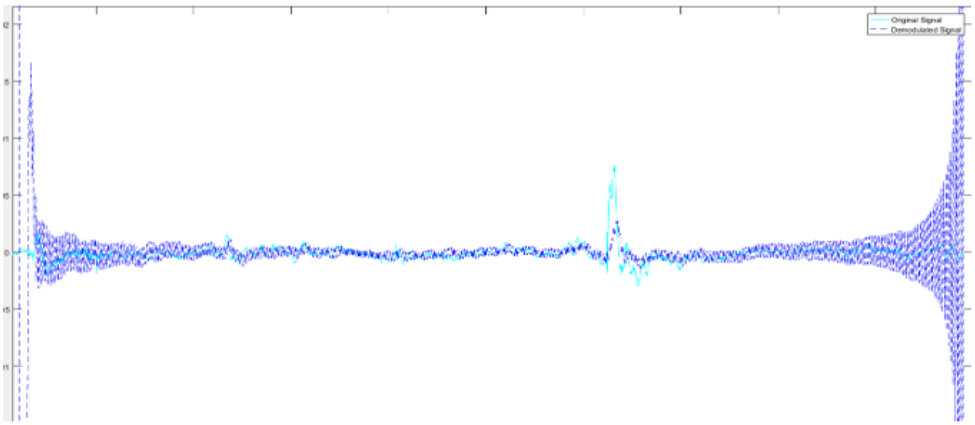
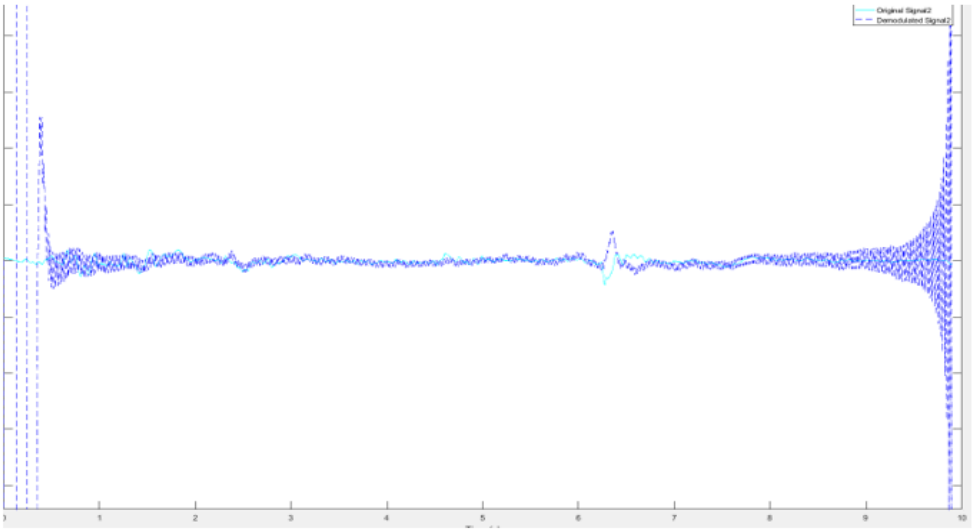
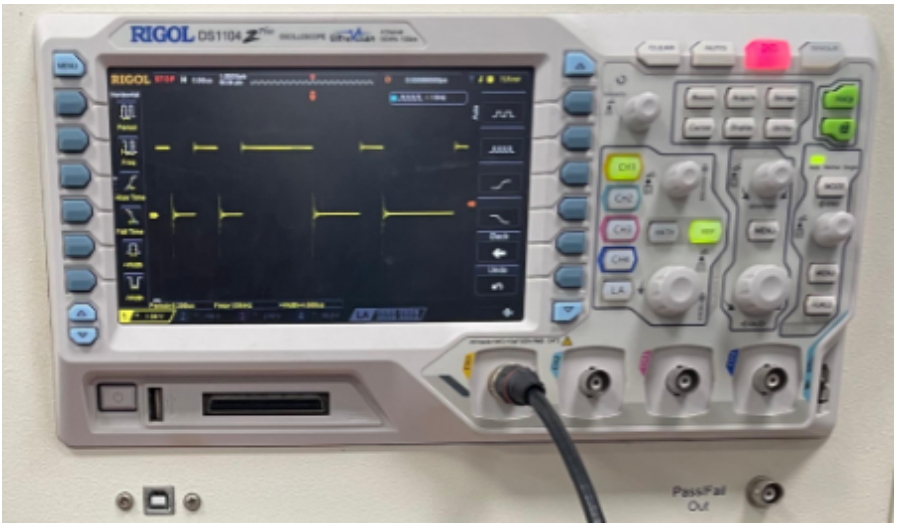
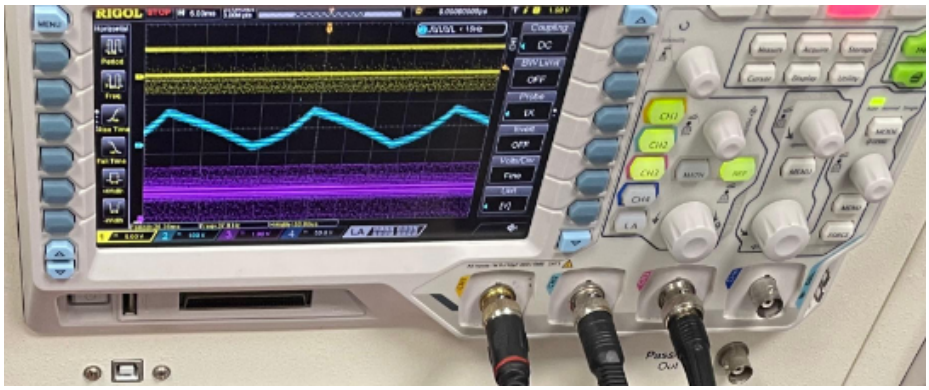
```
clear all;
BW = 4000;
G=500;
[x , fs]= audioread('chan1_1k_10s.wav');
Fc= BW*2;                % carrier = 1MHz
FS=2.2*Fc;    % sampling frequency for output signal
deviation=20; % freq. deviation
SAfm = dsp.SpectrumAnalyzer('SampleRate',FS, ...
      'Title','FM Broadcast Signal');
smod=fmmod(x, Fc, FS, deviation);
% s1=abs(fft(smod));
% plot(smod);
step(SAfm,smod);
%%
[x2 , fs]= audioread('chan2_1k_10s.wav');
Fc2= BW*4;               % carrier = 1MHz
FS2=2.2*Fc2;             % sampling frequency for output signal
% deviation=2; % freq. deviation
SAfm2 = dsp.SpectrumAnalyzer('SampleRate',FS2, ...
      'Title','FM Broadcast Signal');
smod2=fmmod(x2, Fc2, FS2, deviation);
step(SAfm2,smod2);
sumx = smod + smod2 ;
%% recovery
wn1 = [Fc-200 Fc+200];
[A1,B1] = butter(3, wn1/FS/2, 'bandpass');
rec1 = filter(A1, B1, sumx);
