Solution –:

(i) The current relation for a single tone amplitude modulation is expressed as

$$I_t = I_c \sqrt{1+\frac{\mu^2}{2}}$$

$$\frac{I_t}{I_c} = \sqrt{1+\frac{\mu^2}{2}}$$

$$\mu^2 = 2\left[\left(\frac{I_t}{I_c}\right)^2 - 1\right]$$

$$\mu = \sqrt{2\left[\left(\frac{I_t}{I_c}\right)^2 - 1\right]} \quad \text{-----(1)}$$

Given that

I_t = 8 Amp

I_T = 8.93

Putting all value in eqn (1)

$$\mu = \sqrt{2\left[\left(\frac{8.93}{8}\right)^2 - 1\right]}$$

$$\mu = \sqrt{0.492}$$

$$\mu = 0.701$$

$$\boxed{\mu = 70.1\%}$$

Lecture: 14 & 15 verified

06/02/2014

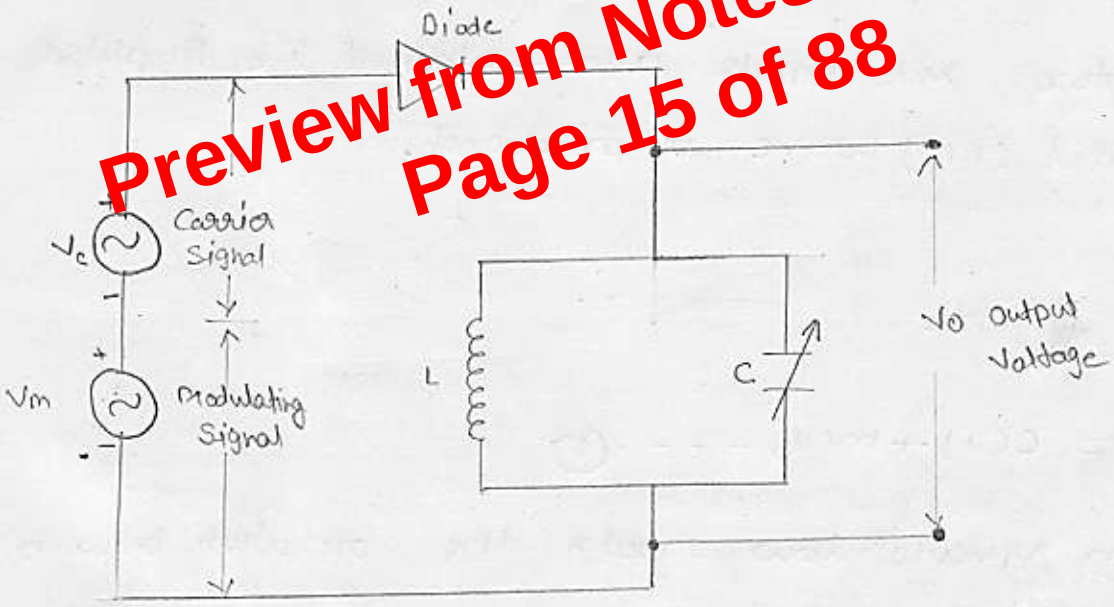
Ques Explain generation method of AM wave using square law modulator ?

Ans **Square law Modulator :-**

The square law modulator require modulating wave, Carrier wave and non-linear element.

Working :- Figure show the carrier of square law diode modulation.

The working of this circuit may be Explained by considering the fact when two different frequencies are passed through a non-linear device



Square law diode modulation

The process of amplitude modulation take place. Hence when carrier and modulating frequencies are applied at the input of diode, then different frequency terms appear at the output of diode. These different frequency terms are applied across a tuned circuit which is tuned to the carrier frequency and has a narrow bandwidth just to pass two side bands alongwith the carrier and reject other frequencies. Hence at the output of tuned circuit, carrier and two side bands are obtained i.e. Amplitude modulated (AM) wave is produced.

