CMPE-480 Digital Signal Processing

Fall 2024 Semester (2241)

Lectures: M/W/F 1:00 PM – 1:50 PM @ LBR-A201

Prerequisites: MATH-231; MATH-241; and EEEE-282 or equivalent courses

(Note: some experience or knowledge of Matlab is expected)

Instructor: Dr. Alexander Loui Office: GLE-3419

Email: acleec@rit.edu Phone: 475-5799

Office hours (tentative): Tuesday 10:30-11:30am (Online: https://rit.zoom.us/j/99608493579?from=addon) and Friday 2:00-3:00pm (Office)

Graders/TAs: John Evans (jbe5115@rit.edu), Eric Falcone (eff6185@rit.edu), and Aniket Sonika (as7434@rit.edu)

Course Description

This course introduces the basic elements of continuous and discrete time signals and systems and fundamental signal processing techniques, such as FIR and IIR Filtering, the Fourier Transform, the Discrete Fourier Transform and the z-Transform. Theory is strengthened through MATLAB-based projects and exercises.

Course Learning Objective

Students will learn and acquire knowledge of the following fundamental topics:

- Spectrum of periodic signals and Fourier Series (FS) representation.
- Spectrum of aperiodic signals and Fourier Transforms (FT).
- Sampling, aliasing, and reconstruction.
- Linear Time-Invariant (LTI) systems and convolution.
- Frequency response of LTI systems and filtering.
- Discrete-time filters and DTFT.
- Computation of the spectrum: DFT and FFT.
- Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters.
- Z-transforms, properties, and applications.
- Matlab toolkits for digital signal processing.

Course Learning Outcomes

- Comprehension
  - Develop a fundamental understanding of complex exponentials as building blocks for signals.
  - Understand the fundamental Time-Frequency properties of signals.
  - Understand the importance of Linear Time Invariance and its relation to filtering.
  - Understand the processes of sampling and reconstruction.
- Applications
  - Apply Fourier transform techniques to obtain the spectrum of different signals and filtering.
  - Apply Fourier analysis technique to calculate the response of linear systems to different inputs.
  - Analyze simple signal processing systems involving sampling, reconstruction and digital filters.
  - Analyze and design simple digital signal processing systems using Matlab.

Textbook

- J. H. McClellan, R. W. Schafer, and M. A. Yoder, "DSP First," 2nd Edition, Prentice Hall 2003 (ISBN 0130909998). An introduction to signal processing with emphasis on spectral analysis.

References

- **Software, examples, etc.:** DSP First Website, http://spfirst.gatech.edu with supplementary examples, demos, etc.
- **Matlab:** https://www.mathworks.com/help/matlab/index.html
- **Books:**
  - A.V. Oppenheim and R.W. Schafer, "Discrete-Time Signal Processing," 3rd Edition, Prentice Hall, 2010 (ISBN 0131988425)
  - B.P. Lathi and R. Green, "Signal Processing & Linear Systems," 2nd Edition, Oxford University Press, 2018 (ISBN 9780190299040)
  - T. Holton, "Digital Signal Processing – Principles and Applications," Cambridge University Press, 2021 (ISBN 9781108418447)

Grading Policy

- Homework assignments (7): 24.5% (3.5% each)
- Projects (2): 30%
- Midterms (2): 30%
- Final exam: 15.5%

Grading scale:

Grading Scale
92 ≤ A ≤ 100
88 ≤ A- < 92
84 ≤ B+ < 88
78 ≤ B < 84
75 ≤ B- < 78
72 ≤ C+ < 75
68 ≤ C < 72
64 ≤ C- < 68
60 ≤ D < 64
< 60 F

Note: The instructor reserves the right to change the grading scale and policy.

No late homework, project, or make-up exams will be accepted without prior agreement with the instructor. All special arrangements need to be made with at least 24-hour advance notice to the instructor. All late submissions are subject to 25% delay penalty and will not be accepted after the solution posted or graded HW distributed.

Homework submission: all homework submissions should be uploaded to the corresponding drop box in myCourses. The submission should be in one single file in either PDF or Microsoft Word DOC format. If Matlab code (.m files) are part of the submission, they should be separated from the PDF or Word file.

Academic Integrity

As an institution of higher learning, RIT expects students to behave honestly and ethically at all times, especially when submitting work (including software code) for evaluation in conjunction with any course or degree requirement. The Department of Computer Engineering encourages all students to become familiar with the RIT Honor Code and with RIT's Academic Integrity Policy.

- RIT Honor Code URL: http://www.rit.edu/academicaffairs/policiesmanual/sectionA/honorcode.html
- RIT Academic Integrity Policy URL: http://www.rit.edu/~w-policy/sectionD/D8.html

In addition, Generative AI tools such as ChatGPT are NOT to be used in homework assignments and class projects.

Statement on Reasonable Accommodations

RIT is committed to providing reasonable accommodations to students with disabilities. If you would like to request accommodations such as special seating or testing modifications due to a

disability, please contact the Disability Services Office. It is located in the Student Alumni Union, Room 1150; the Web site is www.rit.edu/dso. After you receive accommodation approval, it is imperative that you see me during office hours so that we can work out whatever arrangement is necessary.

Instructional Continuity

In the event of a university-wide emergency course requirements, classes, deadlines and grading schemes are subject to changes that may include alternative delivery methods, alternative methods of interaction with the instructor, class materials, and/or classmates, a revised attendance policy, and a revised semester calendar and/or grading scheme.

- Process for Emergency Closing (weather, etc.): https://finweb.rit.edu/grms/close_university_process.html
- Emergency Preparedness: http://finweb.rit.edu/publicsafety/preparedness/