EEE 321, ETE 321 – Introduction to Communication Systems

Experiment No: 06

Phase Modulation & Demodulation

Modulation is the process of putting information onto a high frequency carrier for transmission (frequency translation).

Once this information is received, the low frequency information must be removed from the high frequency carrier. This process is known as **Demodulation**.

In analog signal transmission, there are basically three main types of modulation:

1. Amplitude modulation
2. Frequency modulation
3. Phase modulation

Phase Modulation (PM)

In this modulation technique, phase of the carrier changes according to the amplitude of the message or modulating signal.

Equations:

Message or modulating signal: $m(t) = A_m \cos(w_m t)$

Carrier signal: $c(t) = A_c \cos(w_c t)$

Modulated signal: $s(t) = \cos(\theta(t))$

$s(t) = A_c \cos(w_c t + k_{pm} m(t))$

Here k_{pm} is the phase deviation constant in rad/volt.

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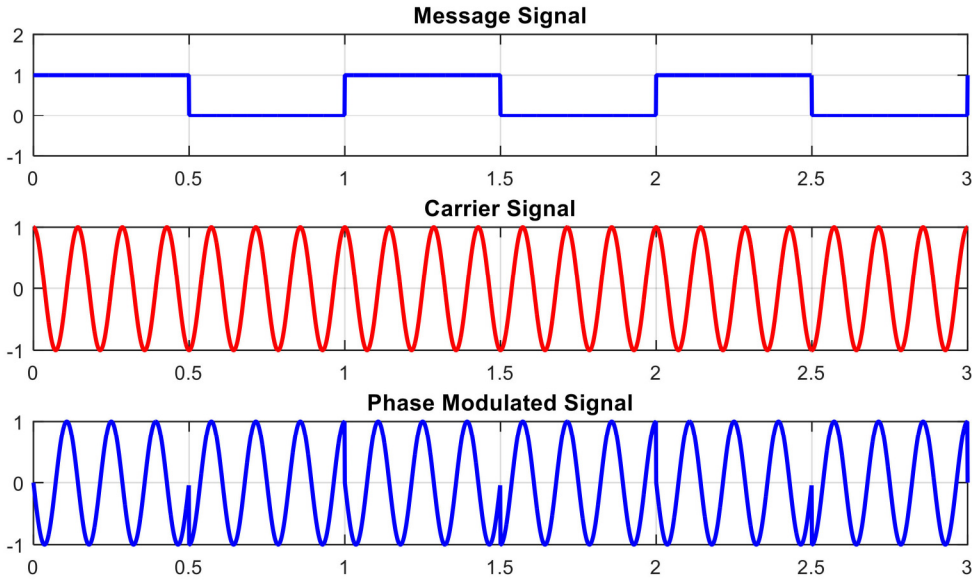
MATLAB code for Phase Modulation:

```
clc; clear all; close all;

% PM using equation
clc; clear all

t = 0: 0.001: 3;      % time variable
fc = 7;               % frequency of carrier signal
fm = 1;               % frequency of message signal
kp = pi/2;            % phase deviation constant

mt = 0.5*(1 + square(2*pi*fm*t));
ct = cos(2*pi*fc*t);
st = cos(2*pi*fc*t + kp*mt);

subplot(3,1,1)
plot(t,mt, 'b','linewidth',2); grid on;
title('Message Signal');
ylim([-1 2]);

subplot(3,1,2)
plot(t,ct, 'r','linewidth',2); grid on;
title('Carrier Signal');

subplot(3,1,3)
plot(t,st, 'b','linewidth',2); grid on;
title('Phase Modulated Signal');
```



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Phase Demodulation

For phase modulation and demodulation, we can also use two built in function of MATLAB: `pmmod()` and `pmdemod()`

- **`pmmod(x,Fc,Fs,phasedev)`** modulates the message signal `x` using phase modulation. The carrier signal has frequency `Fc` (Hz) and sampling rate `Fs` (Hz), where `Fs` must be at least `2*Fc`. The `phasedev` argument is the phase deviation constant (Hz) of the modulated signal.
- **`pmdemod(y,Fc,Fs,phasedev)`** demodulates the modulating signal `y` from the carrier signal using phase demodulation. The carrier signal has frequency `Fc` (Hz) and sampling rate `Fs` (Hz), where `Fs` must be at least `2*Fc`. The `phasedev` argument is the phase deviation (Hz) of the modulated signal.

MATLAB code for Phase Modulation and Demodulation:

```
% PM using built in functions
clc; clear all

fs = 8000;
t = [0: 1: 3*fs]/fs;
fc = 10;                % frequency of carrier signal
fm = 1;                 % frequency of message signal
kp = pi/2;              % phase deviation constant

mt = sin(2*pi*fm*t) + sin(4*pi*fm*t);
x = pmmod(mt,fc,fs,kp);
y = pmdemod(x,fc,fs,kp);

subplot(3,1,1)
plot(t,mt, 'b','linewidth',2); grid on
title('Message Signal')

subplot(3,1,2)
plot(t,x, 'r','linewidth',2); grid on
title('Phase Modulated Signal')

subplot(3,1,3)
plot(t,y, 'm','linewidth',2); grid on
title('Phase Demodulated Signal')
```


