22AIE211 Introduction to Communications and IoT

Lab sheet-2

Signal Modulation and Demodulation Techniques

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**clc;**

**close all;**

**clear all;**

**m = [0.5 1 1.5];**

**Am = 5; %Amp. of modulating signal**

**fm = 20; %frequency of modulating signal**

**Tm = 1/fm;**

**t = 0:0.001:1;**

**ym = Am\*sin(2\*pi\*fm\*t);**

**subplot(5,1,1);**

**plot(t,ym)**

**title('Message Signal');**

**%Carrier signal**

**Ac = Am;**

**fc = 100;**

**Tc = 1/fc;**

**yc = Ac\*sin(2\*pi\*fc\*t);**

**subplot(5,1,2);**

**plot(t,yc)**

**grid on;**

**title('Carrier Signal');**

**%AM Modulation**

**index = 0;**

**titles = {'index=0.5', 'index=1', 'index=1.5'};**

**for i = m**

**subplot(5,1,3+index);**

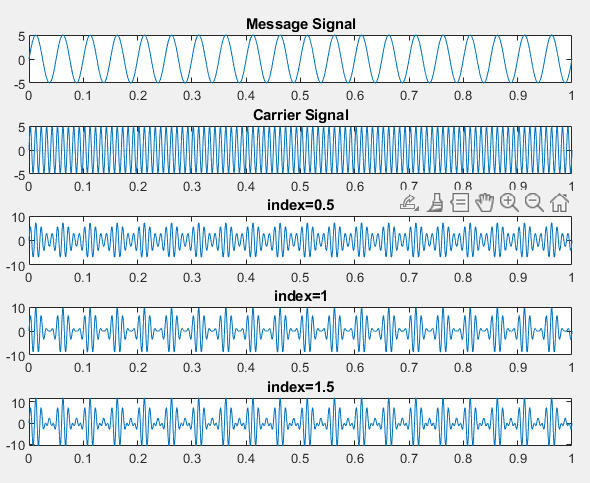
**index = index + 1;**

**y = Ac \* (1+i\*sin(2\*pi\*fm\*t)).\*sin(2\*pi\*fc\*t);**

**plot(t,y)**

**title(titles{index});**

**end**

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**clc;**

**close all;**

**clear all;**

**t = 0:0.001:1;**

**ym = 2\*cos(pi\*t); % message signal**

**yc = 4\*sin(100\*pi\*t + deg2rad(10)); % carrier signal**

**yam = 4\*(1+cos(pi\*t)).\*sin(100\*pi\*t + deg2rad(10)); % Amplitude modulated Signal**

**subplot(3, 1, 1);**

**plot(t, ym);**

**title("Message Signal");**

**subplot(3, 1, 2);**

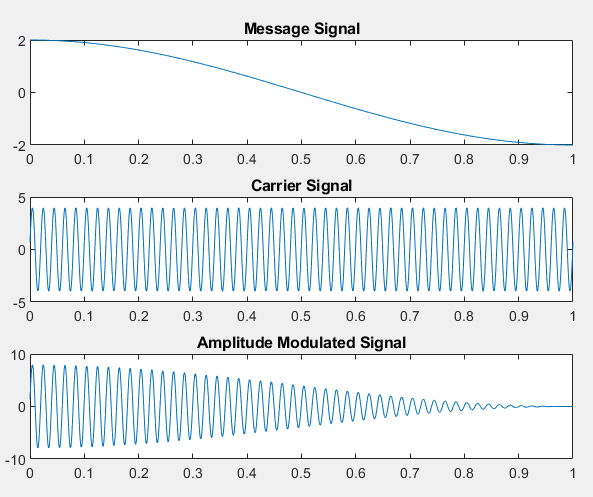
**plot(t, yc);**

**title("Carrier Signal");**

**subplot(3, 1, 3);**

**plot(t, yam);**

**title("Amplitude Modulated Signal");**

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**clc;**