From figure :-

$$V_i = C(t) + m(t) \quad ----(1)$$

From square low roots the relation between input voltage and output voltage

$$V_o = a_1 V_i + a_2 V_i^2 \quad ----(2)$$

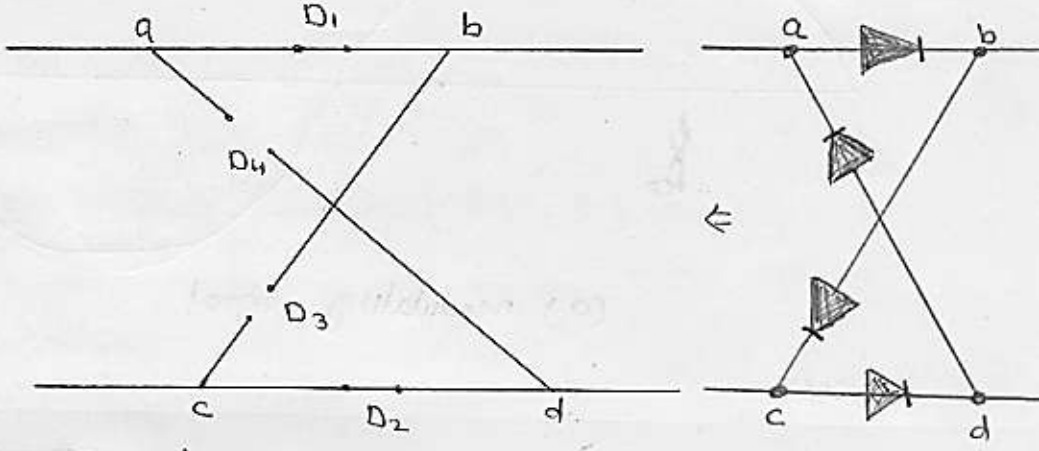
Ques Explain the working of envelope detection ? and determine the relation for optimum value of time constant RC in terms of modulation index and frequency.

Ans Envelop detector :-

An envelope detector consist of a diode and a register capacitor filter. This circuit works only in case of hero band AM wave. which carrier frequency is large as pair with the message band and which the percentage modulation less than 100 %.

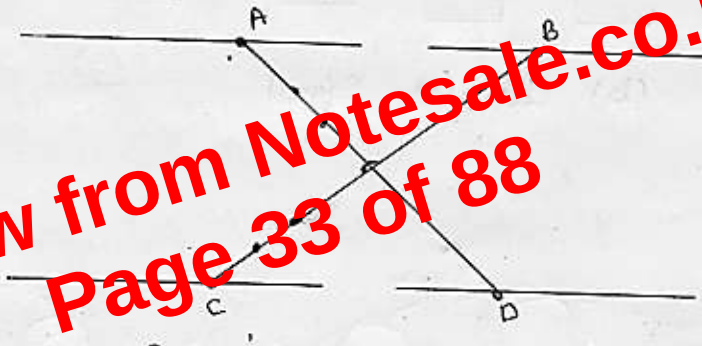
Working :-

On positive half cycle of the input signal the diode is forward bias and the capacitor C charges up to the peak value of the input signal. When the input signal pass below this value the diode become reverse bias and the capacitor C discharge slowly through the load resistance R_L.