%%%%%%%%%%%%%%%%%%%%%%
wn2 = [Fc2-200 Fc2+200];
[A2,B2] = butter(3,wn2/FS2/2, 'bandpass');
rec2 = filter(A2, B2, sumx);
%% demodulation
demd1 = fmdemod(rec1,Fc,FS,deviation);
[A11,B11] = butter(2, 30/fs/2 , 'low');
dem1 = filter(A11, B11, demd1)
%%%%%%%%%%%%%%%%%%%%%%%%%
demd2 = fmdemod(rec2,Fc2,FS2,deviation);
[A22,B22] = butter(2, 25/fs/2 , 'low');
dem2 = filter(A22, B22, demd2)
%% plotting
%channel 1
t = linspace(1/fs,length(x)/fs ,length(x));
figure; subplot(211); plot(t,x);title('Channel 1 before multiplexing');
subplot(212); plot(t, dem1);title('Channel 1 after demultiplexing');
figure;
plot(t,x,'c',t,dem1,'b--');
xlabel('Time (s)')
ylabel('Amplitude')
legend('Original Signal','Demodulated Signal')
%channel 2
figure; subplot(211); plot(t,x2);title('Channel 2 before
      multiplexing');
subplot(212); plot(t, dem2);title('Channel 2 after demultiplexing');
figure;
plot(t,x2,'c',t,dem2,'b--');
xlabel('Time (s)')
ylabel('Amplitude')
legend('Original Signal2','Demodulated Signal2')
```

