
Digital Signal Processing Applications

EE482/682Spring 23

<http://www.ee.unlv.edu/~b1morris/ee482>

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Textbook

Real-Time Digital Signal Processing: Fundamentals, Implementations, and Applications, 3rd Edition, Kuo, Lee, Tian ISBN: 978-1-118-41432-3

Recommended Text

Digital Image Processing, 3rd Edition, Gonzalez and Woods ISBN: 978031687288

Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools and Techniques to Build Intelligent Systems, 2e, Geron ISBN: 9781492032649

The Scientist and Engineer's Guide to Digital Signal Processing, Smith ISBN: 978-0966017632

Grading

Final:	20%	05/15 15:10
Quizzes (5):	25%	TBD
Project:	25%	Due 05/08
Homework:	30%	Bi-Weekly

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 homework will be accepted unless prior notification and arrangements are made.

The course will have a term project. You will be required to submit a project report in the form of a conference styled manuscript and make a presentation.

Catalog Description

Application of signals and systems theory. Topics may include audio and speech signal processing, image processing, multi-spectral imaging, biomedical signals, and active sensing technologies such as Radar and Lidar.

Prerequisites: EE 361

Topics

The most up-to-date information regarding the class will be available on the course website – this will include the course schedule and assignment.

<http://www.ee.unlv.edu/~b1morris/ee482>

General Topics

- Review of DSP Fundamentals
- Design and Implementation of FIR and IIR Filters
- Frequency Domain Analysis of Signals
 - Discrete Fourier Transform (DFT)
 - Fast Fourier Transform (FFT)
 - Spectral Analysis and Power Spectral Density
- Speech Signal Processing
 - Speech Coding Techniques
 - Speech Enhancement
- Audio Signal Processing
 - Audio Coding
 - Audio Equalizers
 - Audio Effects
- Digital Image Processing
 - 2D-Signals, Systems. and Representation
 - Histograms
 - Image Filtering
- Radar/Lidar Processing
 - Object Detection and Ranging
 - Kalman Tracking

Course Outcomes (Program Outcomes)[UULO]

Upon completion of this course, students will be able to:

- Design a digital filters to meet specifications (1, 2, 6) [1, 2]
- Represent a finite length sequence by its DFT and compute the FFT(1, 6) [1, 2]
- Digitally encode, decode, and enhance speech signals (1, 6) [1, 2, 3]
- Digitally encode/decode audio signals and perform processing for audio effects (1, 6) [1, 2, 3]
- Digitally represent an image and perform basic image processing (1, 6) [1, 2, 3]
- Understand Radar/Lidar signals and track objects (1, 6) [1, 2, 3]
- Design and implement an open-ended DSP application (1, 2, 5, 6) [1, 2, 3]

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>)

Electrical Engineering Program Objectives

The Program Educational Objective of the Electrical Engineering program is to create, apply, and disseminate knowledge immediately or within a few years after graduation such that the graduate:

1. can successfully practice and mature intellectually in the field of Electrical Engineering or a related field.
2. can be admitted to and successfully progress through a post graduate program in Electrical Engineering or related program

Electrical Engineering Program Goals

To achieve these objectives and goals, each graduate of the Electrical Engineering Major will attain the following outcomes before graduation:

1. Appropriate technical knowledge and skills
2. Appropriate interpersonal skills
3. The knowledge and skills to be a responsible citizen

Electrical Engineering ABET Student Outcomes

To achieve the above objectives and goals, each graduate of the Electrical Engineering Major will attain the following outcomes before graduation:

- (1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- (2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- (3) An ability to communicate effectively with a range of audiences
- (4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- (5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- (6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- (7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

University Undergraduate Learning Outcomes [UULO]

The five University Undergraduate Learning Outcomes (UULOs) define what all UNLV students should know and be able to do when they graduate. Because students engage with the UULOs in both their general education and academic majors, the UULOs help make the undergraduate experience intentional and coherent.

Full context online (<https://www.unlv.edu/provost/gen-ed/uulo>)

- [1] Intellectual Breadth and Lifelong Learning
- [2] Inquiry and Critical Thinking
- [3] Communication
- [4] Global/Multicultural Knowledge and Awareness
- [5] Citizenship and Ethics



University Policies

All instructors are required to include the academic policies listed below in the syllabi for their courses, perhaps under a section entitled University Policies. This document is posted on the [University Policies](https://www.unlv.edu/policies/additional) webpage, <https://www.unlv.edu/policies/additional>, in the Executive Vice President and Provost section, under Academic Semester Memos.