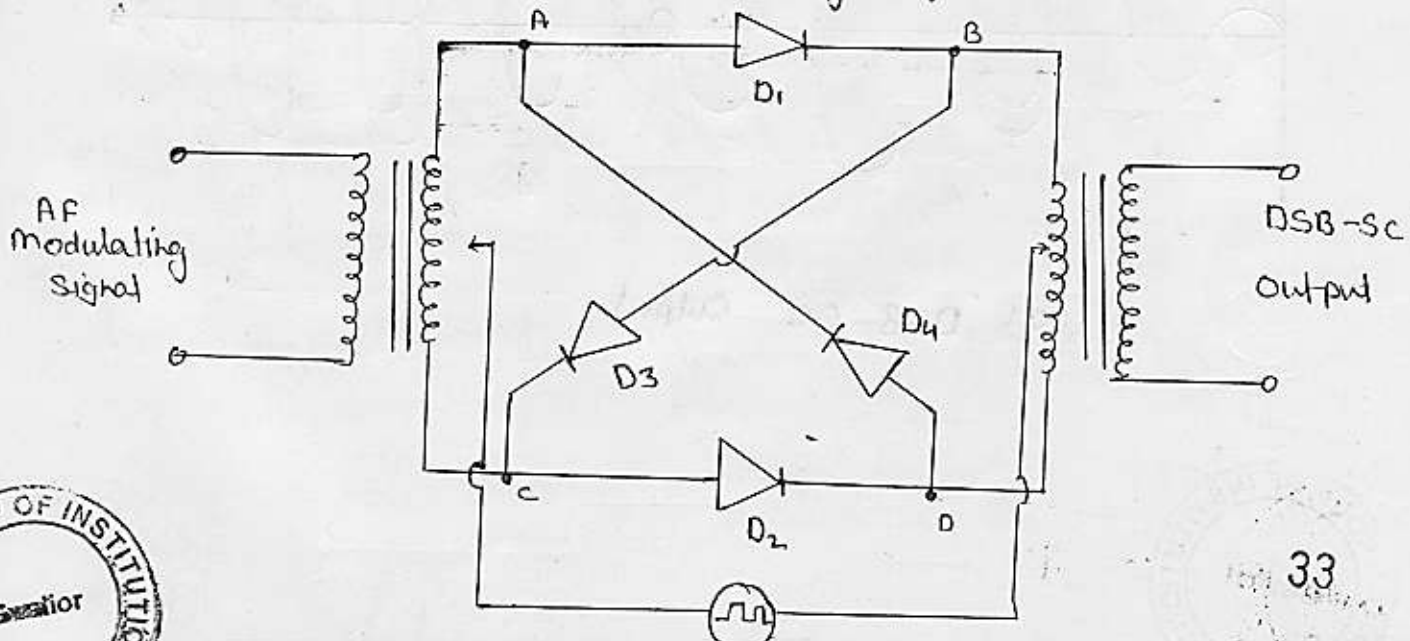


Carrier supply +ve

When the carrier supply is negative the s becomes reversed bias and the modulator multiply base band signal by -1.



