

**American International University- Bangladesh**

**COE 3103: DATA COMMUNICATION**

**Final Lab Report 07**

**Spring 2021-2022**

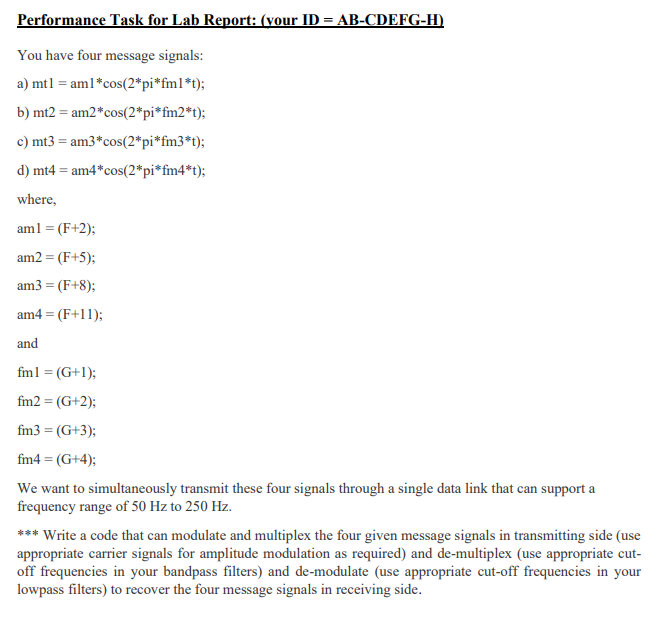
**Section: I**

**Date: 12/04/2022**

**Submitted by, Group 03**

|  |  |
| --- | --- |
| Student Name | Student Id |
| Rahman, Sheikh Talha Jubayer | 19-41468-3 |
| Shifat, Mahabub Hasan | 19-41460-3 |
| Hasan, Sayeed | 19-41005-2 |
| Islam, Hasan Sanjry | 19-39589-1 |
| Durjoy, Md. Badrul Alam | 18-39248-3 |

**Tasks**



**Solution of Performance Task**

%ID: 19-41468-3

A = 1;

B = 9;

C = 4;

D = 1;

E = 4;

F = 6;

G = 8;

H = 3;

fs = 4000; %sampling frequency

t = 0:1/fs:(1-(1/fs)); %time axis

am1 = (F+2); %amplitude for first message = (F+2) = (6+2) = 8

am2 = (F+5); %amplitude for second message = (F+5) = (6+5) = 11

am3 = (F+8); %amplitude for third message = (F+8) = (6+8) = 14

am4 = (F+11); %amplitude for fourth message = (F+11) = (6+11) = 17

fm1 = (G+1); %frequency for first message = (G+1) = (8+1) = 9

fm2 = (G+2); %frequency for second message = (G+2) = (8+2) = 10

fm3 = (G+3); %frequency for third message = (G+3) = (8+3) = 11

fm4 = (G+4); %frequency for fourth message = (G+4) = (8+4) = 12

fc1 = 75; %frequency for first carrier signal

fc2 = 125; %frequency for second carrier signal

fc3 = 175; %frequency for third carrier signal

fc4 = 225; %frequency for fourth carrier signal

mt1 = am1\*cos(2\*pi\*fm1\*t); %first message signal

mt2 = am2\*cos(2\*pi\*fm2\*t); %second message signal

mt3 = am3\*cos(2\*pi\*fm3\*t); %third message signal

mt4 = am4\*cos(2\*pi\*fm4\*t); %fourth message signal

c1 = cos(2\*pi\*fc1\*t); %first carrier signal

c2 = cos(2\*pi\*fc2\*t); %second carrier signal

c3 = cos(2\*pi\*fc3\*t); %third carrier signal

c4 = cos(2\*pi\*fc4\*t); %fourth carrier signal

x = mt1.\*c1 + mt2.\*c2 + mt3.\*c3 + mt4.\*c4; %compositet signal between 50 to 250 Hz frequency range

%Passing the Composite Signal Through Bandpass Filter

[num1, den1] = butter(5, [(fc1-fm1-12)/(fs/2) , (fc1+fm1+12)/(fs/2)]); %Butterworth Filter Window Determining for Bandpass Filter

bpf1 = filter(num1,den1,x); %Filtering is done here

[num2, den2] = butter(5, [(fc2-fm2-12)/(fs/2) , (fc2+fm2+12)/(fs/2)]);

bpf2 = filter(num2,den2,x);

[num3, den3] = butter(5, [(fc3-fm3-12)/(fs/2) , (fc3+fm3+12)/(fs/2)]);

bpf3 = filter(num3,den3,x);

[num4, den4] = butter(5, [(fc4-fm4-12)/(fs/2) , (fc4+fm4+12)/(fs/2)]);

bpf4 = filter(num4,den4,x);

%Mixing

z1 = 2\*bpf1.\*c1;

z2 = 2\*bpf2.\*c2;

z3 = 2\*bpf3.\*c3;

z4 = 2\*bpf4.\*c4;

%Passing the Mixed Signals Through Lowpass Filter

[num5, den5] = butter(5, (fm1+6)/(fs/2)); %Low pass filter is made here

rec1 = filter(num5,den5,z1); %Filtering is done here

[num6, den6] = butter(5, (fm2+6)/(fs/2));

rec2 = filter(num6,den6,z2);

[num7, den7] = butter(5, (fm3+6)/(fs/2));

rec3 = filter(num7,den7,z3);

