$\therefore Z_0 = \sqrt{\frac{R}{G}}.$$

For parallel line wire,

$$Z_0 = 276 \log \frac{2s}{d} \ \Omega.$$

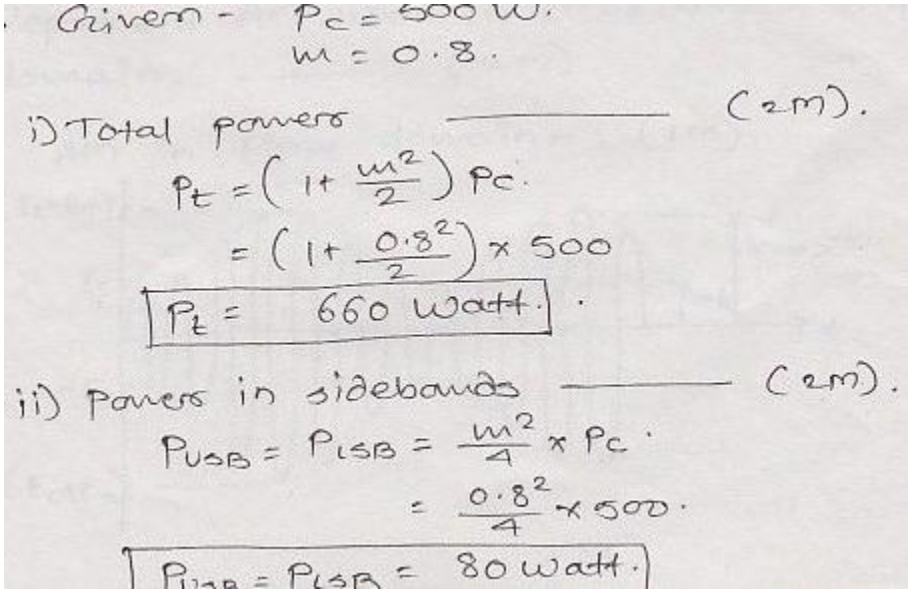
For coaxial line,

$$Z_0 = \frac{138}{\sqrt{K}} \log \frac{D}{d} \ \Omega.$$

f) A 500 watts carrier is modulated to depth of 80 % calculate:

i) Total power in AM **ii) Power in sidebands**

Ans :-


Given - $P_c = 500\ W$.
$m = 0.8$.

i) Total powers ——— (2M).

$$P_t = \left(1 + \frac{m^2}{2}\right) P_c$$
$$= \left(1 + \frac{0.8^2}{2}\right) \times 500$$
$$P_t = 660 \text{ watt}.$$

ii) Powers in sidebands ——— (2M).

$$P_{USB} = P_{LSB} = \frac{m^2}{4} \times P_c$$
$$= \frac{0.8^2}{4} \times 500.$$
$$P_{USB} = P_{LSB} = 80 \text{ watt}.$$

Q3) Attempt any FOUR of the following: (16 Marks)

a) Explain the effect of modulation index on AM wave with waveforms for Following values of M:

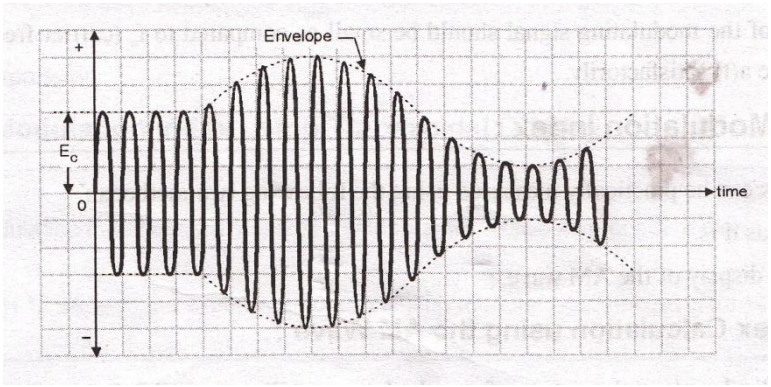
i) m< 1 **(Effect - 1M,Waveform-1M)**

ii) m = 1 **(Effect - 1M,Waveform-1M)**

Ans:

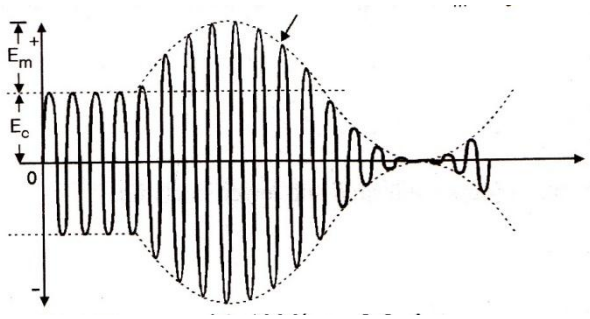
i) m< 1

- If m < 1 or if the percentage of modulation is less than 100% the this type of modulation is known as under modulation
- The amplitude of modulating signal less than carrier amplitude, no distortion will occur.



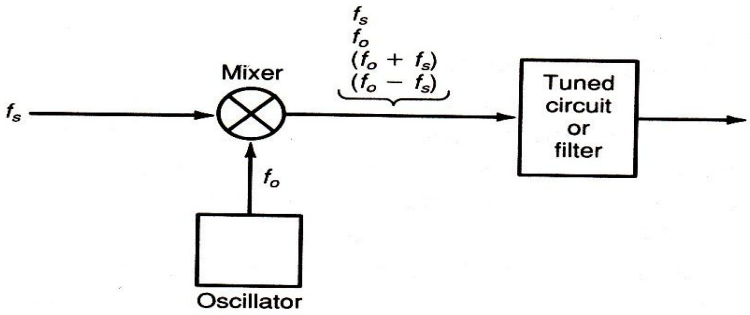
ii) M = 1

- If m = 1 or percentage of modulation is 100 this type modulation is 100% modulation
- The ideal condition for AM is m =1, since this will produce the greatest output at the receiver with no distortion.



b) Explain the function of mixer in AM receiver with neat diagram.