**close all;**

**clear all;**

**mf = 10;**

**fs = 10000;**

**fm = 35;**

**fc = 500;**

**Am = 1;**

**Ac = 1;**

**t = 0:1/fs:0.1;**

**ym = Am\*cos(2\*pi\*fm\*t);**

**yc = Ac\*cos(2\*pi\*fc\*t);**

**yfm = Ac\*cos(2\*pi\*fc\*t + mf\*sin(2\*pi\*fm\*t));**

**subplot(3, 1, 1);**

**plot(t, ym);**

**title("Modulated Signal");**

**subplot(3, 1, 2);**

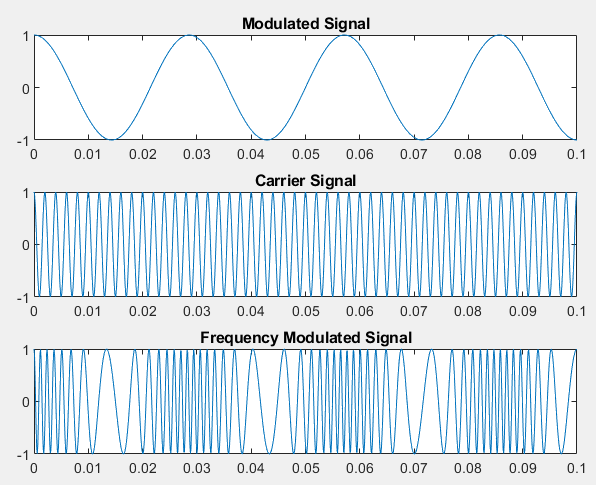
**plot(t, yc);**

**title("Carrier Signal");**

**subplot(3, 1, 3);**

**plot(t, yfm);**

**title("Frequency Modulated Signal");**

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**clc;**

**close all;**

**clear all;**

**t = 0:0.001:5;**

**ym = sin(2\*pi\*5\*t);**

**yc = square(5\*t);**

**yam = sin(2\*pi\*5\*t + ym);**

**subplot(3, 1, 1);**

**plot(t, ym);**

**title("Message Signal");**

**subplot(3, 1, 2);**

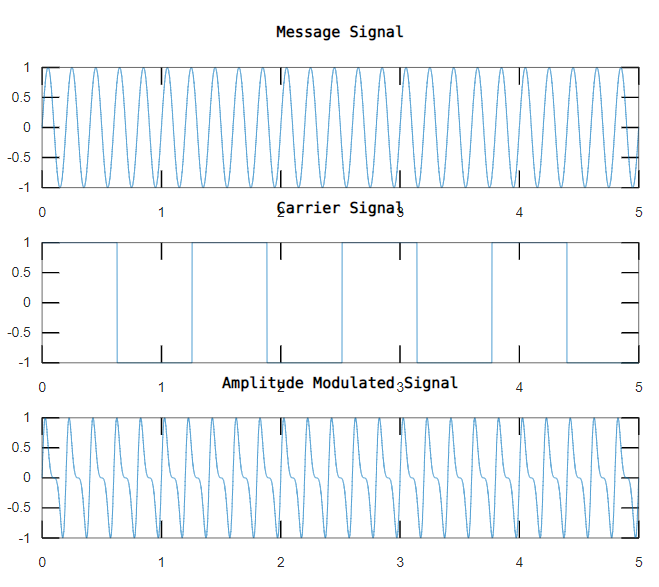
**plot(t, yc);**

**title("Carrier Signal");**

**subplot(3, 1, 3);**

**plot(t, yam);**

**title("Amplitude Modulated Signal");**

****

****

**clc;**

**close all;**

**clear all;**

**t = 0:0.001:1;**

**ym = 5 \* sin(2\*pi\*10\*t);**

**yc = 5 \* sin(2\*pi\*50\*t);**

**ypm = 5 \* sin(2\*pi\*50\*t + 4\*ym);**

**subplot(3,1,1);**

**plot(t, ym);**

**title('Message Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

**subplot(3,1,2);**

**plot(t, yc);**

**title('Carrier Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

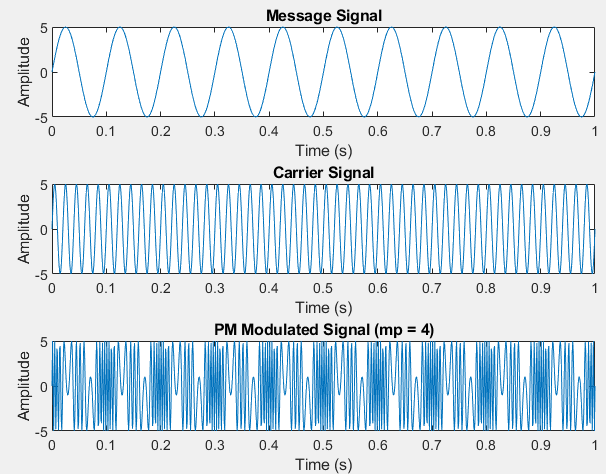
**subplot(3,1,3);**

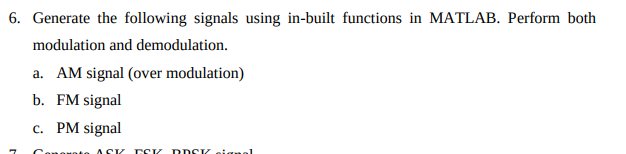
**plot(t, ypm);**

**title('PM Modulated Signal (mp = 4)');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

****

****

**clc;**

**close all;**

**clear all;**

**cf = 1;**

**Fs = 100;**

**mi\_am = 5;**

**mi\_fm = 5;**

**mi\_pm = 2;**

**t = 0:1/Fs:5;**

**ym = sin(2\*pi\*1\*t);**

**yc = sin(2\*pi\*cf\*t);**

**yam = ammod(ym, cf, cf\*mi\_am);**

**tam = amdemod(yam, cf, cf\*mi\_am);**

