Experiment 03: FM - Answer Book

• **Name:**	**Lab Date:**
• **Student No.:**	**Day of the week:** **Time:**
• **Name:**	**TA Signature:**
• **Student No.:**	**Grade:**

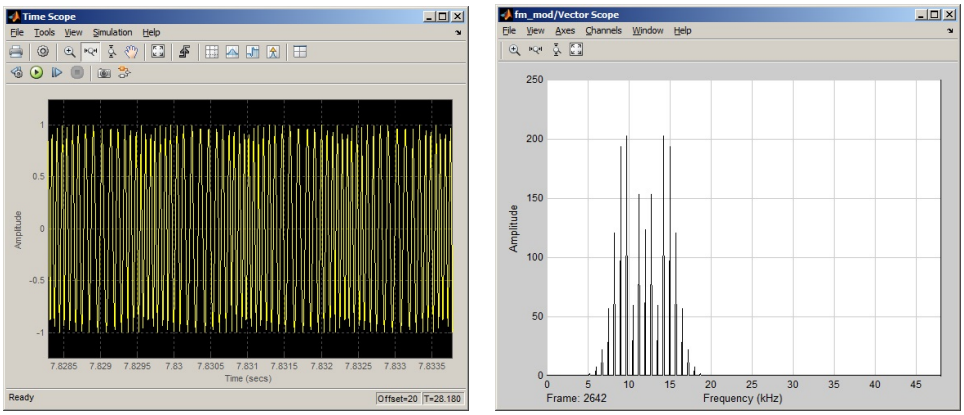
2. Experiment

2.1 Designing and Simulating an FM Modulator

- *Rewrite your FM equation to make a* `Simulink` *model doable.* **(0.5)**

- *Draw the new block diagram for the FM modulator.* **(0.5)**

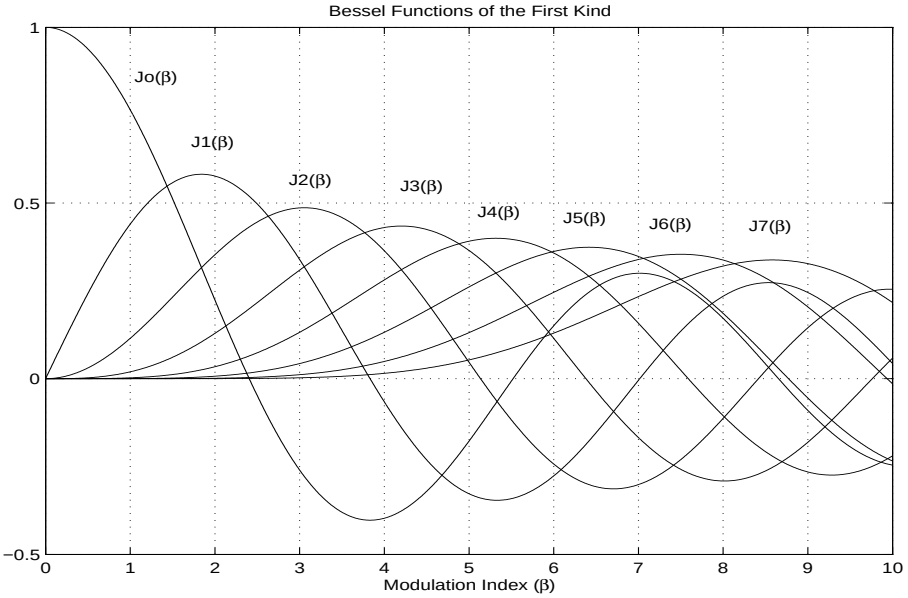
- *The output signal observed in the time and frequency domains should look similar to the pictures below. Identify the carrier component on the frequency domain picture below* **(0.5)**.



(a) Time Domain Display (b) Frequency Domain Display

Figure 1. Simulated Time Domain and Frequency Domain Display for FM

For the next questions, use the graph presented below, when necessary.