Ans: **(Neat Diagram -2M, Explanation-2M)**



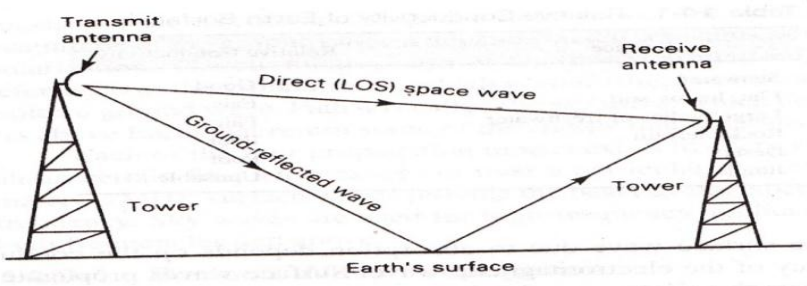
Explaination:

- The mixer receives signals from the Rf amplifies at frequency f_s and from the local ascillator at frequency for such that $f_o > f_s$..
- The mixes will mix these signal to produce signals having frequencies f_s ,f_o, (f_o + f_s) and (f_o - f_s). out of these the difference of frequency component i.e. (f_o - f_s) is selected and all other are rejected.

c) Explain space wave propagation with sketch. List its advantage and Disadvantage.

Ans: **(Sketch-1M, Explanation-1M, Advantages-1M, Disadvantages-1M)**

Space wave propagation:



Explanation:

- Space wave propagation of electromagnetic energy includes radiated energy that travels in the lower few miles of Earth's atmosphere. Space waves include direct and ground – reflected waves.
- Direct waves travel essentially in a straight line between the transmit and receive antennas. Space wave propagation with direct waves is commonly called line-of-sight (LOS) transmission. Therefore, direct space wave propagation is limited by the curvature of the Earth. Ground reflected waves are waves reflected by Earth's surface as they propagate between the transmit and receive antennas.

Advantages:

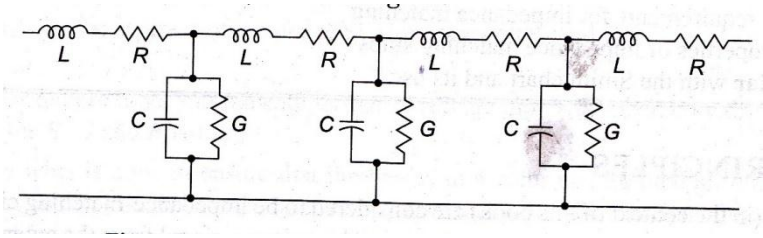
- The frequency above 30 MH_z is used.
- Duct propagation is possible.

Disadvantages:

- Due to the straight line nature of the space wave they will at some point be blocked due to curvature of earth
- Limited signal transmission
- Interference exists at a distance for enough from the transmitter for the direct and the ground reflected rays to be received simultaneously.

d) How the primary constant R.G.L.C. affect distortion less and minimum Attenuation conditions of transmission line?

Ans: **(Explanation- 2M, 2M For R, G, L, C)**



Explanation:

- The series resistance R and inductance L represent the power loss taking place in the transmission line. The values of these components will be directly proportional to the length of the transmission line.
- The capacitor C is the one, formed between the two conductors of the transmission line and the dielectric in between them.

- The conductors G represent the leakage resistance of the dielectric material used between the conductors.

e) Compare resonant antenna and non-resonant antenna on the basis of:

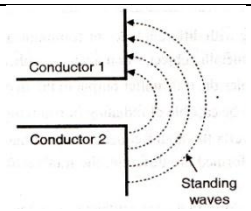
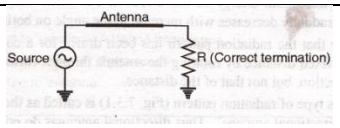
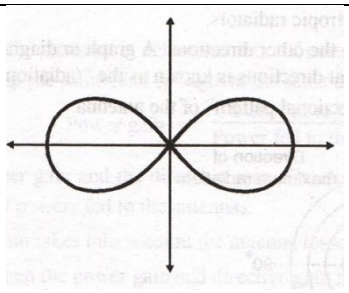
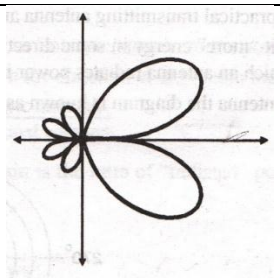
i) Definition

