6 Assignment 5 — Continuous-Time Fourier Transform

Before starting work on this assignment, it is **critically important** that the student carefully read Section 1 (titled "General Information"), which starts on page 1 of this document.

6.1 Part A

Regular Problems

◇ 6.1 c d **[find Fourier transform by first principles]**
◇ 6.3 c d e f g **[find Fourier transform]**
◇ 6.4 a b c d e f **[find Fourier transform]**
◇ 6.5 a **[find Fourier transform of periodic signal]**
◇ 6.10 a **[find frequency/magnitude/phase spectrum]**

MATLAB Problems

This part of the assignment has no MATLAB problems.

6.2 Part B

Regular Problems

◇ 6.14 b **[differential equation to frequency response]**
◇ 6.15 b **[frequency response to differential equation]**
◇ 6.16 a **[filtering]**
◇ 6.17 a b c d **[circuit analysis, frequency response, impulse response]**
◇ 6.24 a b **[amplitude modulation]**
◇ 6.26 a b c **[sampling]**
◇ 6.27 a b **[sampling]**

MATLAB Problems

◇ 6.201 a b c **[calculate frequency response]**
◇ 6.203 a b c d **[filters]** [**Hint:** The MATLAB appendix (i.e., Appendix D) in the textbook has some examples of how to use the `butter` and `besself` functions. Refer to the section titled "Signal Processing" and its associated subsections for more information. In particular, the specific pages of relevance can be found by looking up the terms "Butterworth filter" and "Bessel filter" in the textbook index. To compute the frequency response from the coefficient vectors obtained from the `butter` and `besself` functions, you can use the `freqw` function developed in Problem 6.101. Alternatively, the `freqs` function can be used to calculate the frequency responses of the filters from the coefficient vectors returned by the `butter` and `besself` functions.]
◇ Problem M.1:
Background: The sampling theorem states that a (bandlimited) continuous-time signal can be uniquely/unambiguously represented by its samples. Therefore, all of the operations that we can apply to a continuous-time signal can be converted into equivalent operations on their samples. When processing signals inside of a computer, this is always how things are done. That is, we operate on the samples of a continuous-time signal instead of the original continuous-time signal directly. In this problem, you will experiment with some code that processes continuous-time signals by performing equivalent operations on their samples.
Comment on Negative Frequencies: In this problem (and the associated MATLAB code), when dealing with frequency spectra, we only concern ourselves with nonnegative frequencies since real-valued signals always have even/odd symmetry in their magnitude/phase spectra, making the half of the spectra for negative frequencies redundant.
Problem: Download the `audioDemo.zip` Zip archive from the "Assignments" section of the course web-site home page. This archive contains several MATLAB source files. Extract the contents of the Zip file using the unzip