Assignments
(Version: 2026-09-21)

1 General Information

With the possible exception of Assignment 1 (which is mostly review material), each of the assignments in the course will take a **significant amount of time to complete**. Therefore, students are **very strongly advised** to start working on each assignment **well in advance** of the submission deadline. To assist students in being able to start working on each problem as soon as possible, the general topic covered by each problem is indicated in square brackets after the problem number. In this way, a student can more easily determine whether they should be able to solve a problem based on the material covered in the lectures so far. Some assignments are partitioned into multiple parts (e.g., parts A and B). For such assignments, the submission deadlines for different parts may be different.

1.1 Submission Deadlines

The submission deadlines for assignments will be posted on the course website and/or the Brightspace site.

1.2 Policy on Late/Incomplete Assignments

Late assignments will not be accepted and will receive a mark of zero. Incomplete assignments will be accepted, however. So, it is much better to submit an incomplete assignment on time than a complete assignment that is late.

1.3 Assignment Submissions

Every assignment submission **must adhere to the following guidelines**:

1. The following information **must be included on the first page** of each assignment submission:
   (a) the student's full name (with the family name written either **last or in all-capital letters** in order to distinguish it from the given names);
   (b) the student ID; and
   (c) the student's **lecture section** (e.g., A01, A02, etc.).
2. The order of answers in an assignment submission **must match the order in which the questions are listed in this handout**. If this order requirement is not followed, a grading penalty may be applied (which may be significant, depending on the degree of deviation from the required order).
3. Unless explicitly indicated otherwise, for each of the MATLAB problems in the assignments, the student must include the following in their assignment submission:
   (a) a source listing of any code written; and
   (b) a copy of any output/results produced by MATLAB, such as graphs or numerical results.

1.4 Assignment Problems

For the most part, the problems that constitute each assignment are simply identified by number (e.g., A.1, 2.1, etc.). Problems identified only by number can be found in the textbook. More specifically, problem *x.y* can be found in the textbook at the end of chapter/appendix *x* (typically in a section titled "Exercises"). For example, problem A.1 on this handout would correspond to exercise A.1 in the exercises section at the end of Appendix A in the textbook.

1.5 Additional Remarks Concerning MATLAB

Students who are less familiar with MATLAB are **strongly encouraged** to read the MATLAB appendix (i.e., Appendix D) of the textbook before attempting any of the MATLAB problems in this course, as this will very likely save such students a considerable amount of time in the long run.

2 Assignment 1 — Complex Analysis (Mostly Review)

Before starting work on this assignment, it is **critically important** that the student carefully read all of Section 1, and especially Section 1.3. **Answers must be presented in the order the questions are listed below.**

Regular Problems

The following is **review** material:

- ◇ A.1 c **`[convert to Cartesian form]`**
- ◇ A.2 b d **`[convert to polar form, principal argument]`**
- ◇ A.3 a b f g **`[complex arithmetic]`**
- ◇ A.4 b e **`[properties of complex numbers]`**
- ◇ A.5 c f **`[magnitude/argument]`**
- ◇ A.6 b **`[Euler's relation]`**

The following is intended to be **new** (i.e., non-review) material:

- ◇ A.11 c d **`[analyticity]`**
- ◇ A.13 b c **`[poles/zeros]`**

MATLAB Problems

- ◇ D.1 a b c d e **`[MATLAB identifiers]`**
- ◇ D.2 a b c d **`[MATLAB expressions]`**

3 Assignment 2 — Signals and Systems

Before starting work on this assignment, it is **critically important** that the student carefully read all of Section 1, and especially Section 1.3. **Answers must be presented in the order the questions are listed below.**