ii) Circuit

iii) Reflection Pattern

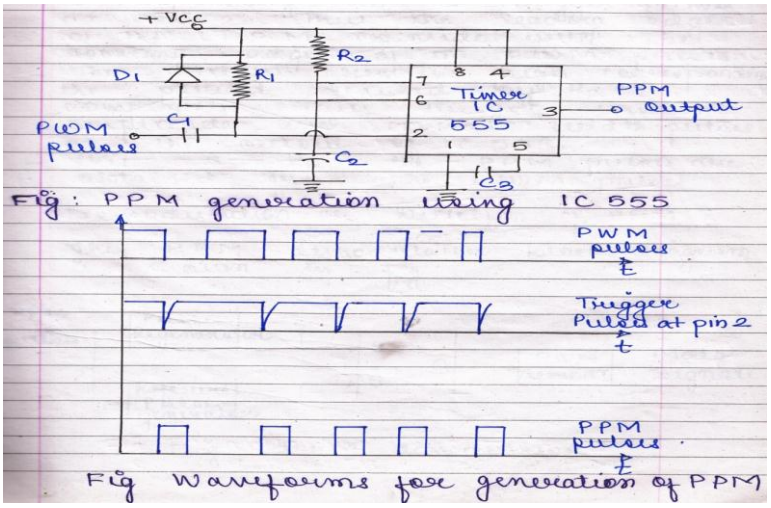
iv) Radiation pattern

Ans: **(1M for Each Parameter)**

Parameter	**Resonant antenna**	**Non resonant antenna**
i) Definition	It is transmission Line of length equal to multiples of λ2 and open at both and.	It is transmission line whose length is not a multiple of λ2
ii) Circuit		
iii) Reflection Pattern	Standing wave present	Standing wave not present
iv) Radiation Pattern		

f) Explain with neat diagram and waveform the generation of PPM using IC555.

Ans: **(Diagram 1 ½ M, Waveforms- 1M, Explanation-1 1/2M)**



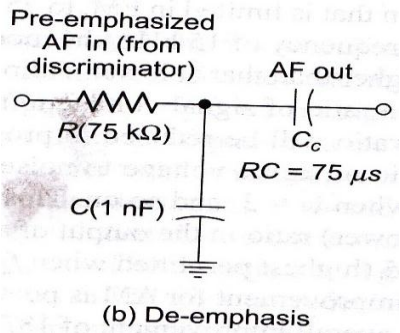
Explanation:

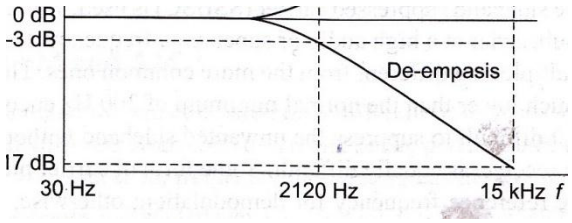
- The PWM pulses are applied to the trigger input pin 2 of the monostable IC through a differentiating network consisting of D1, R1 and C1
- The output of IC 555 goes high corresponding to the trigger pulses at pin 2 thus leading edges of the PPM coincide with the trailing edges of the PWM pulses.
- The output remains high corresponding the period decided by R2, C2 components. Thus we get constant amplitude and constant width pulses at the output of IC 555.
- This is how the PPM pulses are obtained from the PWM pulses.

Q 4) Attempt any FOUR of the following: (16 Marks)

a) Explain the concept of De-emphasis with neat diagram.

Ans: (Diagram-2M, Explanation-2M)



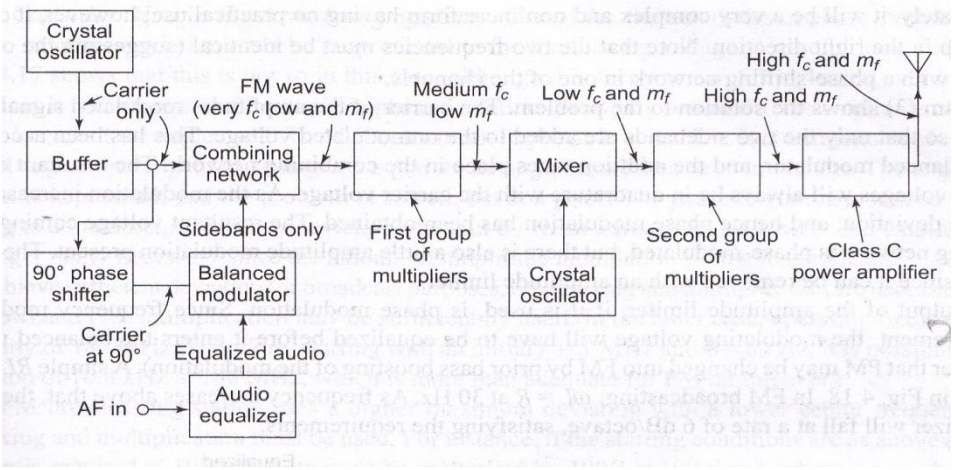


Explanation:

- The noise triangle showed that noise has a greater effect on the higher modulating frequencies than on the lower ones. Thus, if the higher frequencies were artificially boosted at the transmitter and correspondingly cut at the receiver, an improvement in noise immunity could be expected, thereby increasing the signal-to-noise ratio. This boosting of the higher modulating frequencies, in accordance with a prearranged curve, is termed pre-emphasis, and the compensation at the receiver is called de-emphasis.
- A-75-µs de-emphasis corresponds to a frequency response curve that is 3 dB down at the frequency whose time constant RC is 75 µs. This frequency is given by f = ½ πRC and its therefore 2120 Hz. With 50 µs de-emphasis it would be 3180Hz.

b) Draw and explain the block diagram of Armstrong method to generate FM wave.

