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| Analog Communications Lab  (EACN332C) |
| Lab Record |
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|  |
| **ARUNAV BHATNAGAR** |

**ROLL NO – IEC2015084**

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19-August-2016

**EXPERIMENT - 01**

**Question -01**

v1(t) = cos((2\*pi\*t)/12)

v2 (t) = cos((8\*pi\*t)/31)

v3(t) = cos(t/6)

**Matlab Code**

t = [0: pi/60:16\*pi];

y1 = cos((2\*pi\*t)/12);

y2 = cos((8\*pi\*t)/31);

y3 = cos(t/6);

subplot(3,1,1);

plot(t,y1);

title('Arunav Bhatnagar IEC2015084');

xlabel('time');

ylabel('cos((2\*pi\*t)/12)');

subplot(3,1,2);

plot(t,y2);

xlabel('time');

ylabel('cos((8\*pi\*t)/31)');

subplot(3,1,3);

plot(t,y3);

xlabel('time');

ylabel('cos(t/6)');

axis([0 60 -1 1]);

**Question – 02**

v1[n] = cos[(2\*pi\*n)/12]

v2[n] = cos[(8\*pi\*n)/31]

v3[n] = cos[n/6]

**Matlab Code**

n=[1:1:50];

v1 = cos((2\*pi\*n)/12);

v2 = cos((8\*pi\*n)/31);

v3 = cos(n/6);

subplot(3,1,1);

stem(n,v1);

xlabel('Time');

ylabel('v1');

title('Arunav Bhatnagar IEC2015084');

subplot(3,1,2);

stem(n,v2);

xlabel('Time');

ylabel('v2');

subplot(3,1,3);

stem(n,v3)

xlabel('Time');

ylabel('v3');

**Question -03**

v1(t) = e(-0.2t)

v2 (t) = e(-0.2t)\*cos((8\*pi\*t)/31)

v3[n] = e(-0.2n)

v4[n] = e(-0.2n)\*cos((8\*pi\*n)/31)

**Part -01**

**Matlab Code**

n = [1:1:30];

t= [0:0.05:20];

v1 = exp((-0.2)\*t);

v3 = exp((-0.2)\*n);

subplot(2,1,1);

plot(t,v1);

xlabel('time')

ylabel('v1')

title('Arunav Bhatnagar IEC2015084');

subplot(2,1,2);

stem(n,v3);

xlabel('Integer');

ylabel('v3')

**Part – 02**

**Matlab Code**

n = [1:1:30];

t = [0:0.05:20];

v2 = ((exp((0.2)\*t\*(-1))).\*(cos((8\*pi\*t)/31)));

v4 = ((exp((0.2)\*n\*(-1))).\*(cos((8\*pi\*n)/31)));

subplot(2,1,1);

plot(t,v2);

title('Arunav Bhatnagar IEC2015084');

xlabel('time');

ylabel('v2');

subplot(2,1,2);

stem(n,v4);

xlabel('Integer');

ylabel('v4');

26-August-2016

**EXPERIMENT – 02**

**Question -01**

Study of Sine & Cosine Fourier Series representation of Square Wave with fundamental period =2 & Unity amplitude. Plot Fourier Series representation for n= 2, 3, 7, 14 & Comment on plot by comparing with original function.

**Matlab Code**

syms t

syms n

T=2;

w=2\*pi/T;

n=1:25;

a0=(int(1,t,0,1));

an=1\*(int(cos(n\*w\*t),t,0,1));

bn=1\*(int(sin(n\*w\*t),t,0,1));

t1=0:0.01:10;

y=.5+(.5\*square(pi\*t1));

m=1;

for r=[1 3 7 17]

sum=a0;

for j=1:2:r

sum=(sum+(an(j)\*cos(n(j)\*w\*t1))+(bn(j)\*sin(n(j)\*w\*t1)));

end

subplot(2,2,m)

m=m+1;

plot(t1,sum-0.5,t1,y);

title('IEC2015084');

xlabel('t')

ylabel('sum')

end

02-September-2016

**EXPERIMENT – 03**

**Question -01**

Generate various Signals & Sequences of following:-

1. Ramp Function

(b)Unit Step Function

**Matlab Code**

*(a)Ramp Function*

function ramp();

n = 10;

t = 0:1:n;

subplot(2,1,1);

plot(t,t);

xlabel('time');

ylabel('Amplitude');

title 'Ramp Function IEC2015084';

subplot(2,1,2)

stem(t,t);

xlabel('time');

ylabel('Amplitude');

*(b) Unit Step Function*

function unitstep();

n = 10;

t = -n+0.1:0.5:n-0.5;

y = heaviside(t);

subplot(2,1,1)

plot(t,y);

title 'Unit Step Function IEC2015084';

xlabel('time');

ylabel('Amplitude');

subplot(2,1,2)

stem(t,y);

xlabel('time');

ylabel('Amplitude');

**Question -02**

Generate 15 period of Sawtooth Wave with fundamental frequency of 100Hz.