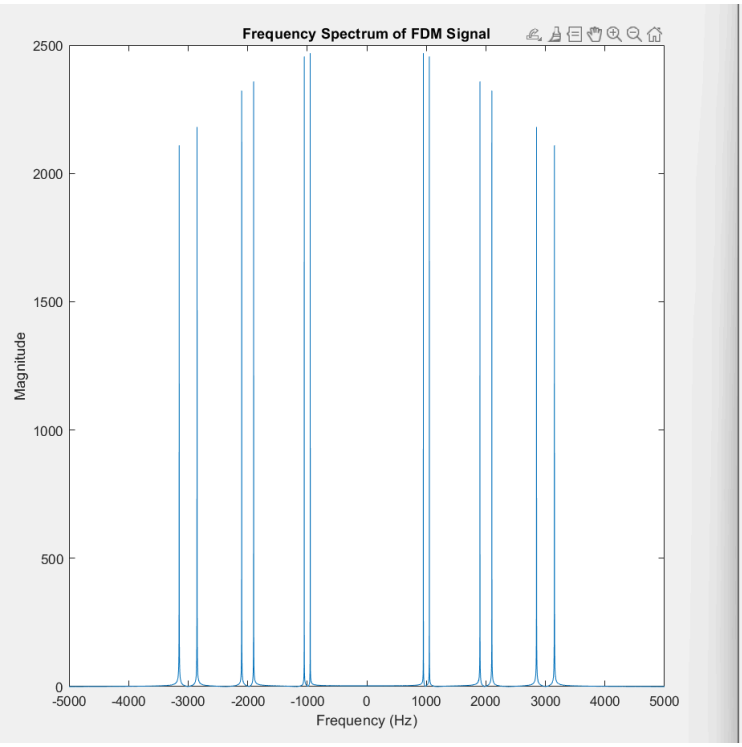

Original Signal
Demodulated Signal

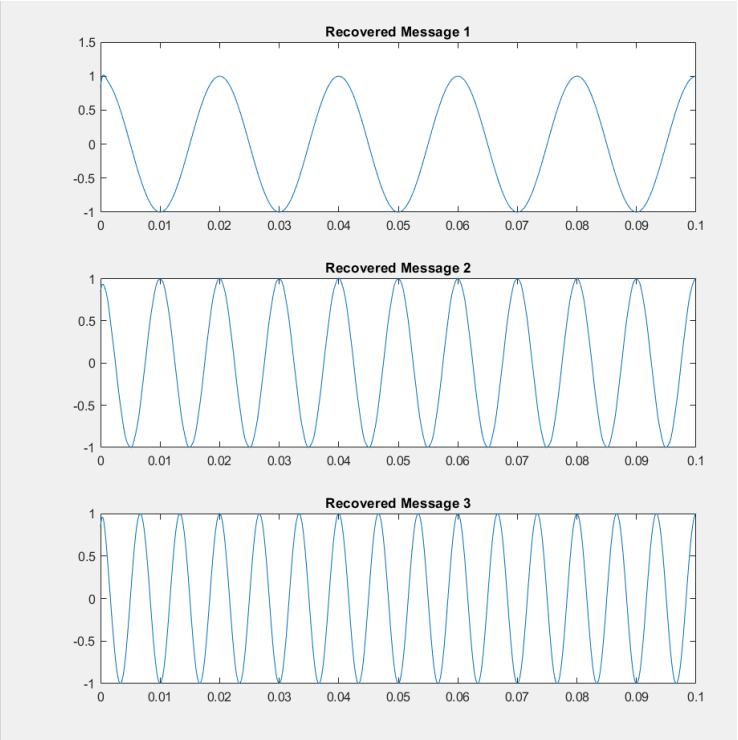

Original Signal2
Demodulated Signal2

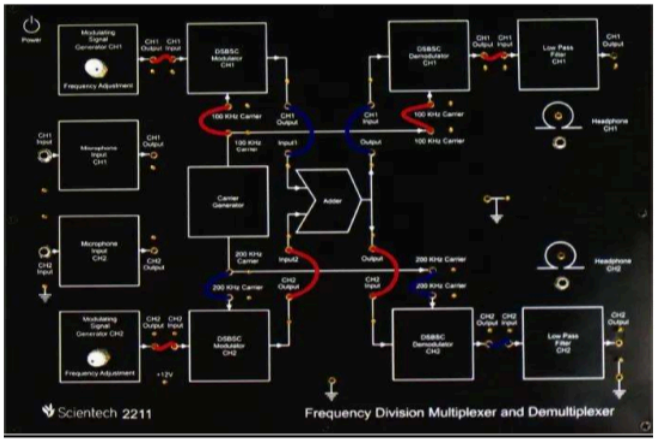

RIGOL DS1104
Pass/Fail
Out

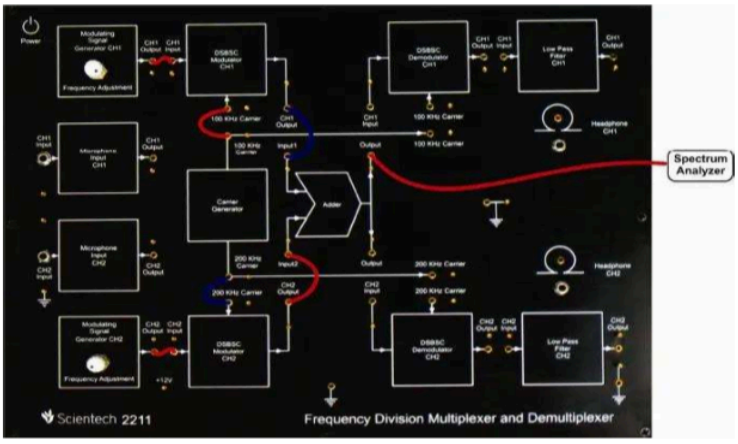

RIGOL

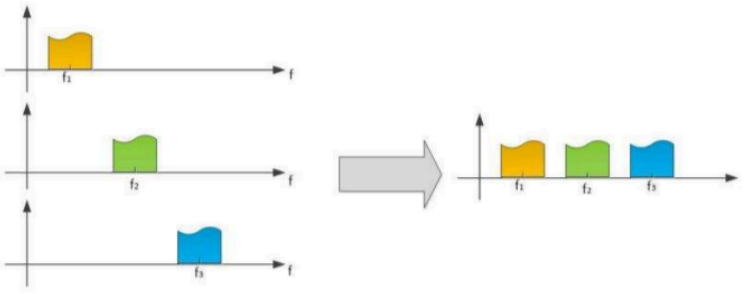
```
clc;
clear;
close all;
% Parameters
Fs = 10000;                % Sampling frequency
t = 0:1/Fs:1;              % Time vector (1 second
   duration)
% Message signals
m1 = cos(2*pi*50*t);       % Message 1: 50 Hz
m2 = cos(2*pi*100*t);      % Message 2: 100 Hz
m3 = cos(2*pi*150*t);      % Message 3: 150 Hz
% Carrier frequencies for FDM
f1 = 1000;
f2 = 2000;
f3 = 3000;
% Modulation (DSB-SC for simplicity)
s1 = m1 .* cos(2*pi*f1*t);  % Modulated signal 1
s2 = m2 .* cos(2*pi*f2*t);  % Modulated signal 2
s3 = m3 .* cos(2*pi*f3*t);  % Modulated signal 3
% Combine signals (FDM)