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



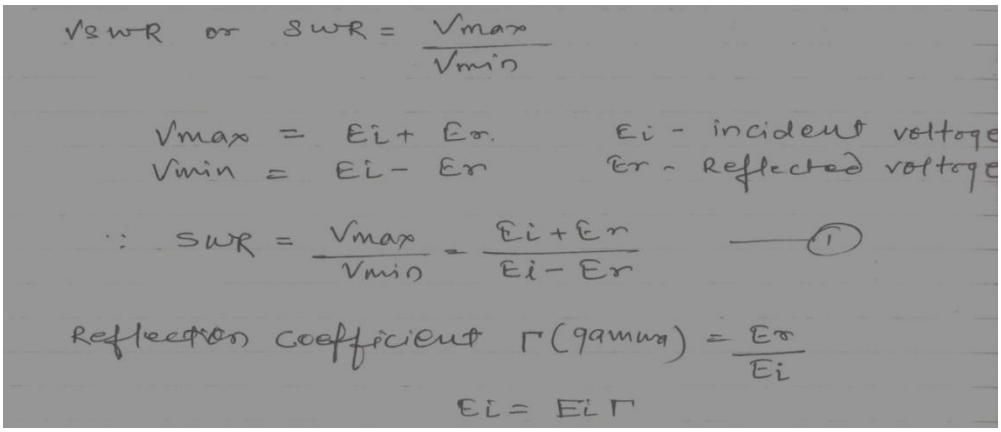
Explanation:

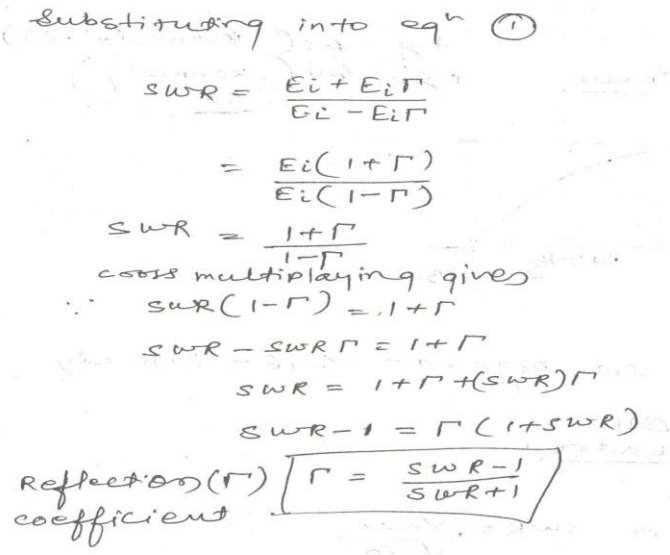
- The crystal oscillator generates the carrier at low frequency typically at 1 MHz. This is applied to the combining network and a 90^o phase shifter.
- The modulating signal is passed through an audio equalizer to boost the low modulating frequencies for the reason discussed earlier. The modulating signal is than applied to a balanced modulator.

- The balanced modulator produces two sidebands such that their resultant is 90^o phase shifted with respect to the unmodulated carrier.
- The unmodulated carrier and 90^o shifted sidebands are added in the combining network.
- As discussed earlier, at the output of the combining network we get FM wave. This FM wave has a low carrier frequency f_c and low value of the modulation index m_f.
- The carrier frequency and the modulation index are then raised by passing the FM wave through the first group of multipliers. The carrier frequency is then raised by using a mixer and then f_c and m_f both are raised to the required high values using the second group of multipliers. The effect of multiplication and mixing is as discussed earlier.
- The FM signal with high f_c and high m_f is then passed through a class C power amplifier to raise the power level of the FM signal.

c) Derive the relation between reflection coefficient and VSWR.

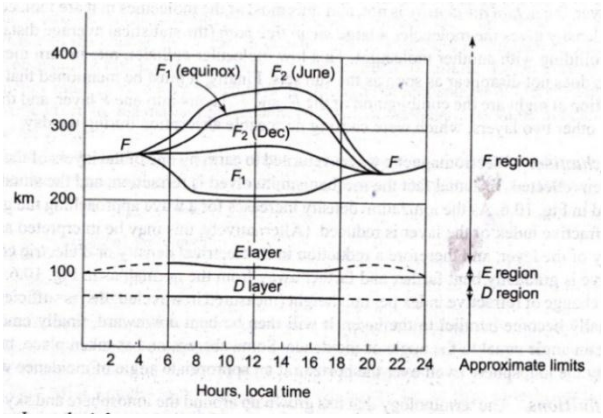
Ans: **(Derivation-4M)**





d) Explain ionospheric propagation with proper sketch.

Ans: **(Diagram 2M & Explanation 2M)**



Explanation:

- The transmitted signal travels into the upper atmosphere where it is reflected back to earth due to the presence of layers called as ionosphere in the upper atmosphere.
- The D layer is the lowest and it exist at a height of about 70 Km from the earth surface.
- The E layer existing at an approximate height of 100 Km. The E layer also almost disappears at night due to recombination of ions and molecules.
- The E_s layer is a thin layer of very high ionization density, sometimes making an appearance with the E layer.
- The F_1 layer exist at a height of 180Km in daytime & combines with F_2 layer at night its daytime thickness is almost 20Km.

e) Explain the following terms related to antenna:

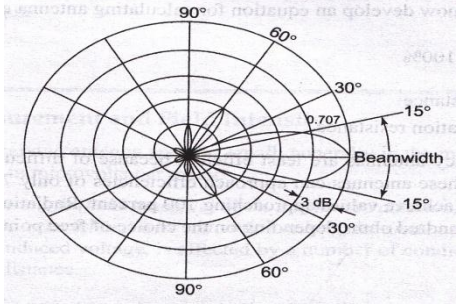
i) Beam width

ii) Directivity

Ans: **(Definition – 2M Each)**

i) Beam width:-

The beam width of an antenna is described as the angles created by comparing the half power points (3db) on the main radiation to be its maximum power points.



ii) **Directivity:-**

The directive gain is defined as the ratio of the power density in a particular direction of one antenna to the power density that would be radiated by an omnidirectional antenna (isotropic antenna).