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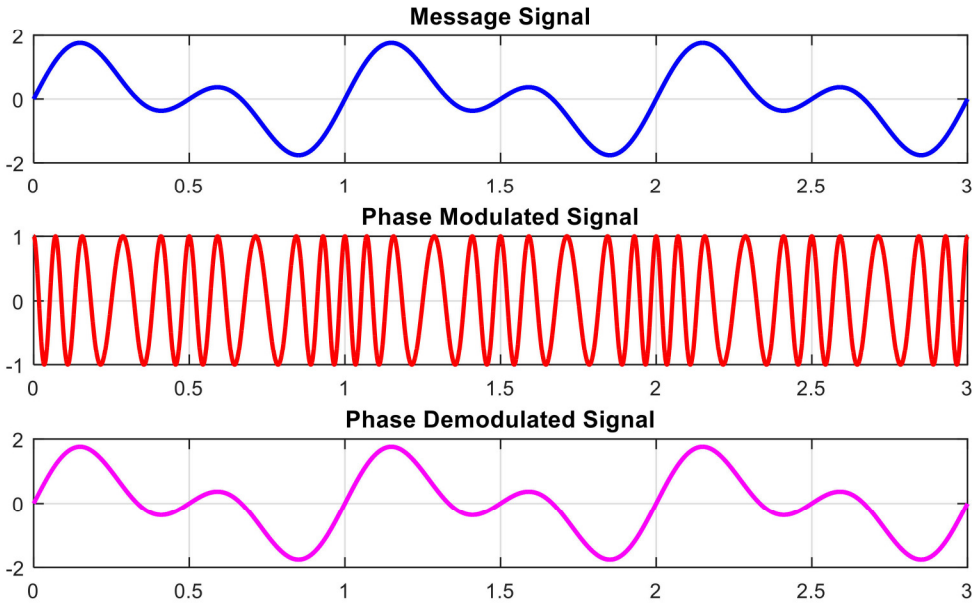
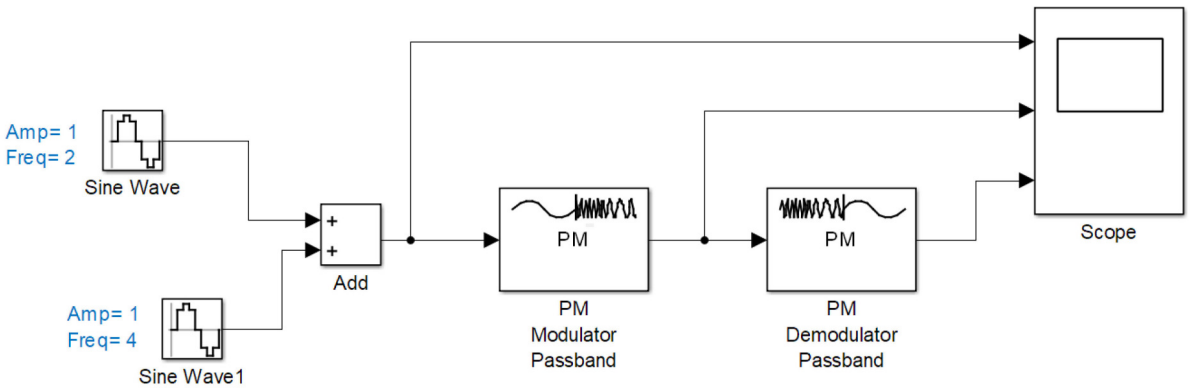
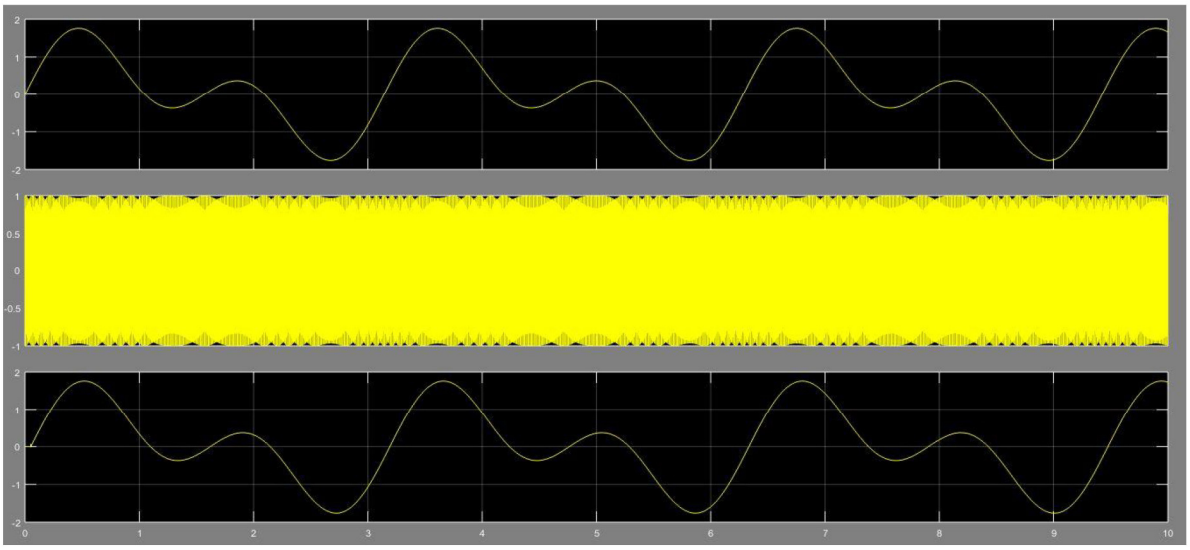


PM Modulation & Demodulation Using SIMULINK





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