fdm_signal = s1 + s2 + s3;
% Plot frequency spectrum
N = length(fdm_signal);
f = linspace(-Fs/2, Fs/2, N);
FDM_freq = abs(fftshift(fft(fdm_signal, N)));
figure;
plot(f, FDM_freq);
xlabel('Frequency (Hz)');
ylabel('Magnitude');
title('Frequency Spectrum of FDM Signal');
%% Demodulation of individual signals
% Coherent demodulation
r1 = fdm_signal .* (2*cos(2*pi*f1*t));  % Multiply
   with carrier
r1_filtered = lowpass(r1, 200, Fs);     % Low-pass
   filter
r2 = fdm_signal .* (2*cos(2*pi*f2*t));
r2_filtered = lowpass(r2, 200, Fs);
r3 = fdm_signal .* (2*cos(2*pi*f3*t));
r3_filtered = lowpass(r3, 200, Fs);
% Plot demodulated signals
figure;
subplot(3,1,1);
plot(t, r1_filtered);
title('Recovered Message 1');
xlim([0 0.1]);
subplot(3,1,2);
plot(t, r2_filtered);
title('Recovered Message 2');
xlim([0 0.1]);
subplot(3,1,3);
plot(t, r3_filtered);
title('Recovered Message 3');
xlim([0 0.1]);
```