The maximum directive gain is called directivity.

f) State four features of the following:

i) Quarter wavelength line and

ii) Half wavelength line

Ans:

i) Quarter wavelength line: (2M, ½ M for Each Point)

1) Its physical length equal to λ/4 meters at the operating frequency.
2) It reflects the opposite of its load impedance
3) If a λ/4 wavelength line is connected to impedance, then the normalized input impedance of this line is equal to the normalized load admittance
4) It is used for impedance matching

ii) Half wavelength line (2M, ½ M for Each Point)

1) Its physical length equal to λ/2 meters at the operating frequency
2) The λ/2 line reflects its load impedance directly
3) It also works as an impedance matching
4) It is also possible to find the velocity factor and dielectric constant of the insulation.

Q5) Attempt any four of the following: (16 Marks)

a) A frequency modulated signal is represented by the voltage equation

$$e_{FM} = 10\sin(6\times10^{8}t + 5\sin 1250t)$$

Calculate:

i) Carrier frequency fc

i) Modulating frequency fm

ii) Maximum deviation

iii) What power will this FM wave dissipates in 20Ω resistor?

Ans: (Each answer 1M)

a) $e_{FM} = 10 \sin(6\times10^8 t + 5 \sin 1250t)$

Calculate

i) Carrier frequency, f_c

We know

$e_{FM} = 10 \sin\left(\omega_c t + \frac{\delta f}{f_m} \cos(\omega_m t)\right)$

$\omega_c = 6\times10^8$

$2\pi f_c = 6\times10^8$

$f_c = \frac{6\times10^8}{2\pi} = 95.492\times10^6$ Hz

≈ 95.5 MHz

Carrier frequency = 95.5 MHz.

ii) Modulating frequency, f_m

$\omega_m = 1250$

$2\pi f_m = 1250$

$f_m = \frac{1250}{2\pi} = 198.94$ Hz.

iii) Maximum deviation δf

$\frac{\delta f}{f_m} = 5$

$\delta f = 5\times198.94$

$= 998.718$ Hz.

∴ Maximum deviation = 998.718 Hz

iv) Power dissipated in 20Ω resisto (P)

$P = \frac{V_{rms}^2}{R_c} = \frac{(V_c/\sqrt{2})^2}{R_c}$

Given $V_c = 10$

$R_c = 20\Omega$

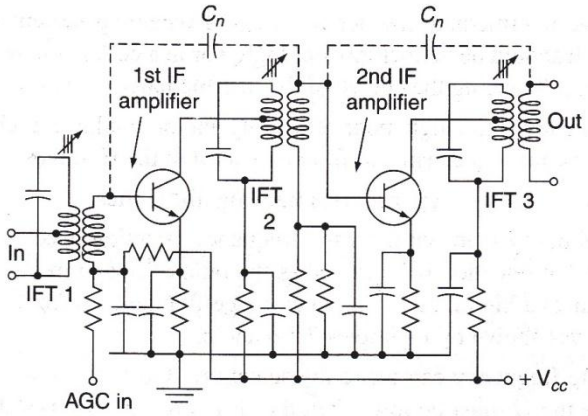
$\therefore P = \frac{(10/\sqrt{2})^2}{20}$ Watts

$P = 2.5$ Watts.

∴ Power dissipated = 2.5 Watts.

b) Draw a neat circuit diagram of two stage IF amplifier & explain its working.

Ans: (Circuit Diagram2M, Explanation 2M)



Two-stage IF amplifier

- The IF amplifier is a fixed frequency amplifier.
- It rejects adjacent unwanted frequencies.
- The above diagram is two stage amplifiers with all IF transformers signal tuned.
- The IF amplifier gives most of the gain ($\therefore Sensitivity$) & bandwidth requirement of receiver.

c) State & explain any four properties of quarter wave transformer.

Ans (1M for each Property)

- It is used for impedance transformation upto the highest frequency of VHF range.
- AS $Z_S = \frac{Z0^2}{ZL}$, the impedance at the input of a λ/4 line depends on
- Load impedance
- Characteristics impedance of the interconnecting TL.If Z_0 is varied, impedance as seen at the input of λ/4 line will also vary accordingly & load may thus be matched to the characteristics impedance of the main line.
- λ/4 line is used as transformer. It is placed between the source & load to Match the characteristics impedance of TL to the load.
- A TL one quarter wavelength long acts as a step up or step down. Transformer depending on whether Z_L is greater than or less than Z_0.
- A short circuit λ/4 line is equivalent to a parallel LC tuned circuit.

d) Explain with neat sketch of Yagi-Uda antenna.

