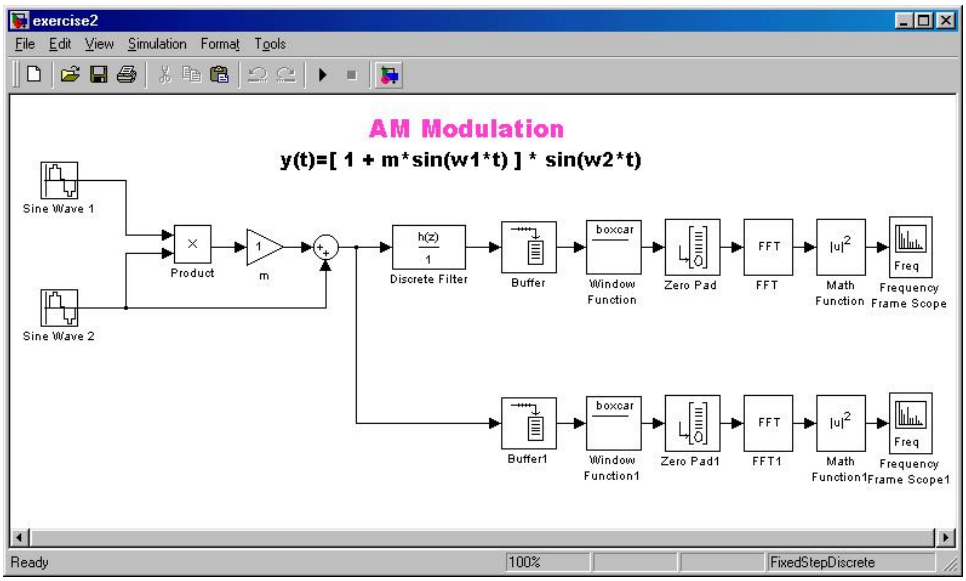
Matlab/Simulink Exercise: Design of FIR Filter

The simulink diagram below illustrates the implementation of a conventional AM modulator, whereby the representation of the AM modulated signal is given by

$$y(t) = [1 + m\sin(\omega_1 t)]\sin(\omega_2 t)$$

It is further assumed that:

Modulation index:	$m = 1$,
Information bearing signal:	$\omega_1 = 2\pi 10^3$ rad/s,
Carrier angular frequency:	$\omega_2 = 2\pi 10^4$ rad/s,
Sampling Frequency:	$f_s = 40$ kHz.



1. Determine and plot the spectrum of the modulated signal.

2. Change the modulation index from 1 to 0.5 and explain how it affects the spectrum derived in part 1.

3. Design and apply an FIR bandpass filter around the upper sideband with the following specifications:
Passband: 10800-11200
Stopband: 10200-12800
Passband Ripple: R_p = 0.1 dB Stopband attenuation: R_s = 50 dB
Sampling frequency: f_s = 40 kHz

4. Design a highpass FIR filter that could be used to eliminate both the lower sideband and the carrier and thus achieve a similar result.

5. Design and apply an FIR bandpass filter around the lower sideband with the following specifications:
Passband: 8800-9200
Stopband: 8200-9800
Passband Ripple: Rp = 0.1dB
Stopband attenuation: Rs = 50 dB
Sampling frequency: fs = 40kHz

6. Design a lowpass FIR filter that could be employed to suppress both the upper sideband and the carrier and thus achieve a similar result.