Please address questions to Kate Korgan, Senior Vice Provost for Academic Affairs, via [email](mailto:SVPA@unlv.edu) at SVPA@unlv.edu or (702) 895-5950.

Public Health Directives

Face coverings are currently optional for all faculty and students in the classroom. Students must follow all active UNLV public health directives while enrolled in this class. UNLV public health directives are found at [Health Requirements for Returning to Campus](https://www.unlv.edu/coronavirus/health-requirements), <https://www.unlv.edu/coronavirus/health-requirements>. Students who do not comply with these directives may be asked to leave the classroom. Refusal to follow the guidelines may result in further disciplinary action according to the [UNLV Student Conduct Code](https://www.unlv.edu/sites/default/files/page_files/27/StudentConduct-Code.pdf), https://www.unlv.edu/sites/default/files/page_files/27/StudentConduct-Code.pdf, including being administratively withdrawn from the course.

Academic Misconduct

Academic integrity is a legitimate concern for every member of the University community. We 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 Student Academic Misconduct Policy, and are encouraged to always take the ethical path whenever faced with choices. Students enrolling at UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's educational mission. An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another person, from the Internet or any other source without proper citation of the source(s). See the [Student Conduct Code](https://www.unlv.edu/studentconduct/student-conduct), <https://www.unlv.edu/studentconduct/student-conduct>.

Auditing a Course

Auditing a course allows a student to continue attending the lectures and/or laboratories and discussion sessions associated with the course, but the student will not earn a grade for any component of the course. Students who audit a course receive the same educational experience as students taking the course for a grade, but will be excused from exams, assessments, and other evaluative measures that serve the primary purpose of assigning a grade.

Classroom Conduct

Students have a responsibility to conduct themselves in class and in the libraries in ways that do not interfere with the rights of other students to learn, or of instructors to teach. Use of devices such as cellular phones and pagers, or other potentially disruptive activities are only permitted with the prior explicit consent of the instructor.

Students are specifically prohibited to record classes without instructor authorization, including online/remote classes (either audio only, or video and audio). The instructor may rescind permission at any time during the class. If a student does not comply with established requirements or obstructs the functioning of the class, the instructor may initiate an administrative withdrawal of the student from the course.

Since the COVID-19 pandemic forced some instruction to be delivered remotely starting in Spring 2020, numerous students have asked instructors to record their synchronous classes, so that they can access them at their

convenience. Instructors who agree to record their classes (audio only, or video and audio) should inform students in advance. Recorded lectures may not be broadly released to anyone, but made available exclusively to those students enrolled in the class during the particular academic term. Recorded lectures must be stored securely, and are subject to the Nevada System of Higher Education's Records Retention Policy, meaning that the recordings can only be deleted 120 days after the end of class (i.e., after grades are posted). Once this requirement is met, the recordings should be deleted. Class recordings are protected from disclosure, as they are deemed part of an educational record under the Family Educational Rights and Privacy Act (FERPA).

Copyright

The University requires all members of the University Community to familiarize themselves with and 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 student or employee 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 [copyright policy information](https://www.unlv.edu/provost/copyright) is available at <https://www.unlv.edu/provost/copyright>.

Disability Resource Center (DRC)

The [UNLV Disability Resource Center](https://www.unlv.edu/drc) (Campus Resource Center (CRC), across Harmon from the Lied Library, <https://www.unlv.edu/drc>, telephone 702-895-0866) provides resources for students with disabilities. Students who believe that they may need academic accommodations due to a permanent disability, temporary or permanent medical need, or academic support due to pregnancy are encouraged to contact the DRC as early as possible in the academic term. A Disabilities Specialist will discuss what options may be available to you. Students who are already registered with the DRC should request their accommodations online each semester, and make an appointment to discuss their accommodations with their instructors.

Final Examinations and Study Week

The University requires that final exams given at the end of a course occur on the date and at the time specified in the Final Exam schedule. The general schedule is typically available at the start of the semester, and the classroom locations are available approximately one month before the end of the semester. See the [Final Exam Schedule](https://www.unlv.edu/registrar/calendars), <https://www.unlv.edu/registrar/calendars>.