Sample rate is 2kHz.

function sawtooth();

t = 15\*(1/100);

fs = 1000000;

dt = 1/fs;

t=0:dt:t-dt;

x = sawtooth(2\*pi\*100\*t);

subplot(3,1,1)

plot(t,x);

grid on;

title('Sawtooth Wave IEC2015084');

xlabel('time');

ylabel('Amplitude');

**Question -03**

Generate 20 period of Triangular Wave with fundamental frequency of 100Hz.

Sample rate is 2kHz.

function triangular();

T2 = 20/100;

Fs2 = 200;

dt2 = 1/Fs2;

t4 = 0:dt2:T2-dt2;

y3 = 0.5 + sawtooth(2\*pi\*100\*t4);

subplot(3,1,2)

plot(t4,y3);

grid on

title('Triangular Wave IEC2015084');

xlabel('time');

ylabel('Amplitude');

**Question -04**

Generate Sine Wave with amplitude 5, frequency 10Hz for a period of 0.2sec.

Sample frequency is 20kHz.

function sine();

T3 = 0.2;

Fs3 = 100000;

dt3 = 1/Fs3;

t5 = 0:dt3:T3-dt3;

y4 = 5\*sin(2\*pi\*10\*t5);

subplot(3,1,3)

plot(t5,y4);

grid on

title('Sine Wave IEC2015084');

xlabel('time');

ylabel('Amplitude');

09-September-2016

**EXPERIMENT – 04**

**Question -01**

Study Fourier Transform response of the g(t) = 0.8cos(2pi100t) and plot the One –Sided Amplitude and phase spectra.

**Matlab Code**

fs = 1000;

ts = 1/fs;

N = 1024;

t = [0:1:N-1]\*(1/fs);

x = 0.8\*cos(2\*pi\*100\*t);

subplot(3,1,1);

plot(t,x);

axis([0 0.05 -1 1]);

grid;

xlabel('t');

ylabel('Amplitude');

title('Input signal IEC2015084');

x1 = fft(x,N);

k = 0:N-1;

Xmag = abs(x1);

subplot(3,1,2);

plot(k,Xmag);

grid;

xlabel('frequency');

ylabel('Amplitude');

axis([0 1100 0 350])

title('Amplitude of Transformed Signal');

Xphase = angle(x1)\*(180/pi);

subplot(3,1,3);

plot(k,Xphase);

grid;

xlabel('Frequency');

ylabel('Angle degree');

axis([0 1100 -200 200]);

title('Phase of Transformed Signal');

**Question -02**

Study Fourier Transform of a gate function ranging from t = -1/2 to t =+1/2 with amplitude 1.Draw the original gate function along with its continuous magnitude and phase spectra. Comment on Amplitude and phase Spectra.

**Matlab Code**

t = -5:0.001:5;

f = zeros(size(t));

for i = 1:length(t)

if abs(t(i)) <= 1/2

f(i) = 1;

else

f(i) = 0;

end

end

figure;

subplot(3,1,1);

plot(t,f,'LineWidth',2);

xlabel('time');

ylabel('f(t)');

title('Gate Function IEC2015084');

omega = [-50 : 0.1 : 50];

F = zeros(size(omega));

for i =1 : length(omega)

F(i) = trapz(t,f.\*exp(-j\*omega(i)\*t));

end

F\_magnitude = abs(F);

subplot(3,1,2);

plot(omega./(2\*pi),F\_magnitude,'LineWidth',2);

ylim([0 1])

xlabel('Frequency');

ylabel('|F(j\omega)|');

title('Fourier transform magnitude of Gate Function');

F\_angle = angle(F);

subplot(3,1,3);

plot(omega./(2\*pi),F\_angle.\*(180/pi),'LineWidth',2);

xlabel('Frequency');

ylabel('angle F(j\omega)');

title('Fourier transform phase of Gate Function');

16-September-2016

**EXPERIMENT – 05**

**Question -01**

Study all the properties of an LTI system for identical x(t) and h(t) as gate function(between -1.2 to 1.2 with value 1 ranging between -1 to 1).

