D.Y. PATIL INTERNATIONAL UNIVERSITY
B.TECH CSE FY SEM-2
A.Y. 2022-2023

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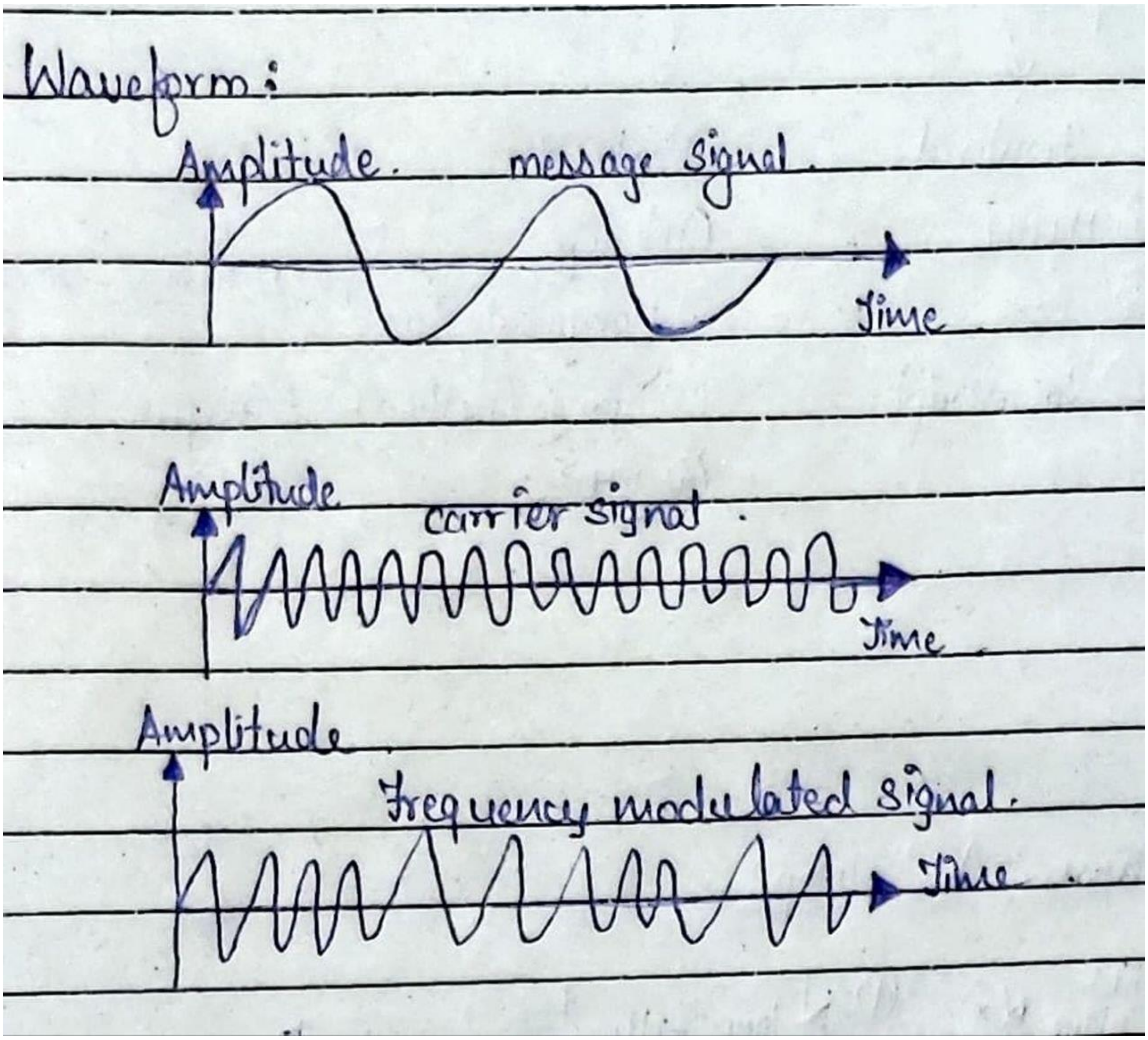
SUBJECT: INTRODUCTION TO COMMUNICATION SYSTEMS
BATCH: A1

EXPERIMENT: 05

Title: Frequency Modulation and Demodulation

Apparatus: Matlab Simulink and Matlab Code waveform: Frequency Modulation and Demodulation

