1.Write down the basic equation of FM Modulated signal.

$$Y_{FM}(t) = A\cos\left[2\pi f_c t + 2\pi K_f \int_0^t x(t)\,dt\right]$$

Where,

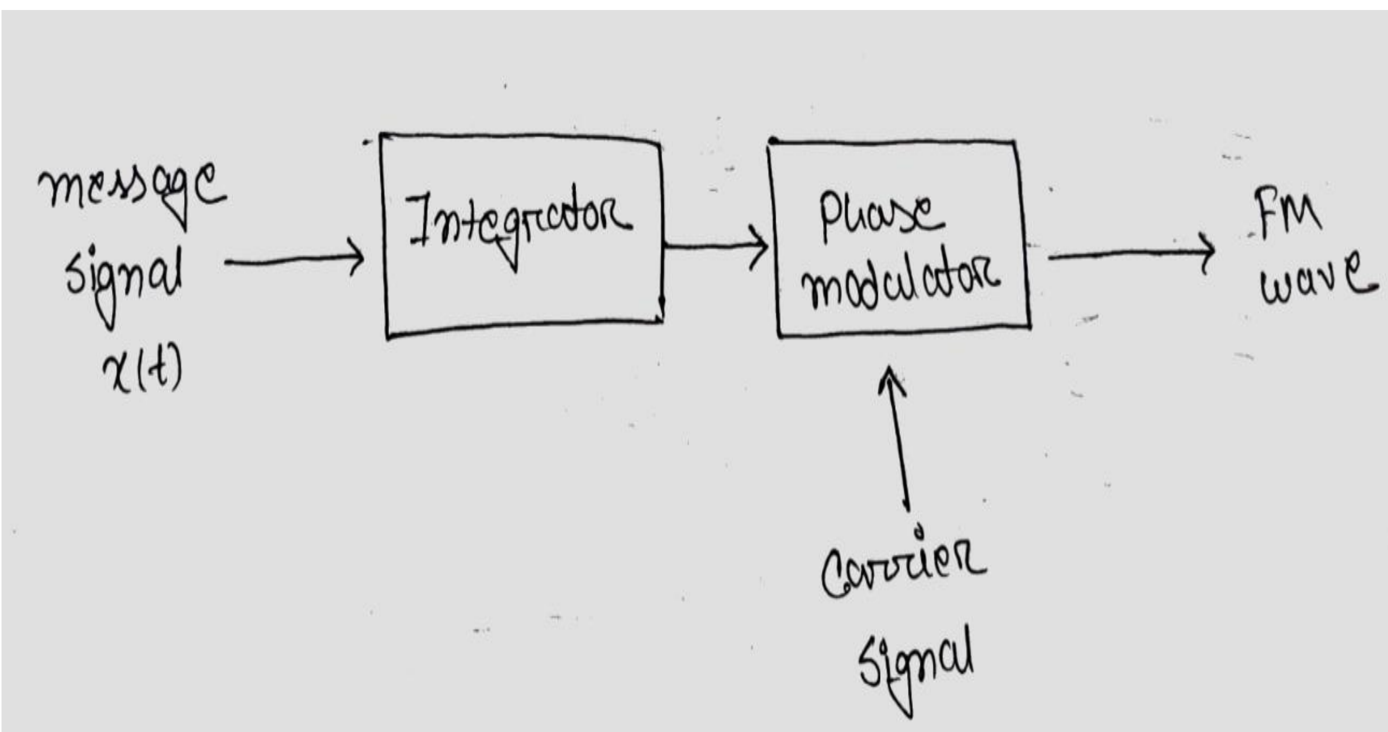
A = Amplitude of carrier Signal

$x(t)$ = message signal

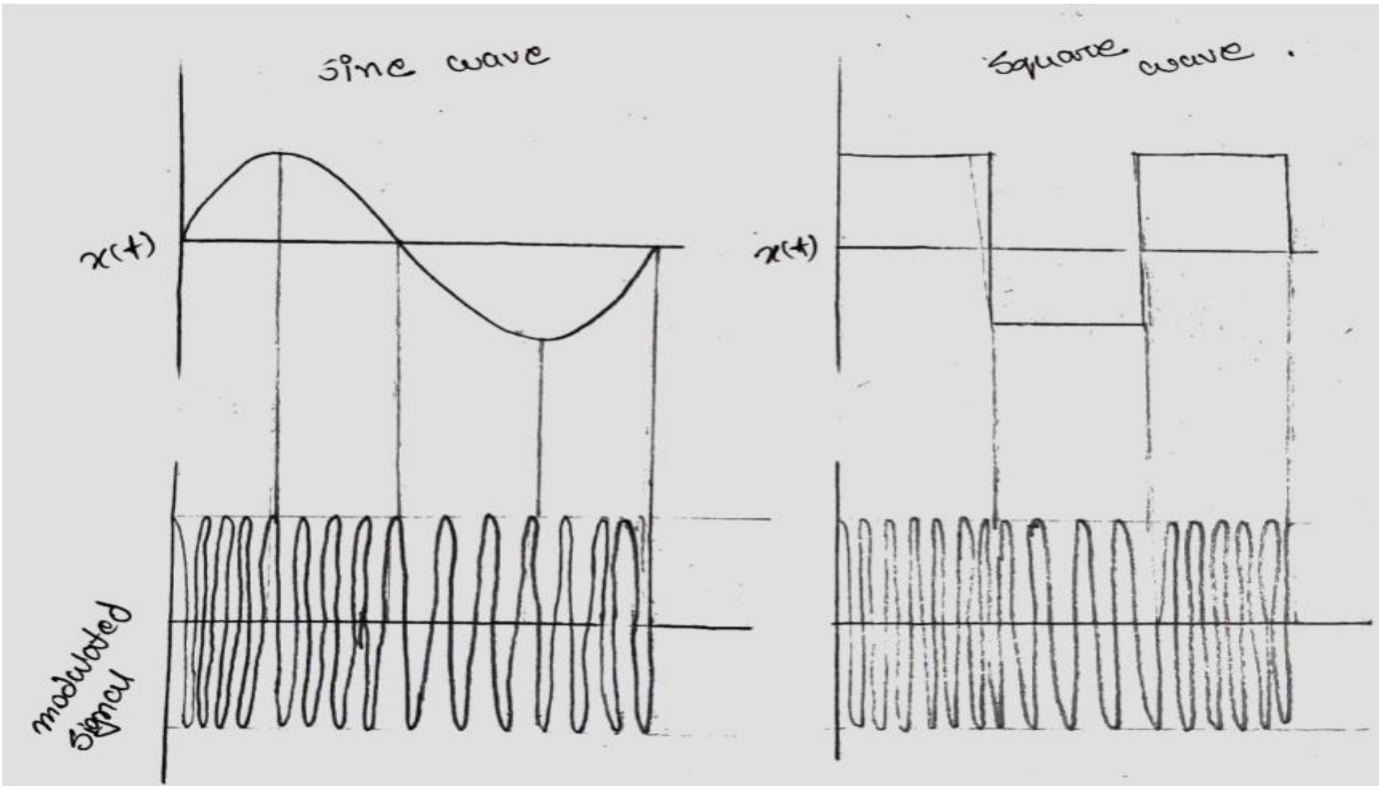
f_c = Frequency of carrier

K_f = Frequency shifting sensivity

2.Draw the block diagram of FM Modulator.



3.Draw FM Modulated signal for Sine wave and for Square wave modulating signal that means message signal.



5. Find the FM modulation index if modulating signal is 100Cos(2*pi*1000*t) and deviation constant is 20 Hz/volt.

$x(t) = 100\cos(2\pi 1000t)$

$\therefore A_m = 100V, \quad f_m = 1000\ Hz, \quad K_f = 20\ Hz/V$

$$m_f = \frac{\Delta f}{f_m} = \frac{A_m K_f}{f_m}$$

$$= \frac{100 \times 20}{1000}$$

$$= 2$$

4. Write down the FM modulated signal equation with respect to modulation index when carrier signal is a sine wave and message signal is cosine.

$$y_{FM}(t) = A \sin\left[2\pi f_c t + 2\pi K_f \int_0^t x(t)\, dt\right]$$

$$= A \sin\left[\omega_c t + 2\pi K_f \int_0^t A_m \cos \omega_m t \, dt\right]$$

$$= A \sin\left[\omega_c t + \frac{2\pi K_f A_m}{\omega_m} \sin \omega_m t\right]$$

$$= A \sin\left[\omega_c t + \frac{2\pi K_f A_m}{2\pi f_m} \sin \omega_m t\right]$$

$$= A \sin\left[\omega_c t + \frac{A_m K_f}{f_m} \sin \omega_m t\right]$$

$$= A \sin\left[\omega_c t + \frac{\Delta f}{f_m} \sin \omega_m t\right]$$

$$= A \sin\left[\omega_c t + m_f \sin \omega_m t\right]$$

↑ modulation Index.