**Matlab Code**

|  |  |
| --- | --- |
| t=-1.2:0.0001:1.2  x=zeros(size(t));  h=zeros(size(t));  x(t>=-1 & t<=1)=1;  subplot(3,2,1);  plot(t,x);  xlabel('time');  ylabel('x(t)');  title('IEC2015084');  h(t>=-1 & t<=1)=1;  subplot(3,2,2);  plot(t,h);  xlabel('time');  ylabel('h(t)');  title('IEC2015084');  y=conv(x,h);  tt=t(1)+t(1) : 0.0001 : t(end)+t(end);  subplot(3,2,3);  plot(tt,y\*0.0001);  xlabel('time');  ylabel('y(t)');  title('IEC2015084')  x2=x+x;  ya=conv(x2,h);  tt=t(1)+t(1) : 0.0001 : t(end)+t(end);  subplot(3,2,4);  plot(tt,ya\*0.0001);  yb=y+y;  hold on;  plot(tt,yb\*0.0001,'r');  xlabel('time');  ylabel('addition property');  title('IEC2015084'); | xs=2\*x;  ya=conv(xs,h);  tt=t(1)+t(1) : 0.0001 : t(end)+t(end);  subplot(3,2,5);  plot(tt,ya\*0.0001);  yb=2\*y;  hold on;  plot(tt,yb\*0.0001,'r');  xlabel('time');  ylabel('scaling property');  title('IEC2015084')  t=-1.2:0.0001:1.2;  x1=zeros(size(t));  x1(t>=-0.8 & t<=1.2)=1;  y1=conv(x1,h);  tt=t(1)+t(1) : 0.0001 : t(end)+t(end);  subplot(3,2,6);  plot((1:length(y1))\*0.0001,y1\*0.0001);  hold on;  pad=zeros(1,0.2/0.0001);  y2=[pad y];  plot((1:length(y2))\*0.0001,y2\*0.0001,'b');  xlabel('time');  ylabel('time variance property');  title('IEC2015084') |

16-October-2016

**EXPERIMENT – 06**

**Question -01**

t = -2:0.005:2

x = 2\*pi;

y = 2\*pi\*5;

X = 4\*sin(x\*t);

Y = 7\*sin(y\*t);

P = Y + X.\*Y;

subplot(5,1,1);

plot(X);

title 'IEC2015084';

xlabel ‘message’;

subplot(5,1,2);

plot(Y);

xlabel ‘carrier’;

subplot(5,1,3);

plot(P);

xlabel 'transmitted wave 1'

K = Y + 0.5\*X.\*Y;

subplot(5,1,4);

plot(K);

xlabel 'transmitted wave 0.5'

J = Y + 2\*X.\*Y;

subplot(5,1,5);

plot(J);

xlabel 'transmitted wave 2'

16-October-2016

**EXPERIMENT – 06**

**Question -01**

Write a MATLAB code to study the amplitude modulated wave in time and frequency domain for carrier and message signals of 1.08 MHz and 5 KHz respectively. Choose modulation index of 0.5, 1 and 2 to display the results.

fm=5000;

fc=1080000;

time=0:2.3148e-7:8e-4;

amp=1;

ac=2;

k=amp/ac;

modwave=amp\*sin(2\*pi\*fm\*time);

carwave=ac\*sin(2\*pi\*fc\*time);

mt=k\*sin(2\*pi\*fm\*time);

msg = sin(2\*pi\*fm\*time);

sam=ac\*(1+mt).\*sin(2\*pi\*fc\*time);

sam1=ac\*(1+msg).\*sin(2\*pi\*fc\*time);

sam2=ac\*(1+2\*msg).\*sin(2\*pi\*fc\*time);

n=length(time);

subplot(5,1,1)

spectrum=abs(fftshift(fft(modwave,n)))/n;

fw=-2160000:1250:2160000;

plot(fw(1152:2304),spectrum(1152:2304))

title({'IEC2015077';'Frequency Domain analysis of modulating wave'})

xlabel('Frequency (Hz)')

ylabel('Magnitude')

subplot(5,1,2)

spectrum1=abs(fftshift(fft(carwave,n)))/n;

fw=-2160000:1250:2160000;

plot(fw,spectrum1)

title('Frequency Domain analysis of carrier wave')

xlabel('Frequency (Hz)')

ylabel('Magnitude')

subplot(5,1,3)

spectrum2=abs(fftshift(fft(sam,n)))/n;

fw=-2160000:1250:2160000;

plot(fw,spectrum2)

title('Frequency Domain analysis of modulated wave(mu = 0.5)')