Carrier supply negation



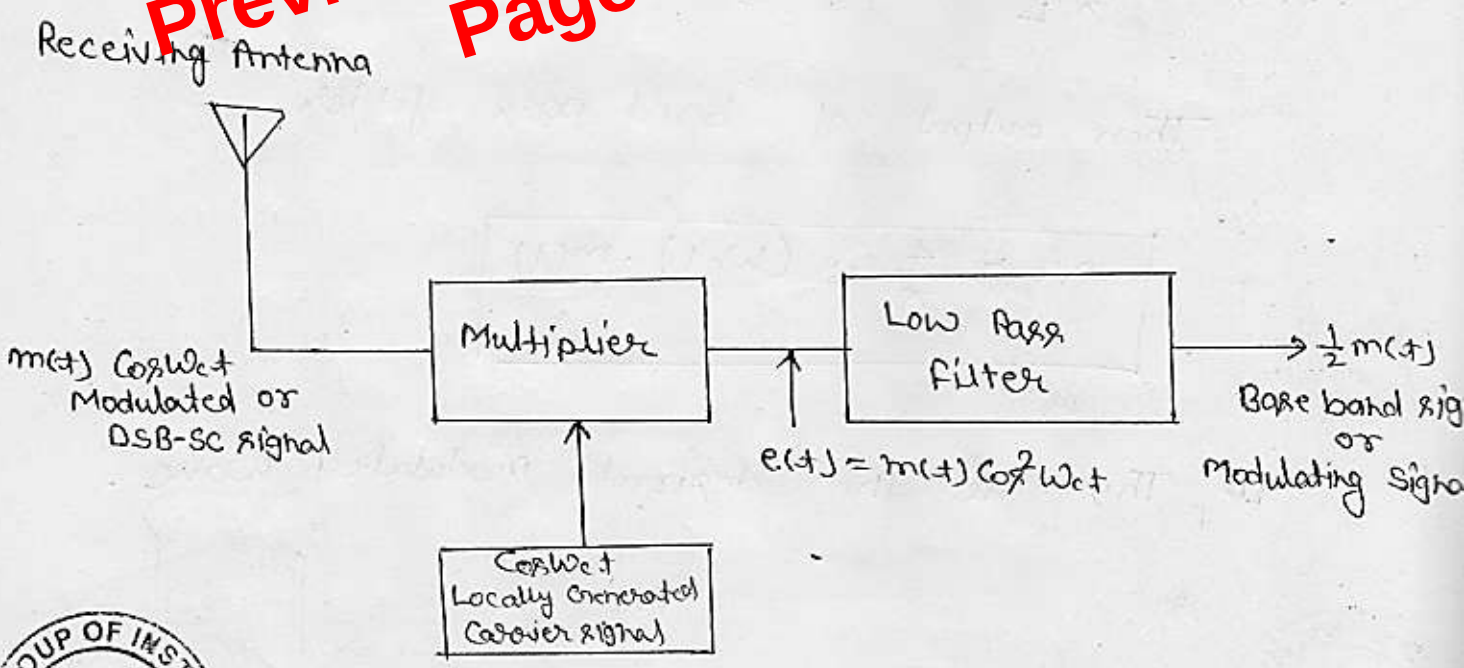
Detection of DSB-SC Signal :-

The DSB-SC signal may be modulated by the following two methods.

* Synchronous detection method
* Envelope detection after carrier reinsertion

Synchronous detection technique of DSB-SC signal :-

A method of DSB-SC detection is known as synchronous detection. Figure shows the block diagram of synchronous detection method.



-: UNIT- 3 :-

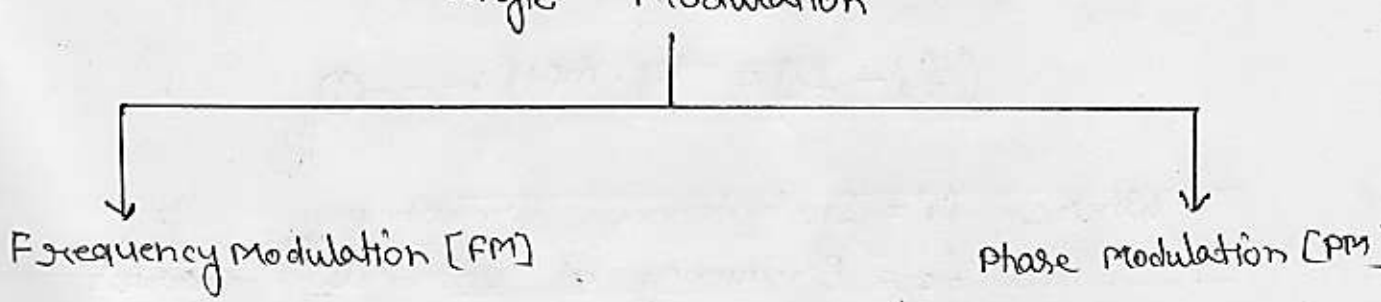
Angle Modulation

Angle Modulation -:

Angle modulation may be defined as the process in which the total phase angle of carrier wave is varied in accordance with the instantaneous value of the modulating or message signal while keeping the keeping the amplitude of the carrier constant.

Types of Angle Modulation -:

* Frequency modulation [FM]
* Phase Modulation [PM]



Ques A 107.6 MHz Carrier signal is frequency modulat by a 7 KHz sine wave. The resultant FM signal has a frequency deviation of 50 KHz. Determine the following :-

(i) The Carrier wave swing to the FM signal

(ii) The heighest and lowest frequencies attained by the modulated signal.