Ans: **(2M for sketch, 2M Explanation)**

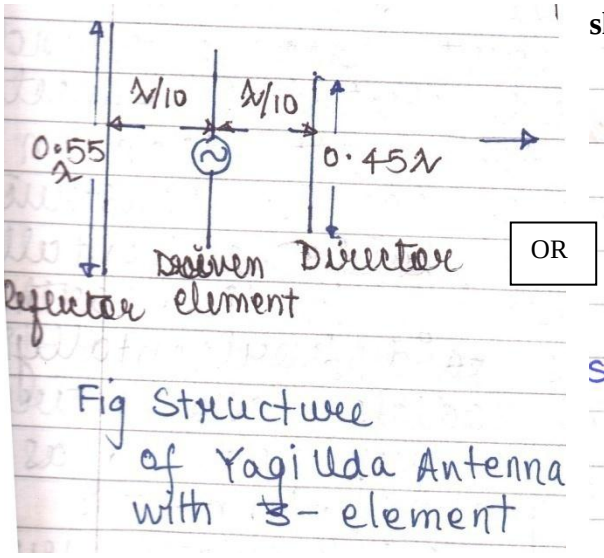


Fig Structure of Yagi Uda Antenna with 5- element

OR

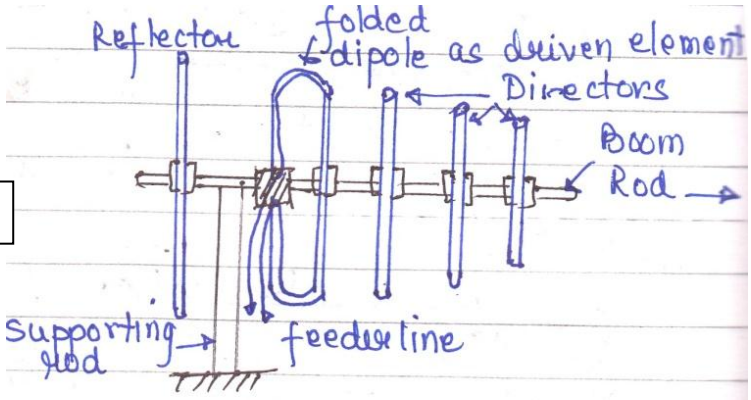


Fig Typical Yagi Uda Antenna with 5 elements

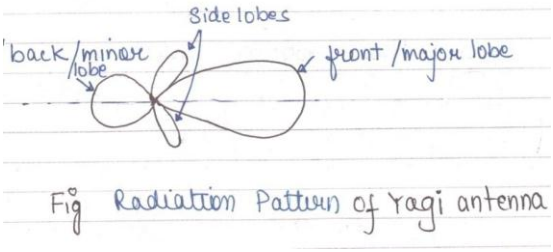
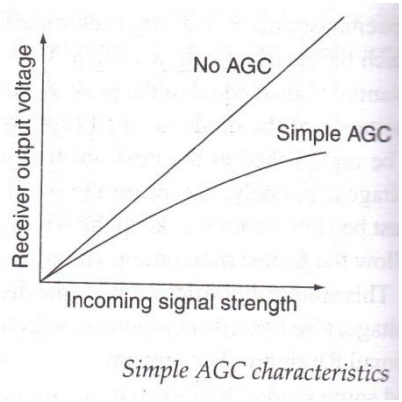


Fig Radiation Pattern of Yagi antenna

- The Yagi-Uda antenna is an array or a group of antennas consisting of a driven element & one or more parasitic element. They are arranged collinearly & close together as shown above.
- The radiation pattern is as shown in figure is directional pattern.
- It consists of large front lobe & small back lobe. By adjusting the distance between the adjacent directors it is possible to improve the front to back ratio.

e) What is the need of AGC? Explain simple AGC with its characteristics Graph.

Ans: **(Need of AGC 1M, Graph 2M Explanation 1M)**



Simple AGC characteristics

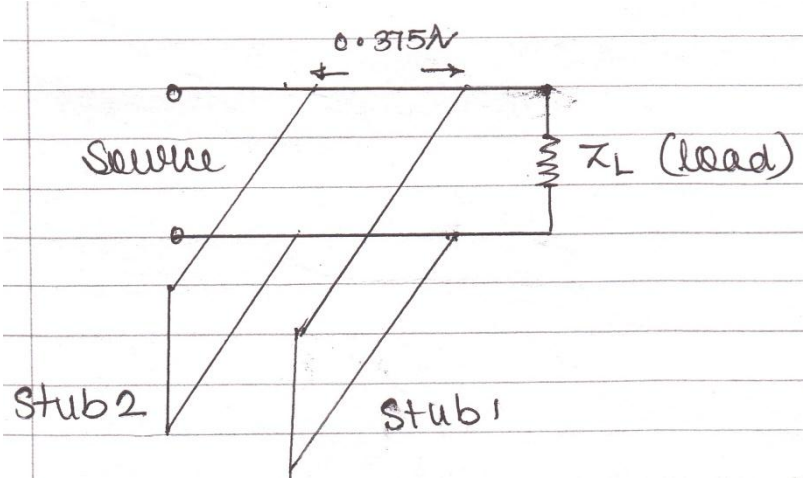
- The need or purpose of AGC circuit is to maintain the output voltage level (volume) of radio receiver constant over a wide range of RF input signal level.
- AGC also helps to smooth out the rapid fading which may occur with long distance short wave reception & prevents overloading of the last IF amplifier which might otherwise have occurred.

Simple AGC:

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

f) Give the need of stub & explain double stub matching with neat diagram.

Ans: **(Need of Stub 1M, Diagram 2M, Explanation 1M)**



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.

Double Stub Matching:

Double stub matching is a device used to match a load to the TL over a range of different matching situation. It has variable parameters or degree of freedom. Here a second stub of adjustable position is added to the first stub as shown in figure. Hence two variables are provided & good matching is possible.

Q.6. Attempt any FOUR of the following:

a) Explain the generation of PWM using timer IC555 with neat circuit diagram.

Ans: (Circuit diagram 2M, Explanation 2M)

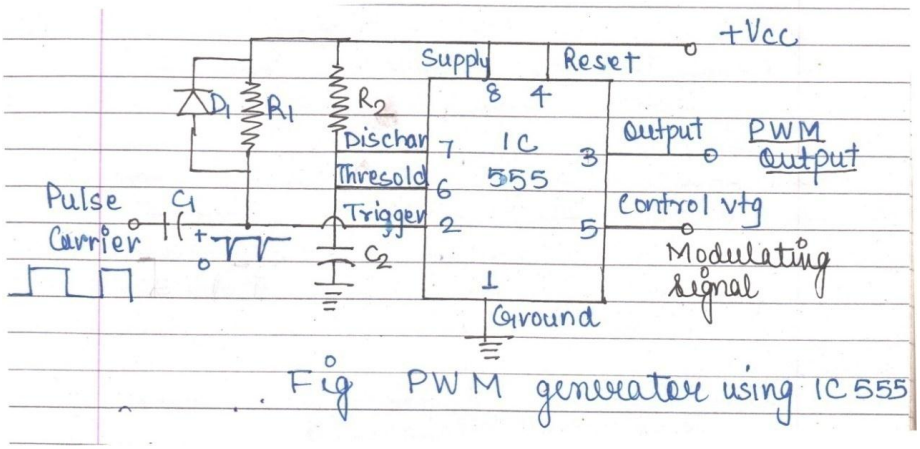


Fig PWM generator using IC 555

Operation:

i. The timer IC555 is operated in monostable mode.