3.1 Part A

Regular Problems

◇ 2.4 c e f g i j k **[notation; mappings; domain/codomain]**
◇ 8.4 e f **[period of sinusoidal sequence]**
◇ 3.6 e **[sum of periodic functions]**
◇ 8.5 a b **[sum of periodic sequences]**
◇ 3.34 d **[find sequence of CT time-transformation operators]**
◇ 8.1 b **[find sequence of DT time-transformation operators]**
◇ 3.4 b d **[apply CT time transformations]**
◇ 8.2 a g **[apply DT time transformations]**
◇ 3.2 b **[relate functions by time transformations]**
◇ 3.9 d **[even/odd symmetry]**
◇ 3.10 e **[even/odd symmetry and sums/products]**
◇ 3.17 c **[signal properties, signal transformations, even/odd decomposition]**
◇ 8.14 a **[signal properties, signal transformations]**
◇ 3.22 c **[representations using unit-step function]**
◇ 8.17 b **[representations using unit-step sequence]**
◇ 3.20 a c **[properties of delta function]**
◇ 8.16 e g **[properties of delta sequence]**

MATLAB Problems

◇ D.9 a b c **[element-wise operations, case collapsing]**
◇ 8.201 **[shift of periodic sequence]**

3.2 Part B

Regular Problems

◇ 3.24 d **[memoryless]**
◇ 8.18 a **[memoryless]**
◇ 3.25 f **[causal]**
◇ 8.19 f **[causal]**
◇ 3.26 b **[invertible]**
◇ 8.20 b **[invertible]**
◇ 3.27 a **[BIBO stable]**
◇ 8.21 f **[BIBO stable]**
◇ 3.28 b **[time invariant]**
◇ 8.22 a **[time invariant]**
◇ 3.29 b **[linear]**
◇ 8.23 b **[linear]**
◇ 3.33 a for x_1 and x_3 only **[eigenfunctions]**
◇ 8.25 b for x_1 and x_3 only **[eigensequences]**

MATLAB Problems

◇ 8.202 **[MATLAB audio loading/playback]**
◇ 8.203 b **[MATLAB audio recording]**
Submit a wav file of you speaking your first name.

4 Assignment 3 — LTI Systems

Before starting work on this assignment, it is **critically important** that the student carefully read all of Section 1, and especially Section 1.3. **Answers must be presented in the order the questions are listed below.**

4.1 Part A

Regular Problems

◇ 4.1 e **[compute convolution]**
◇ 9.1 a **[compute convolution (graphical/tabular approach)]**
◇ 4.3 f **[compute convolution]**
◇ 9.3 b **[compute convolution (tabular approach)]**
◇ 4.5 **[manipulation of expressions involving convolution]**
◇ 4.9 **[meaning of LTI]**

MATLAB Problems

◇ 9.203 a b **[convolution]**

4.2 Part B

Regular Problems

◇ 4.11 a b **[find impulse response]**
◇ 9.12 c **[find impulse response]**
◇ 4.12 a b **[impulse response and series/parallel interconnection]**
◇ 4.13 b **[convolution, impulse response, system interconnection]**
◇ 9.14 c **[convolution, impulse response, system interconnection]**
◇ 4.14 a g **[causality, memory]**
◇ 9.15 f **[causality, memory]**
◇ 4.15 g **[BIBO stability]**
◇ 9.17 f **[BIBO stability]**
◇ 4.16 a **[inverse system]**
◇ 9.16 b **[inverse system]**
◇ 4.17 a **[system function, eigenfunctions]**
◇ 9.20 a **[system function, eigensequences]**

MATLAB Problems

◇ 9.201 a b **[LTI system analysis]**
◇ 9.202 a b.i b.ii **[convolution reverb]**
Submit a wav file for the output for part b.ii.

