Digital Signal Processing

EE480/ECG680 Fall 2013

http://www.egr.unlv.edu/∼b1morris/

Professor:	Brendan Morris	Class:	TuTh 16:00 - 17:15, SEB 1240
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Textbook

Discrete-Time Signal Processing, A. Oppenheim and R. Schafer, 3rd Edition

Recommended Text

Schaum's Outlines: Digital Signal Processing, M.H. Hayes

Grading

Midterms	55%	02/21, 04/18
Final:	30%	05/16 18:00
Homework:	15%	Weekly

Homework will include Matlab programming problems. Students may study together in groups but all assignments must be completed individually. Homework will be due in class on the designated date. No late homeworks will be accepted unless prior notification and arrangements are made.

Catalog Description

Review of discrete linear system theory including the z-transform, the Fourier transform, discrete and fast Fourier transform. Sampling, reconstruction and multirate systems, IIR and FIR digital filter design including digital filter structures and finite word length effects.

Prerequisites: EE361

Topics

- Discrete-time signals and systems
  - Linear time-invariant (LTI) systems and properties
  - Difference equation description of LTI systems
  - Discrete-time Fourier transform
- Z-transform
  - Properties of z-transform
  - Properties of the region of convergence (ROC)
  - Inverse z-transform methods of inspection, partial fractions, and power series
- Sampling of continuous-time signals
  - Periodic sampling and reconstruction
  - Multirate systems
- Transform analysis of LTI systems

  - Frequency response and group delay
  - All-pass, minimum phase, and generalized linear phase systems
- Structures for discrete-time systems
  - Block and signal flow graph representation
  - Basic structures for IIR and FIR systems
    - Direct forms, cascade form, parallel form
- Filter design techniques
  - IIR filter design from continuous-time filters
  - FIR filter design by windowing
- Discrete and fast Fourier transforms

Additional course material not present in the textbook will be distributed to the class when needed.

Course Objectives and Outcomes
Upon completion of this course, students will be able to:

- Represent and analyze a discrete-time system (1.1, 1.2, 1.6, 1.9, 1.10)
  - Model an LTI system by linear difference equations
  - Determine the discrete-time Fourier transform of signal and system
  - Determine the z-transform of a signal and system
- Use the sampling techniques to study LTI systems (1.1, 1.2, 1.4, 1.6, 1.7,1.8,1.9, 1.10, 1.11)
  - Determine the sampling constraints necessary for signal reconstruction without aliasing.
  - Use up- and down-sampling of signals in multirate systems to improve signal processing.
- Represent IIR and FIR structures for discrete-time systems (1.1, 1.2, 1.6, 1.7, 1.8,1.9, 1.10, 1.11)
- Design IIR and FIR digital filters (1.1, 1.2, 1.4, 1.6, 1.7,1.8, 1.10, 1.11)
  - Transform continuous-time filters into discrete-time IIR filters
  - Use windowing techniques for FIR filtering.
- Represent a finite length sequence by its discrete Fourier transform and compute the fast Fourier transform (1.1, 1.2, 1.4, 1.6, 1.9, 1.10, 1.11)

Course Policies

- There will be no make-up exams or late homework without prior arrangements.
- Extensions will only be granted for medical emergencies or due to the observance of a religious holiday. The instructor must be notified of the absence prior to the last day of late registration.
- As a university student it is your responsibility to conduct yourself ethically and with integrity as described in the Academic Misconduct Policy. Cheating and plagiarism will not be tolerated. Any student caught cheating will be given an F grade.
  (http://studentconduct.unlv.edu/misconduct/policy.html)

University Policies

Academic Misconduct – Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of the Academic Misconduct Policy and are encouraged when faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLVs function as an educational institution.

An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the *Student Academic Misconduct Policy* (approved December 9, 2005) located at: `http://studentconduct.unlv.edu/misconduct/policy.html`.

Copyright - The University requires all members of the University Community to familiarize themselves and to follow copyright and fair use requirements. **You are individually and solely responsible for violations of copyright and fair use laws**. The university will neither protect nor defend you nor assume any responsibility for employee or student violations of fair use laws. Violations of copyright laws could subject you to federal and state civil penalties and criminal liability, as well as disciplinary action under University policies. Additional information can be found at: `http://provost.unlv.edu/copyright/statements.html`.

Disability Resource Center (DRC) - The UNLV Disability Resource Center (SSC-A 143, `http://drc.unlv.edu/`, 702-895-0866) provides resources for students with disabilities. If you feel that you have a disability, please make an appointment with a Disabilities Specialist at the DRC to discuss what options may be available to you.

If you are registered with the UNLV Disability Resource Center, bring your Academic Accommodation Plan from the DRC to me during office hours so that we may work together to develop strategies for implementing the accommodations to meet both your needs and the requirements of the course. Any information you provide is private and will be treated as such. To maintain the confidentiality of your request, please do not approach me before or after class to discuss your accommodation needs.

Religious Holidays Policy - Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor no later than the end of the first two weeks of classes, February1, 2013, of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. This policy shall not apply in the event that administering the test or examination at an alternate time would impose an undue hardship on the instructor or the university that could not reasonably been avoided. For additional information, please visit: `http://catalog.unlv.edu/content.php?catoid=4&navoid=164`.

Incomplete Grades – The grade of I - Incomplete - can be granted when a student has satisfactorily completed all course work up to the withdrawal date of that semester/session but for reason(s) beyond the students control, and acceptable to the instructor, cannot complete the last part of the course, and the instructor believes that the student can finish the course without repeating it. A student who receives an I is responsible for making up whatever work was lacking at the end of the

semester. If course requirements are not completed within the time indicated, a grade of F will be recorded and the GPA will be adjusted accordingly. Students who are fulfilling an Incomplete do not register for the course but make individual arrangements with the instructor who assigned the I grade.

Tutoring - The Academic Success Center (ASC) provides tutoring and academic assistance for all UNLV students taking UNLV courses. Students are encouraged to stop by the ASC to learn more about subjects offered, tutoring times and other academic resources. The ASC is located across from the Student Services Complex (SSC). Students may learn more about tutoring services by calling (702) 895-3177 or visiting the tutoring web site at: `http://academicsuccess.unlv.edu/tutoring/`.

UNLV Writing Center - One-on-one or small group assistance with writing is available free of charge to UNLV students at the Writing Center, located in CDC-3-301. Although walk-in consultations are sometimes available, students with appointments will receive priority assistance. Appointments may be made in person or by calling 895-3908. The students Rebel ID Card, a copy of the assignment (if possible), and two copies of any writing to be reviewed are requested for the consultation. More information can be found at: `http://writingcenter.unlv.edu/`

Rebelmail - By policy, faculty and staff should e-mail students Rebelmail accounts only. Rebelmail is UNLVs official e-mail system for students. It is one of the primary ways students receive official university communication such as information about deadlines, major campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the university. Students e-mail prefixes are listed on class rosters. The suffix is always `@unlv.nevada.edu`.

Final Examinations - The University requires that final exams given at the end of a course occur at the time and on the day specified in the final exam schedule. See the schedule at: `http://www.unlv.edu/registrar/calendars`