(iii) The modulation index of the FM wave.

Solution :- Given that

$f_c = 107.6$ MHz

$f_m = 7$ KHz

$\Delta f = 50$ KHz

(i) Carrier swing = 2 X frequency deviation

= 2 X 50 = 100 KHz

(ii) The highest frequency attained by the modulated signal

$f_H = f_c + \Delta f$

$f_H = (107.6 \times 10^6) + (50 \times 10^3)$

$f_H = 107600 \times 10^3 + 50 \times 10^3$

$f_H = 107.65$ MHz

Narrow band frequency modulation :-

In the narrowband frequency modulation the value of modulation index $\beta \ll 1$

We know that the single tone FM wave

$$S(t) = A_c \cos[\omega_c t + \beta(\sin\omega_m t)]$$

$$S(t) = A_c[\cos\omega_c t \cdot \cos(\beta\sin\omega_m t) - \sin\omega_c t \sin[\beta(\sin\omega$$

Assuming that the modulation index β is small compared to 1 radian then

$$\cos[\beta\sin\omega_m t] \cong 1$$

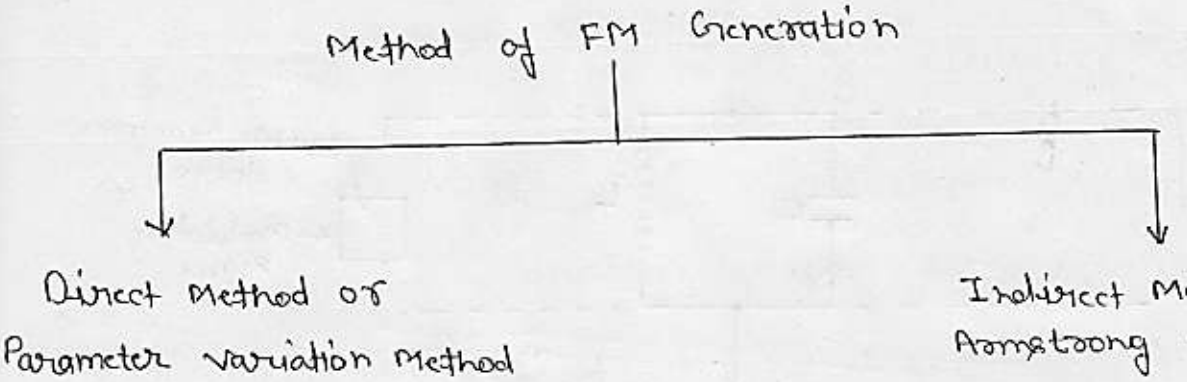
$$\sin[\beta\sin\omega_m t] \cong \theta$$

$$S(t) = A_c[\cos\omega_c t - \sin\omega_c t \cdot \theta]$$

$$S(t) = \underbrace{A_c \cos\omega_c t}_{\text{Carrier}} - \underbrace{\frac{\beta A_c}{2}[\cos(\omega_c - \omega_m)t}_{\text{LSB}} - \underbrace{\cos(\omega_c+\omega$$

This is the expression of single tone frequency modulation [FM] wave.

FM Generation :-



Ques Explain direct or Parameter variation method of FM generation.

Ans Parameter variation Method :-

In direct method or Parameter variation method, the base band or modulating signal directly modulates the carrier. The carrier signal is generated with the help of an oscillator circuit.