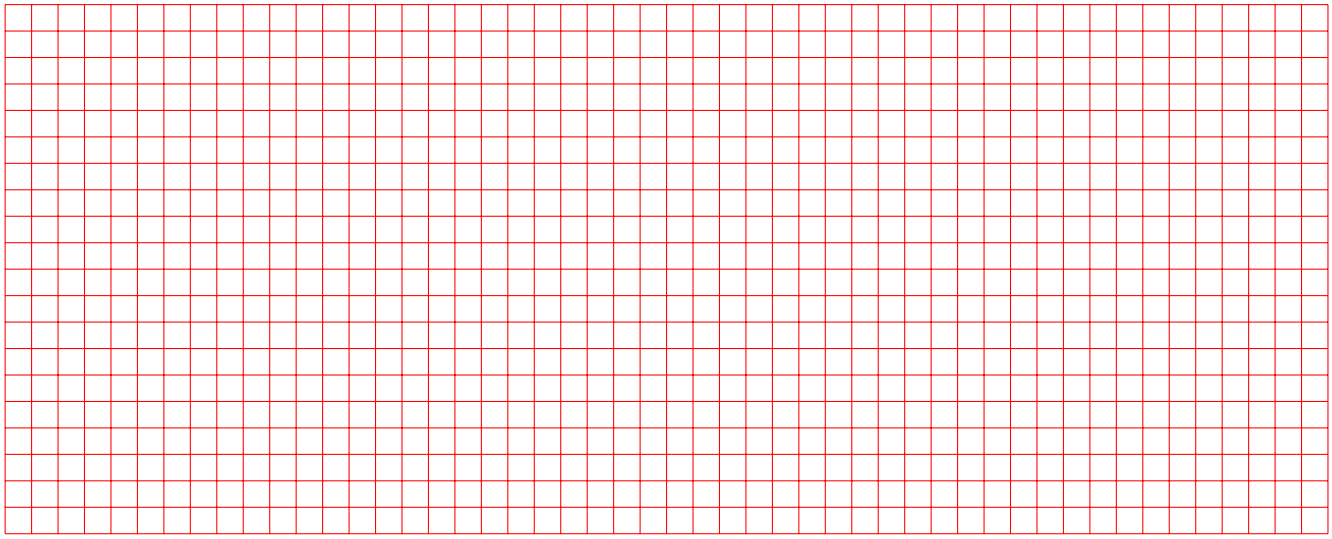


- *Report the frequency values for the carrier and two frequency components on each side of the carrier, as well as the $J_n(\beta)$ associated with those frequency components.* **(1.0)**

- *Deviation ratio calculation.* **(1.0)**

- *Bandwidth following Carson's Rule.* **(1.0)**

- *Change the amplitude of the message signal to 0.8 (that is 1.6Vpp). Draw what you observe in the frequency domain. For crying outloud, what happened to your carrier? Explain.* **(1.0)**



- *Your input signal is a 1 V_p sinusoid. Is there any other input signal frequency for which there will* **not** *be a carrier component in the frequency domain? Present some values for those frequencies (use the Bessel Function graph given and test them using the simulation).* **(1.0)**

- *If you set your β to be $<<1$, what will be the bandwidth? How about for $\beta >> 1$?* **(0.5)**

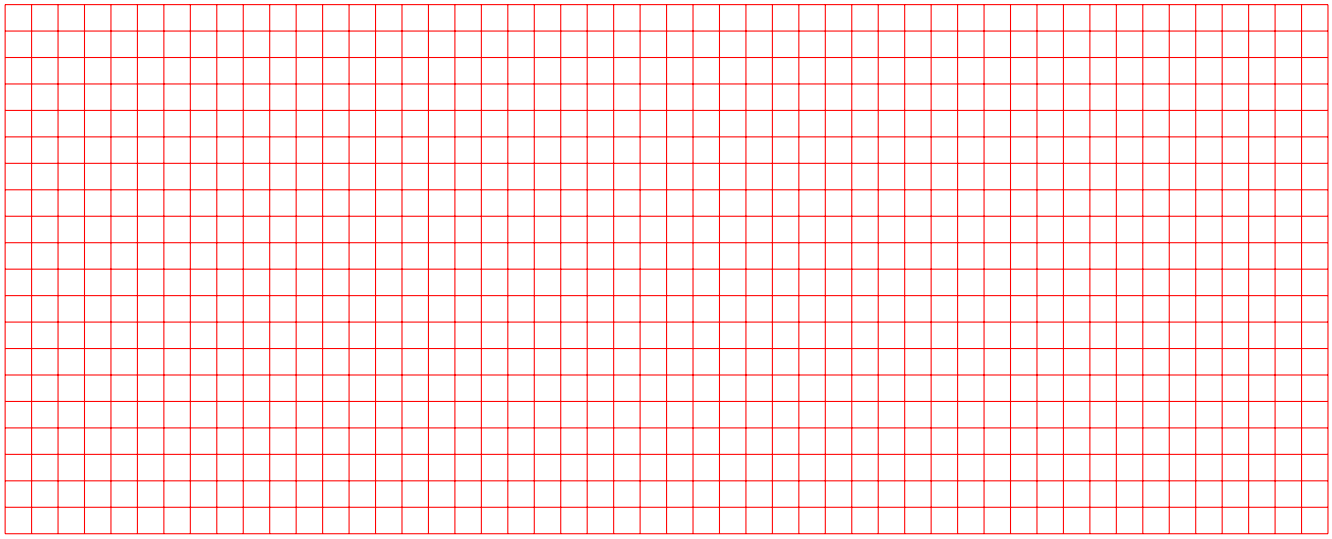
2.2 Designing and Simulating an FM Demodulator

- *Make it work as described in the outline document, and show the T.A.. Make sure the sinusoid you see on the output of the demodulator has the same frequency as the one input to the modulator. Vary the frequency of the message signal up and down by about 1KHz. Does it still work? Explain why to the TA and have the TA sign the box.* **(0.5)**

2.3 Running and Testing Your Modulator and Demodulator

2.3.1 FM Modulator

- *On one channel you have the message signal and on the other channel you have the FM signal. Set your oscilloscope to perform an FFT on the FM-modulated signal. Input a $2V_{pp}$, 1.2KHz sine wave. Use the cursors on the scope to identify the components. Draw below the spectrum of your FM signal. Label the components and verify if they match those you found during the simulation.* **(1.0)**



2.3.2 FM Demodulator

- *Can you demodulate the signal? If you can, have the TA sign the box.* **(0.5)**

3. Two Steps Further

- *Following the directions given in the outline, make your full system work for a sinusoidal message and for music. Earn bragging rights. Now show the TA what you have done and have the TA sign the box below.*