ii. The negative going carrier pulses are to the differentiator formed by R_1 & C_1. The differentiator produces sharp negative pulses which are applied to trigger input pin (2) of IC 555.

iii. 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.

iv. The termination of the pulses is dependent upon,
a) R_2, C_2 discharge time
b) The modulating signal applied to control input pin (5)

v. The modulating signal applied to pin no (5) will vary the control voltage to IC 555 in accordance to the modulating voltage.

vi. As this voltage increases, the capacitor C_2 is allowed to charge through R_2 upto a higher voltage & hence for a longer time (as R_2 C_2 time constant is fixed). The width of the corresponding output pulse will increase due to this action. As soon as VC_2 is equal to the control voltage, the PWM pulse goes to zero.

vii. Thus PWM signal is generated at the output pin (3) of IC555 as monostable microvibrator.

b) Draw the block diagram of FM receiver & explain the function of any three blocks.

Ans: (Block diagram 1M Explanation of (any three) Each 1M)

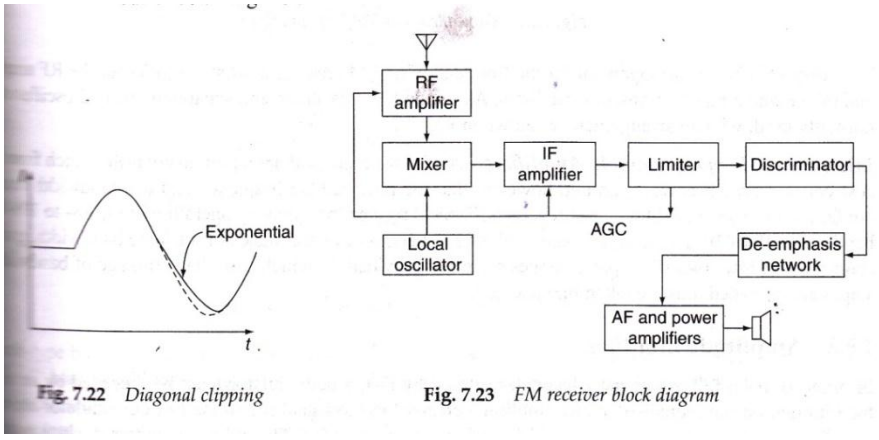


Fig. 7.22 *Diagonal clipping*

Fig. 7.23 *FM receiver block diagram*

RF Amplifier: Its main purpose is to reduce the noise figure which could otherwise be a problem because of the large bandwidth needed for FM. It is also required to match the input impedance of the receiver to that of the antenna.

Intermediate frequency & IF amplifiers:

Receivers operating in the 88 to 108 MH_Z band are an IF to 10.7 MH_Z & a bandwidth of 200 kH_Z. As a consequence of the large bandwidth gain per stage

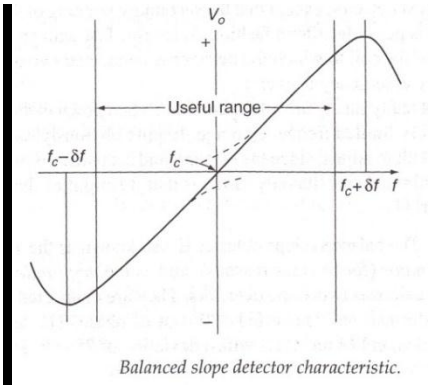
may be low. Two IF amplifier stages are often provided, in which case the shrinkage of bandwidth as stages are cascaded must be taken into account.

Basic FM demodulator:

The function of a frequency to amplitude changer or FM demodulator is to change the frequency deviation of the incoming carrier into an AF amplitude variation (identical to the one that originally caused the frequency variation.) This conversion should be done efficiently & linearly.

c) Draw & explain the balanced slope detector.

Ans: **(Circuit diagram 2M, Explanation2M)**



Balanced slope detector characteristic.

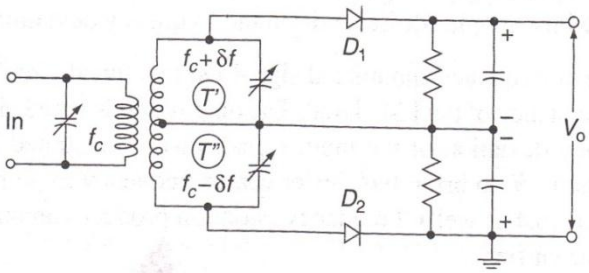
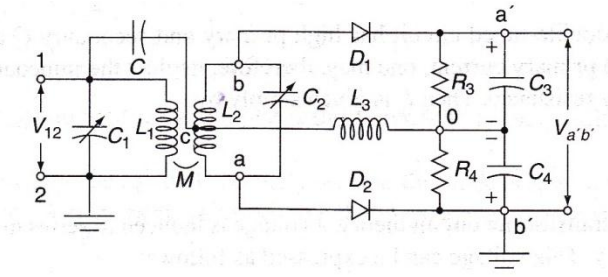


Fig. 7.29 *Balanced slope detector.*

The circuit uses two slope detectors. They are connected back to back to the opposite ends of the If by an amount which, in FM receiver with a deviation of 75 KH_Z, is 100KH_Z. The bottom circuit is similarly tuned below the IF by the same amount. Each tuned circuit is connected to a diode detector with an RC load. The output is taken from across the series combination of the two loads, so that it is the sum of the individual outputs.

d) Draw the circuit diagram & explain the working of phase discriminator.