**yfm = fmmod(ym, cf, cf\*mi\_fm, Fs);**

**tfm = fmdemod(yfm, cf, Fs, cf\*mi\_fm);**

**ypm = pmmod(ym, cf, cf\*mi\_pm, Fs);**

**tpm = pmdemod(ypm, cf, Fs, cf\*mi\_pm);**

**subplot(2,4,1);**

**plot(t, ym);**

**title('Message Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

**subplot(2,4,5);**

**plot(t, yc);**

**title('Carrier Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

**subplot(2,4,2);**

**plot(t, yam);**

**title('AM Modulated Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

**subplot(2,4,3);**

**plot(t, yfm);**

**title('FM Modulated Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

**subplot(2,4,4);**

**plot(t, ypm);**

**title('PM Modulated Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

**subplot(2,4,6);**

**plot(t, tam);**

**title('AM Demodulated Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

**subplot(2,4,7);**

**plot(t, tfm);**

**title('FM Demodulated Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

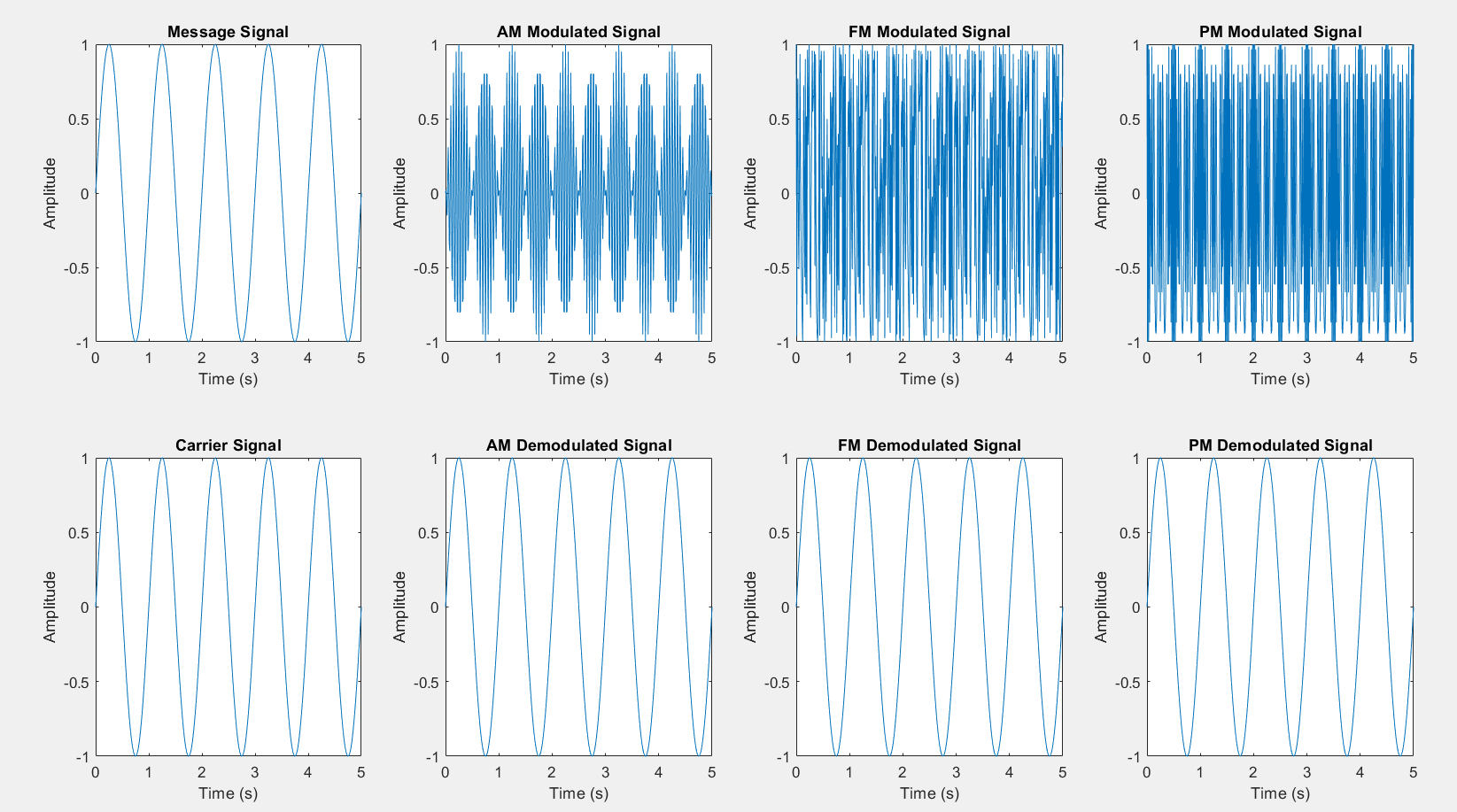
**subplot(2,4,8);**

**plot(t, tpm);**

**title('PM Demodulated Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

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****

**clc;**

**close all;**

**clear all;**

**x = [1 0 0 1 1 0 1];**

**bp = 0.000001;**

**A1 = 10;**

**A2 = 0;**

**f1 = 10 / bp;**

**f0 = 5 / bp;**

**phi1 = 0;**

**phi0 = pi;**

**t\_bit = bp / 100;**

**bit = [];**

**for n = 1:length(x)**

**if x(n) == 1**

**se = ones(1, 100);**

**else**

**se = zeros(1, 100);**

**end**

**bit = [bit se];**

**end**

**t1 = t\_bit : t\_bit : 100 \* length(x) \* t\_bit;**

**% ASK modulation**

**f = 10 / bp;**

**m\_ask = [];**

**for i = 1:length(x)**

**if x(i) == 1**

**y = A1 \* cos(2 \* pi \* f \* t\_bit : 2 \* pi \* f \* t\_bit : 2 \* pi \* f \* t\_bit \* 100);**

**else**

**y = A2 \* cos(2 \* pi \* f \* t\_bit : 2 \* pi \* f \* t\_bit : 2 \* pi \* f \* t\_bit \* 100);**

**end**

**m\_ask = [m\_ask y];**

**end**

**t2 = t\_bit : t\_bit : t\_bit \* length(x) \* 100;**

**% FSK modulation**

**m\_fsk = [];**

**for i = 1:length(x)**

**if x(i) == 1**

**y = cos(2 \* pi \* f1 \* t\_bit : 2 \* pi \* f1 \* t\_bit : 2 \* pi \* f1 \* t\_bit \* 100);**

**else**

**y = cos(2 \* pi \* f0 \* t\_bit : 2 \* pi \* f0 \* t\_bit : 2 \* pi \* f0 \* t\_bit \* 100);**

**end**

**m\_fsk = [m\_fsk y];**

**end**

**t3 = t\_bit : t\_bit : t\_bit \* length(x) \* 100;**

**% PSK modulation**

**m\_psk = [];**

**for i = 1:length(x)**

**if x(i) == 1**

**y = cos(2\*pi\*f1\*t\_bit + phi1:2\*pi\*f1\*t\_bit:2\*pi\*f1\*t\_bit\*100 + phi1);**

**else**

**y = cos(2\*pi\*f1\*t\_bit + phi0:2\*pi\*f1\*t\_bit:2\*pi\*f1\*t\_bit\*100 + phi0);**

**end**

**m\_psk = [m\_psk y];**

**end**

**t4 = t\_bit : t\_bit : t\_bit \* length(x) \* 100;**

**% Plotting**

**subplot(4,1,1);**

**plot(t1, bit, 'r');**

**grid on;**

**axis([0 bp\*length(x) -.5 1.5]);**

**title('Message Signal (Binary)');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

**subplot(4,1,2);**

**plot(t2, m\_ask, 'b');**

**title('ASK Modulated Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

**subplot(4,1,3);**

**plot(t3, m\_fsk, 'g');**

**title('FSK Modulated Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

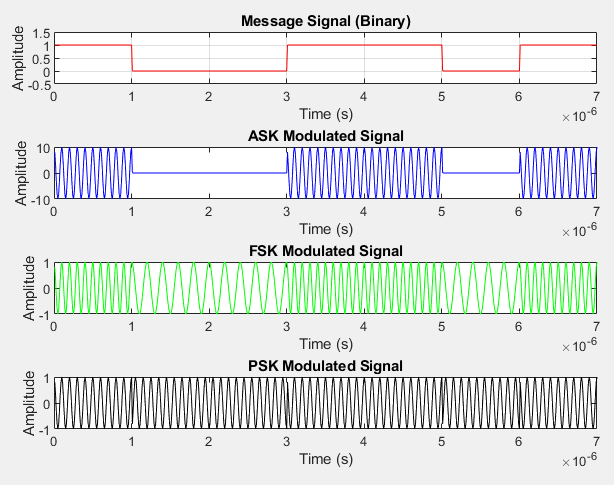
**subplot(4,1,4);**

**plot(t4, m\_psk, 'k');**

**title('PSK Modulated Signal');**

**xlabel('Time (s)');**

**ylabel('Amplitude');**

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