Theory: Block/ Circuit diagram

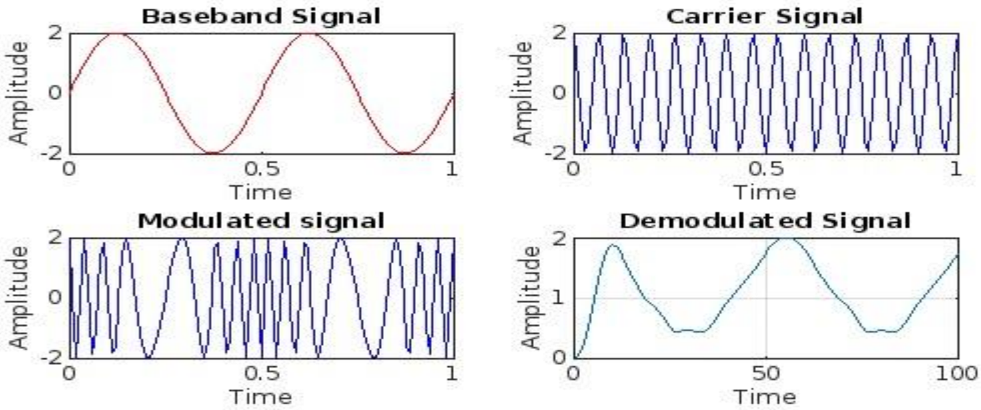


Matlab Code for Frequency Modulation and Demodulation:

```
clc;
Am=2; %Baseband Signal amplitude
Ac=2; %amplitude of carrier
fm=2; %Baseband signal frequency
fc=15; %Carrier Frequency

t=0:0.01:1; %Time axis

m= Am*sin(2*pi*fm*t); %Baseband Signal

subplot(321); %first diagram out of 3 rows 2 coloumn
plot(t,m,'r');
title('Baseband Signal');
xlabel('Time');
ylabel('Amplitude');

c=Ac*sin(2*pi*fc*t);
subplot(322); %second diagram out of 3 rows 2 coloumn
plot(t,c,'b');
title('Carrier Signal');
xlabel('Time');
ylabel('Amplitude');
kf=5; %frequency sensitivity
```

```
beta= (kf*Am)/fm; %Set the frequency modulation index value
s= Ac*cos(2*pi*fc*t - beta*cos(2*pi*fm*t));

%s= Ac*sin(2*pi*fc*t + kf*Am*sin(2*pi*fm*t));
subplot(323); %Second diagram out of 3 rows 2 coloumn
plot(t,s,'b');
title('Modulated Signal');
xlabel('Time');
ylabel('Amplitude');

%Frequency Demodulation
k=diff(s);
d1=abs(k);
[b,a]= butter(3,0.136);
d= filter(b,a,d1);
c= Ac*cos(2*pi*fc*t);
subplot(322); %Second diagram out of 3 rows 2 coloumn
plot(t,c,'b');
title('Carrier Signal');
xlabel('Time');
ylabel('Amplitude');

kf= 5; %frequency sensitivity
beta = (kf*Am)/fm; %set the frequency modulation index value
s= Ac*cos(2*pi*fc*t + beta*sin(2*pi*fm*t));

%s= Ac*sin(2*pi*fc*t + kf*Am*sin(2*pi*fm*t));
subplot(323); %second diagram out of 3 rows and 2 coloumn
plot(t,s,'b');
title('Modulated signal');
xlabel('Time');
ylabel('Amplitude');

%frequency Demodulation
k= diff(s);
d1= abs(k);
[b,a]= butter(3,0.136);
d= filter(b,a,d1);

subplot(324); %second diagram out of 3 rows 2 coloumns
plot(d);
title('Demodulated Signal');
xlabel('Time');
ylabel('Amplitude');

fprintf('Sarwajeet Pratap Singh')
grid on;
```

OUTPUT:



EXPERIMENT: 06

Title: PLL as a FM Demodulator

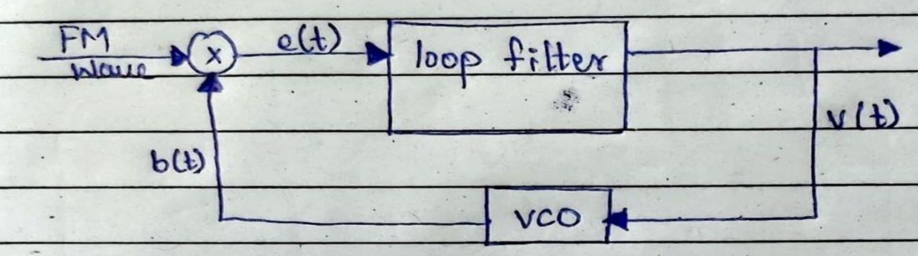
Design a Block or circuit diagram of PLL and explain in detail:

- A Phase-Locked Loop (PLL) is basically a negative feedback system. It consists of three major components such as re multiplier, a loop filter and a voltage controlled oscillator (VCO) connected together in the form of a feedback loop.
- A VCO is a sine wave generator whose frequency is determined by the voltage applied to it from an external source. It means that any frequency modulator can work as a VCO.
- A phase-locked loop (PLL) is primarily used in tracking the phase and frequency of the carrier component of an incoming FM signal.

Working:

- If the signal fed back is not equal to the input signal, the error signal will change the value of the fed back signal until it is equal to the input signal.
- The difference signal between s(t) and b(t) is called an error signal.
- A PLL operates on a similar principle except for the fact that the quantity feedback is not the amplitude, but a generalized phase Φ(t).
- The error signal or difference signal e(t) is utilized to adjust the VCO frequency in such a way that the instantaneous phase angle comes close to the angle of the incoming signal s(t).
- At this point, the two signals s(t) and b(t) are synchronized and the PLL is locked to the incoming signal s(t).
- VCO: A voltage controlled oscillator is an electronic oscillator whose oscillation frequency is controlled by a voltage input.
- Phase detector: It multiply the incoming signal by the output of VCO.
- LPF: Rejects the high frequency components.

PLL: (phase locked loop):



FM DEMODULATION (PLL):