Ans: **(circuit diagram2M xplanation2M)**



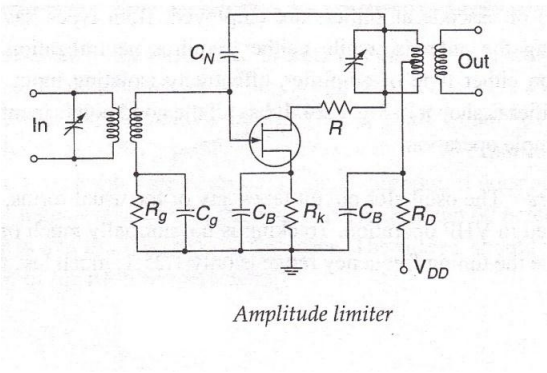
Phase discriminator.

This discriminator is also known as the center tuned discriminator or the Foster-Seeley discriminator after its inventors. It is possible to obtain the same S- Shape response curve from a circuit in which the primary & the secondary winding are both tuned to the center frequency of the incoming signal. This is desirable because it greatly simplifies alignment & also because the process yields far better linearity.

- Thus. Although the individual component voltage will be the same at the diode input at all frequencies, the vector sums will differ with the phase difference between primary & secondary windings.
- The result will be that the individual output voltage will be equal only at f_C.
- At all other frequencies the output of one diode will be greater than that of the other. Which diode has the larger output will depend entirely on whether f_m is above or below f_c.
- As for the output arrangements, it will be positive or negative according to the input frequency.
- As required the magnitude of the output will depend on the deviation of the input frequency from f_C.

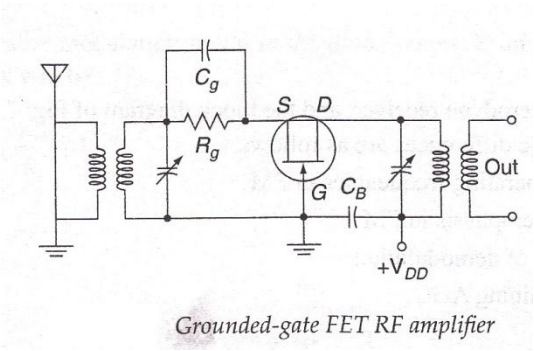
e) Draw the neat circuit diagram of FET amplitude limiter used in FM receiver.

Ans: (circuit diagram 2M Explanation2M)



Amplitude limiter

OR



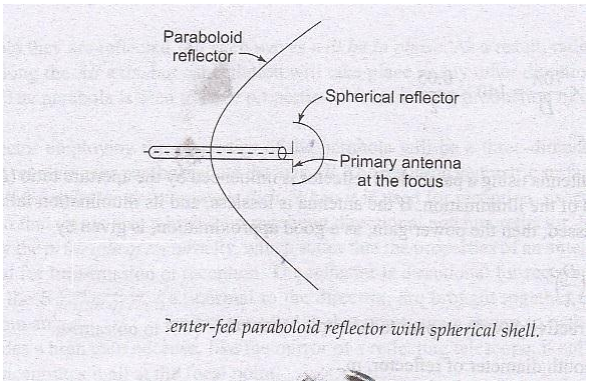
Grounded-gate FET RF amplifier

- In order to make full use of the advantages offered by FM, a demodulator must be preceded by an amplitude limiter, on the ground that any amplitude changes in the signal fed to the FM demodulator are spurious.
- They must therefore be removed if distortion is to be avoided.
- The point is significant, since most FM demodulator react to amplitude changes as well as frequency changes. The limiter is a form of clipping device.
- When input signal voltage rises, current flows in the R_g - C_g bias circuit & a negative voltage is developed across the capacitor. It is seen that the bias on the FET is increased in proportion to the size of the input voltage.

- As a result the gain of the amplifier is lowered, & the output voltage tends to remains constant.

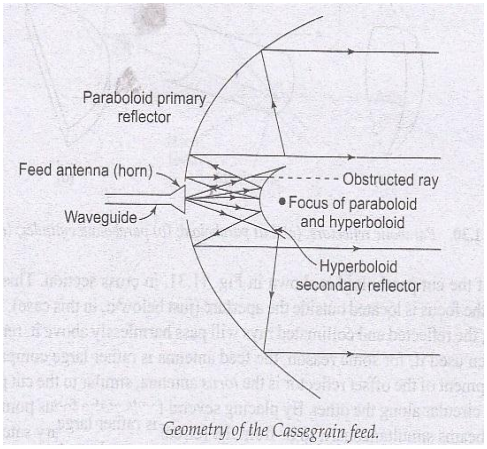
f) Explain with neat sketch the working of parabolic dish antenna.

Ans: **(Sketch2M, Explanation 2M)**



Center-fed paraboloid reflector with spherical shell.

OR



Geometry of the Cassegrain feed.

- A source of radiation placed at the focus. All waves coming from the source & reflected by the parabola will have travelled the same distance by the time they rich the directrix.
- All such wave will be in phase. As a result radiation is very strong & concentrated along the AB axis, but cancellation will take place in any other direction, because of path length differences.
- The parabola is seen to have properties that lead to the production of concentrated beams of radiation.
- When it is used for reception exactly the same behavior is manifested, so that this is also a high gain receiving directional antenna reflector.
- The directional pattern of an antenna using a paraboloid reflector has a very sharp main lobe surrounded by a number of minor lobes which are much smaller.