This oscillator circuit uses a parallel L-C circuit. Thus the frequency of oscillation of the carrier generation is governed by the expression

$$\boxed{W_c = \frac{1}{\sqrt{LC}}}$$

Now we can make the carrier frequency W_c to vary in accordance with the base band or modulating signal $m(t)$. If L and C is varried accordingly to $m(t)$.

$$B.W. = 2[15\times10^3\times5] + [2\times15\times10^3]$$

$$\boxed{B.W. = 180\ KHz}$$

for PM system -:

(i) Phase deviation

$$\Delta f = m_p \cdot f_m$$

$$\Delta f = k_p \cdot A_m \cdot f_m$$

$$\Delta f = 15\times10^3 \times 5 \times 15\times10^3$$

$$\boxed{\Delta f = 1125\ MHz}$$

(ii) Band width $= 2\Delta f$

$B.W. = 2\times1125$

$\boxed{B.W. = 2250\ MHz}$

(iii) Modulation index:-

$\beta_p =$

$\beta_p =$

$\boxed{\beta_p =}$

Pre-Emphasis circuit :-

It has been proved that 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 (β) for higher modulating frequencies (f_m).

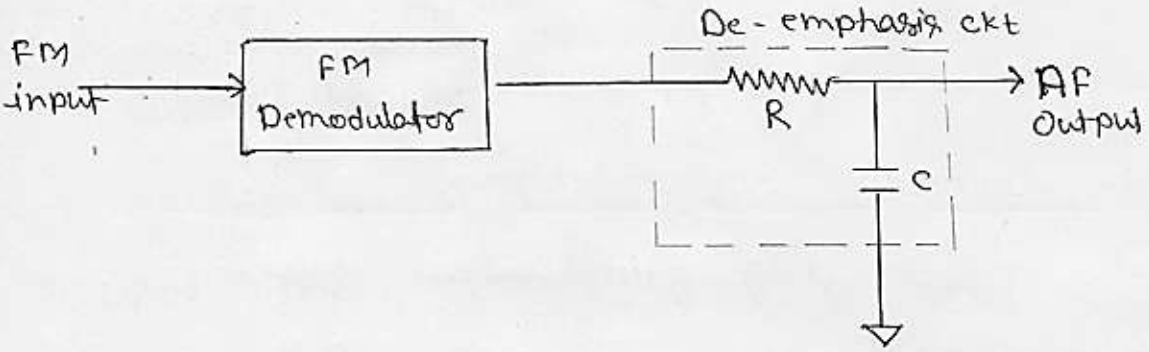
This can be done by increasing the deviation Δf and Δf can be increased by increasing the amplitude of modulating signal at higher modulating frequencies.

The artificial boosting of higher modulating frequencies is called as pre-emphasis.

Boosting of higher frequency modulating signal is achieved by using the pre-emphasis ckt of figure. The modulating AF signal is passed through a high pass R-C filter, before applying it to the FM modulator.

De emphasis :-

The artificial boosting given to the higher modulating frequencies in the process of pre-emphasis is nullified or compensated at the receiver by a process called De-emphasis



The transfer frequency $H_d(\omega)$ of the De-emphasis and that of pre-emphasis ckt have inverse relationship so that there product is constant for the entire message band.

$$H_d(\omega) = \frac{K}{H_p(\omega)}$$

$$\boxed{H_d(\omega) \cdot H_p(\omega) = K}$$

The pre-emphasis circuit at the transmitter is high pass network which behaves like a differentiator similarly the De-emphasis circuit at the receiver is a low pass network which behaves like an integrator.

Seen
L-30-L31
19/03/14

-: Unit - 4 :-

Ques Draw the block diagram of superheterodyne receiver and explain each block in detail.

OR

Explain the working of superheterodyne receiver with the help of block diagram.

Ans Super heterodyne Receiver -:

Superheterodyne receiver is popularly used. The heterodyning gives a far better performance than the Tuned Radio frequency [TR receiver. The block diagram of a superheterod receiver is shown in figure. The significant feature of the heterodyne receiver is that all incoming radio frequencies are converted in to a single intermediate frequency (fi) b the heterodyning or mixing process. The incoming carrier (fc) and a locally generat signal (ft) are mixed in mixer also refer to as first detector. The mixer generat the sum and difference frequencies at the output.