[num8, den8] = butter(5, (fm4+6)/(fs/2));

rec4 = filter(num8,den8,z4);

MT1 = abs(fftshift(fft(mt1)))/(fs/2); %Fourier Transformation of m1

MT2 = abs(fftshift(fft(mt2)))/(fs/2); %Fourier Transformation of m2

MT3 = abs(fftshift(fft(mt3)))/(fs/2); %Fourier Transformation of m3

MT4 = abs(fftshift(fft(mt4)))/(fs/2); %Fourier Transformation of m4

R1 = abs(fftshift(fft(rec1)))/(fs/2); %Fourier Transformation of rec1

R2 = abs(fftshift(fft(rec2)))/(fs/2); %Fourier Transformation of rec2

R3 = abs(fftshift(fft(rec3)))/(fs/2); %Fourier Transformation of rec3

R4 = abs(fftshift(fft(rec4)))/(fs/2); %Fourier Transformation of rec4

X = abs(fftshift(fft(x)))/(fs/2); %Fourier Transformation of x

f = fs/2\*linspace(-1,1,fs);

figure %Plotting the Message and Received Signal 1 in Time-Domain and Frequency-Domain

subplot(4,1,1)

plot(t,mt1);

xlabel('Time (s)');

ylabel('Amplitude');

title('Message Signal 1 in Time Domain');

axis([0 0.5 -20 20]);

subplot(4,1,2)

plot(t,rec1);

xlabel('Time (s)');

ylabel('Amplitude');

title('Received Message Signal 1 in Time Domain');

axis([0 0.5 -20 20]);

subplot(4,1,3)

stem(f,MT1);

xlabel('Frequency');

ylabel('Amplitude');

title('Message Signal 1 in Frequency Domain');

axis([-15 15 0 20]);

subplot(4,1,4)

stem(f,R1);

xlabel('Frequency');

ylabel('Amplitude');

title('Received Message Signal 1 in Frequency Domain');

axis([-15 15 0 20]);

figure %Plotting the Message and Received Signal 2 in Time-Domain and Frequency-Domain

subplot(4,1,1)

plot(t,mt2);

xlabel('Time (s)');

ylabel('Amplitude');

title('Message Signal 2 in Time Domain');

axis([0 0.5 -20 20]);

subplot(4,1,2)

plot(t,rec2);

xlabel('Time (s)');

ylabel('Amplitude');

title('Received Message Signal 2 in Time Domain');

axis([0 0.5 -20 20]);

subplot(4,1,3)

stem(f,MT2);

xlabel('Frequency');

ylabel('Amplitude');

title('Message Signal 2 in Frequency Domain');

axis([-15 15 0 20]);

subplot(4,1,4)

stem(f,R2);

xlabel('Frequency');

ylabel('Amplitude');

title('Received Message Signal 2 in Frequency Domain');

axis([-15 15 0 20]);

figure %Plotting the Message and Received Signal 3 in Time-Domain and Frequency-Domain

subplot(4,1,1)

plot(t,mt3);

xlabel('Time (s)');

ylabel('Amplitude');

title('Message Signal 3 in Time Domain');

axis([0 0.5 -20 20]);

subplot(4,1,2)

plot(t,rec3);

xlabel('Time (s)');

ylabel('Amplitude');

title('Received Message Signal 3 in Time Domain');

axis([0 0.5 -20 20]);

subplot(4,1,3)

stem(f,MT3);

xlabel('Frequency');

ylabel('Amplitude');

title('Message Signal 3 in Frequency Domain');

axis([-15 15 0 20]);

subplot(4,1,4)

stem(f,R3);

xlabel('Frequency');

ylabel('Amplitude');

title('Received Message Signal 3 in Frequency Domain');

axis([-15 15 0 20]);

figure %Plotting the Message and Received Signal 4 in Time-Domain and Frequency-Domain

subplot(4,1,1)

plot(t,mt4);

xlabel('Time (s)');

ylabel('Amplitude');

title('Message Signal 4 in Time Domain');

axis([0 0.5 -20 20]);

subplot(4,1,2)

plot(t,rec4);

xlabel('Time (s)');

ylabel('Amplitude');

title('Received Message Signal 4 in Time Domain');

axis([0 0.5 -20 20]);

subplot(4,1,3)

stem(f,MT4);

xlabel('Frequency');

ylabel('Amplitude');

title('Message Signal 4 in Frequency Domain');

axis([-15 15 0 20]);

subplot(4,1,4)

stem(f,R4);

xlabel('Frequency');

ylabel('Amplitude');

title('Received Message Signal 4 in Frequency Domain');

axis([-15 15 0 20]);

figure %Plotting the Composite Signal in Time-Domain and Frequency-Domain

subplot(2,1,1)

plot(t,x);

xlabel('Time (s)');

ylabel('Amplitude');

title('Composite Signal in Time Domain');

axis([0 0.5 -50 50]);

subplot(2,1,2)

stem(f,X);

xlabel('Frequency');

ylabel('Amplitude');

title('Composite Signal in Frequency Domain');

axis([-250 250 0 10]);

**Figures**



Figure 1: Message & Received Signal 1 in Time & Frequency Domain



Figure 2: Message & Received Signal 2 in Time & Frequency Domain



Figure 3: Message & Received Signal 3 in Time & Frequency Domain



Figure 4: Message & Received Signal 4 in Time & Frequency Domain



Figure 5: Composite Signal in Time & Frequency Domain