5 Assignment 4 — Fourier Series

Before starting work on this assignment, it is **critically important** that the student carefully read all of Section 1, and especially Section 1.3. **Answers must be presented in the order the questions are listed below.**

Regular Problems

- ◇ 5.1 a **[find CTFS]**
- ◇ 5.2 d **[find CTFS]**
- ◇ 5.3 a **[find CTFS]**
- ◇ 10.1 c d **[find DTFS]**
- ◇ 5.9 **[find/plot CT frequency spectrum]**
- ◇ 10.8 a **[find/plot DT frequency spectrum]**
- ◇ 10.11 b c **[DTFS-DFT relationship]**

MATLAB Problems

- ◇ 10.204 a b c **[DTFS computation;** dtfs_1**/**dtfs_2**]**
- ◇ 10.206 a b c **[signal compression]**

6 Assignment 5 — Fourier Transform

Before starting work on this assignment, it is **critically important** that the student carefully read all of Section 1, and especially Section 1.3. **Answers must be presented in the order the questions are listed below.**

6.1 Part A

Regular Problems

- ◇ 6.1 d **[find CTFT from definition]**
- ◇ 11.1 d **[find DTFT from definition]**
- ◇ 6.3 e g **[find CTFT via tables]**
- ◇ 6.4 c g **[find CTFT via tables]**
- ◇ 11.2 f i **[find DTFT via tables]**
- ◇ 11.4 b **[find DTFT via tables]**
- ◇ 6.5 a **[find CTFT of periodic function]**
- ◇ 11.8 a **[find DTFT of periodic sequence]**
- ◇ 6.10 a **[find frequency/magnitude/phase spectrum of function]**
  Note: Use MATLAB to plot the magnitude and phase spectra.
- ◇ 11.15 a **[find frequency/magnitude/phase spectrum of sequence]**
  Note: Use MATLAB to plot the magnitude and phase spectra.

MATLAB Problems

- ◇ 6.204 c d **[CT Fourier transform]**
- ◇ 11.201 a b **[computing DTFT via DFT;** `sample_dtft`**]**

6.2 Part B

Regular Problems

- ◇ 6.14 b **[differential equation to frequency response]**
- ◇ 11.16 d **[difference equation to frequency response]**
- ◇ 6.15 b **[frequency response to differential equation]**
- ◇ 11.17 d **[frequency response to difference equation]**
- ◇ 6.16 a **[filtering]**
- ◇ 6.24 a **[amplitude modulation]**
- ◇ 11.21 **[DT system frequency response]**
- ◇ 6.26 a b c **[sampling]**
- ◇ 6.27 a b **[sampling]**

MATLAB Problems

- ◇ 6.203 a b c d **[CT 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. 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.]
- ◇ 11.203 b c **[DT DSB-SC AM receiver]**
- ◇ 11.204 a b **[DT powerline noise removal]**
  Submit the wav file for the denoised signal.
- ◇ 11.205 a b c **[finding impulse response for convolution reverb]**

7 Assignment 6 — Laplace and Z Transforms

Before starting work on this assignment, it is **critically important** that the student carefully read all of Section 1, and especially Section 1.3. **Answers must be presented in the order the questions are listed below.**

7.1 Part A

Regular Problems

◇ 7.29 a `[find ULT using definition]`
◇ 7.30 c f `[find ULT using tables]`
◇ 7.32 a `[find ULT using tables (piecewise)]`
◇ 12.16 b `[find UZT using definition]`
◇ 12.17 b e `[find UZT using tables]`
◇ 7.31 b `[find inverse ULT]`
◇ 12.18 d `[find inverse UZT]`

MATLAB Problems

◇ 7.203 b `[find ULT]`
◇ 7.204 b `[find inverse ULT]`
◇ 12.201 b `[find UZT]`
◇ 12.202 b `[find inverse UZT]`

7.2 Part B

Regular Problems

◇ 7.14 a `[differential equation to system function]`
◇ 7.13 a `[system function to differential equation]`
◇ 12.8 a `[difference equation to system function]`
◇ 12.9 a `[system function to difference equation]`
◇ 7.16 a `[CT system stability analysis]`
◇ 12.19 b `[DT system stability analysis]`

MATLAB Problems

◇ 12.203 c d `[DT stability analysis]`
◇ 7.205 `[CT HVAC system analysis]`