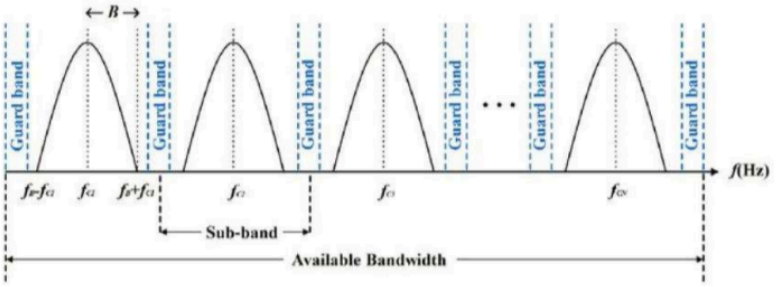


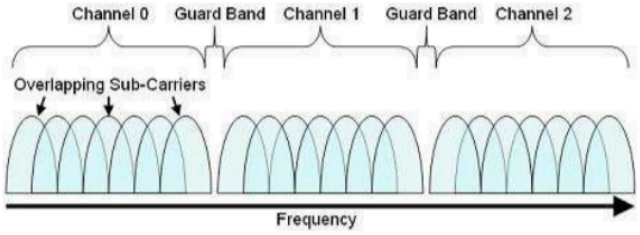


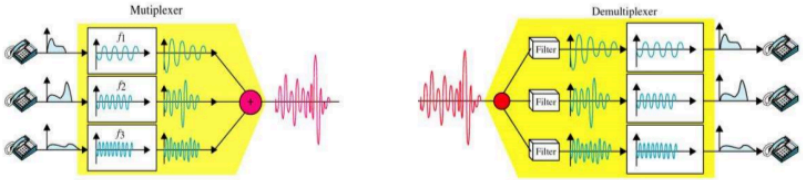

Scientech 2211
Frequency Division Multiplexer and Demultiplexer

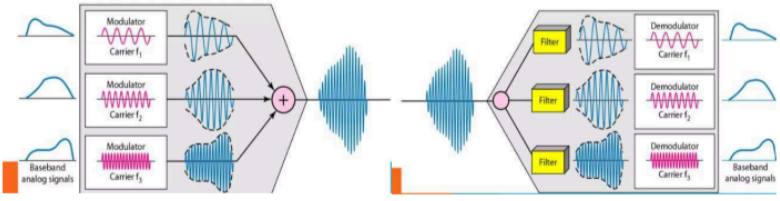

Spectrum Analyzer
Scientech 2211
Frequency Division Multiplexer and Demultiplexer


f1
f2
f3
f


← B →
Guard band
f(Hz)
Sub-band
Available Bandwidth


Channel 0
Guard Band
Channel 1
Guard Band
Channel 2
Overlapping Sub-Carriers
Frequency


Mutiplexer
Demultiplexer
Filter


Modulator
Demodulator
Filter
Baseband analog signals