6.

EXERCISE 17 A sinusoidal modulating wave of amplitude 5 V and frequency 1 kHz is applied to a frequency modulator. The frequency sensitivity of the modulator is 40 Hz/V. The carrier frequency is 100 kHz. Calculate (a) the frequency deviation, and (b) the modulation index.

$A_m = 5V$

$f_m = 1000\ Hz$

$K_f = 40\ Hz/V$

$f_c = 100 \times 10^3\ Hz$

a) Frequency deviation $= \Delta f$

$= A_m K_f$

$= 5 \times 40$

$= 200\ Hz.$

b) modulation Index,

$$m_f = \frac{A_m K_f}{f_m}$$

$$= \frac{200}{1000}$$

$$= 0.2$$

7.Find the transmission bandwidth for fm modulated signal if the modulation Index is 3 and message signal bandwidth is 5 khz.

$$m_f = \frac{\Delta f}{f_m}$$

$m_f = 3$

$f_m = 5000\ Hz$

$$\Rightarrow \Delta f = m_f f_m$$

$$= 3 \times 5000$$

$$= 15000\ Hz$$

$$\text{Bandwidth} = 2\Delta f + 2 f_m$$

$$= 2 \times 15000 + 2 \times 5000$$

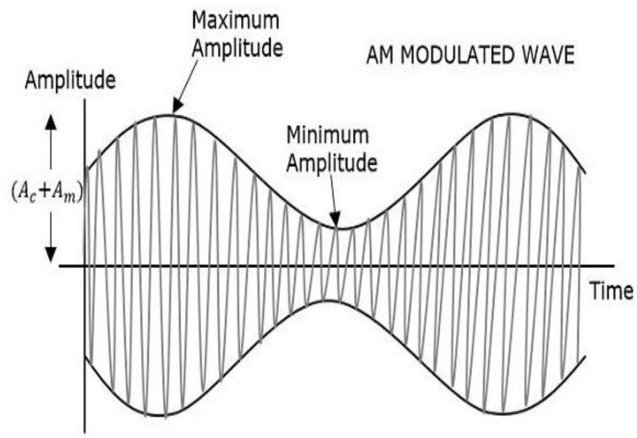
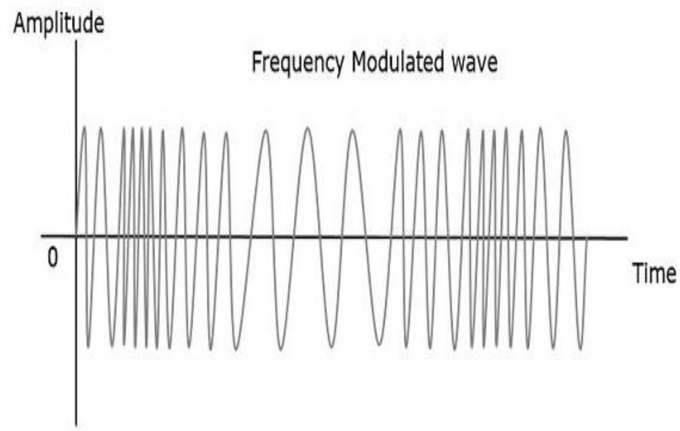
$$= 40000\ Hz$$

$$= 40\ KHz$$

8.Which technique is used more bandwidth FM or AM?

Ans: FM

9.Write the difference between AM and FM Modulation?

AM	FM
Amplitude of carrier signal is changed with respect to the message signal.	Frequency of carrier signal is changed with respect to the message signal.
Equation of modulated signal: $Y_{AM}(t)=[A_c+ x(t)]\cos(2\pi f_c t)$	Equation of modulated signal: $Y_{Fm}(t)=A_c\cos[2\pi f_c t+2\pi k_f\int x(t)dt]$
Modulated wave shape 	Modulated wave shape 
AM modulation needed less Bandwidth for transmission than FM modulation	FM modulation needed more Bandwidth for transmission than AM modulation