xlabel('Frequncy (Hz)')

ylabel('Magnitude')

subplot(5,1,4)

spectrum2=abs(fftshift(fft(sam1,n)))/n;

fw=-2160000:1250:2160000;

plot(fw,spectrum2)

title('Frequency Domain analysis of modulated wave(mu = 1)')

xlabel('Frequncy (Hz)')

ylabel('Magnitude')

subplot(5,1,5)

spectrum2=abs(fftshift(fft(sam2,n)))/n;

fw=-2160000:1250:2160000;

plot(fw,spectrum2)

title('Frequency Domain analysis of modulated wave(mu = 2)')

xlabel('Frequncy (Hz)')

ylabel('Magnitude')

4-November-2016

**EXPERIMENT – 07**

**Question -01**

Write a MATLAB code to study the frequency modulated wave in time and frequency domain for carrier and message signal of 400Hz and 25Hz.

**Matlab Code**

fm=input('Message Frequency=');

fc=input('Carrier Frequency=');

mi=input('Modulation Index=');

t=0:0.0001:0.1;

m=sin(2\*pi\*fm\*t);

subplot(4,1,1);

plot(t,m);

xlabel('time');

ylabel('amplitude');

title('IEC2015084')

grid on;

c=cos(2\*pi\*fc\*t);

subplot(4,1,2);

plot(t,c);

xlabel('time');

ylabel('amplitude');

grid on;

y=cos(2\*pi\*fc\*t+(mi.\*sin(2\*pi\*fm\*t)));

subplot(4,1,3);

plot(t,y);

xlabel('time');

ylabel('amplitude');

grid on;

time=0:2.3148e-7:8e-4;

n=length(time);

subplot(4,1,4)

spectrum1=abs(fftshift(fft(y,n)))/n;

fw=-2160000:1250:2160000;

plot(fw,spectrum1)

title('fm wave')

xlabel('f(Hz)')

ylabel('magnitude')

grid on;

4-November-2016

**EXPERIMENT – 07**

**Question -01**

Write a MATLAB code to study the frequency modulated wave in time and frequency domain for carrier and message signal of 400Hz and 25Hz.

**Matlab Code**

|  |  |
| --- | --- |
| t = linspace(0,1,1000);  fm = 5000;  mi = 0.2;  fc=1080000;  m = 3.2\*sin(2\*pi\*fm\*t);  subplot(2,1,1);  plot(t,m);  title('IEC2015084');  xlabel('Message Signal');  ylabel('Amplitude');  axis([0 0.5 -4 4 ]);    c = 3.2\*sin(2\*pi\*fc\*t);  subplot(2,1,2);  plot(t,c);  xlabel('Carrier Signal');  ylabel('Amplitude');  axis([0 0.5 -4 4 ]);  figure;    y = 3.2.\*sin((2\*pi\*fc\*t) + (mi.\*sin(2\*pi\*fm\*t)));  subplot(3,1,1);  plot(t,y);  ylabel('Amplitude');  title('FM Signal beta = 0.2');  grid on;  mi=2;  y=3.2.\*sin(2\*pi\*fc\*t+(mi.\*sin(2\*pi\*fm\*t)));  subplot(3,1,2);  plot(t,y);  ylabel('Amplitude');  title('FM Signal beta=2');  grid on;  mi=20;  y=3.2.\*sin(2\*pi\*fc\*t+(mi.\*sin(2\*pi\*fm\*t)));  subplot(3,1,3);  plot(t,y);  xlabel('Time');  ylabel('Amplitude');  title('FM Signal beta=20');  grid on; | figure;  mi=0.2;  y=3.2.\*sin(2\*pi\*fc\*t+(mi.\*sin(2\*pi\*fm\*t)));  y=fft(y);  y=abs(y);  subplot(3,1,1);  plot(t,y);  ylabel('Amplitude');  title('FM Signal beta = 0.2');  grid on;  mi=2;  y=3.2.\*sin(2\*pi\*fc\*t+(mi.\*sin(2\*pi\*fm\*t)));  y=fft(y);  y=abs(y);  subplot(3,1,2);  plot(t,y);  ylabel('Amplitude');  title('FM Signal beta=2');  grid on;  mi=20;  y=3.2.\*sin(2\*pi\*fc\*t+(mi.\*sin(2\*pi\*fm\*t)));  y=fft(y);  y=abs(y);  subplot(3,1,3);  plot(t,y);  xlabel('Frequency');  ylabel('Amplitude');  title('FM Signal beta=20');  grid on; |