Identity Verification and Online Course Requirements

All UNLV students must use their Campus-issued ACE ID and password to log in to WebCampus-Canvas. UNLV students enrolled in online or hybrid courses are expected to read and adhere to the [Student Academic Misconduct Policy](https://www.unlv.edu/studentconduct/misconduct/policy), <https://www.unlv.edu/studentconduct/misconduct/policy>, which states that "acting or attempting to act as a substitute for another, or using or attempting to use a substitute, in any academic evaluation or assignment" is a form of academic misconduct. Intentionally sharing ACE login credentials with another person may be considered an attempt to use a substitute, and could result in investigation and sanctions, as outlined in the Student Academic Misconduct Policy. UNLV students enrolled in online courses are also expected to read and adhere to the [Acceptable Use of Computing and Information Technology Resources Policy](https://www.it.unlv.edu/policies/acceptable-use-computing-and-information-technology-resources-policy), <https://www.it.unlv.edu/policies/acceptable-use-computing-and-information-technology-resources-policy>, which prohibits sharing university accounts with other persons without authorization. To the greatest extent possible, all graded assignments and assessments in UNLV online courses should be hosted in WebCampus-Canvas or another UNLV-managed platform that requires ACE login credentials for access.

Incomplete Grades

The grade of "I" (Incomplete) may be granted when a student has satisfactorily completed three-fourths of course work for that semester/session, but cannot complete the last part of the course for reason(s) beyond the student's control and acceptable to the instructor, and the instructor believes that the student can finish the course without repeating it. For undergraduate courses, the incomplete work must be made up before the end of the following regular semester. Graduate students receiving "I" grades in 500-, 600-, or 700-level courses have up to one calendar

year to complete the work, at the discretion of the instructor. If course requirements are not completed within the period indicated, a grade of “F” will be recorded, and the student’s GPA will be adjusted accordingly. Students who are fulfilling an Incomplete grade do not register for the course, but make individual arrangements with the instructor who assigned the “I” grade.

Library Resources

Librarians are available to consult with students on research needs, including developing research topics, finding information, and evaluating sources. To make an appointment with a subject expert for this class, please visit the [Libraries’ Research Consultation](https://guides.library.unlv.edu/appointments/librarian) website, <https://guides.library.unlv.edu/appointments/librarian>. You can also [ask the library staff](https://ask.library.unlv.edu/) questions via chat and text message at <https://ask.library.unlv.edu/>.

Missed Classwork

Any student missing class, quizzes, examinations, or any other class or laboratory work because of observance of religious holidays will be given an opportunity during that semester to make up the missed work. The make-up opportunity will apply to the religious holiday absence only. It is the responsibility of the student to notify the instructor within the first 14 calendar days of the course for Fall and Spring courses (except for modular courses), or within the first 7 calendar days of the course for Summer and modular courses, of their intention to participate in religious holidays which do not fall on state holidays or periods of class recess. For additional information, please visit the Missed Classwork policy, under Registration Policies, on the [Academic Policies](https://catalog.unlv.edu/content.php?catoid=39&navoid=10666) webpage, <https://catalog.unlv.edu/content.php?catoid=39&navoid=10666>.

In accordance with the policy approved by the Faculty Senate regarding missed class time and assignments, students who represent UNLV in any official extracurricular activity will also have the opportunity to make up assignments, provided that the student submits official written notification to the instructor no less than one week prior to the missed class(es).

The spirit and intent of the policy for missed classwork is to offer fair and equitable assessment opportunities to all students, including those representing the University in extracurricular activities. Instructors should consider, for example, that in courses which offer a “Drop one” option for the lowest assignment, quiz, or exam, assigning the student a grade of zero for an excused absence for extracurricular activity is both contrary to the intent of the Faculty Senate’s policy, and an infringement on the student’s right to complete all work for the course.

This policy will not apply in the event that completing the assignment or administering the examination at an alternate time would impose an undue hardship on the instructor or the University that could be reasonably avoided. There should be a good faith effort by both the instructor and the student to agree to a reasonable resolution. When disagreements regarding this policy arise, decisions can be appealed to the Department Chair/School Director, College/School Dean, and/or the Faculty Senate Academic Standards Committee.

For purposes of definition, extracurricular activities may include, but are not limited to academic recruitment activities, competitive intercollegiate athletics, fine arts activities, liberal arts competitions, science and engineering competitions, and any other event or activity sanctioned by a College/School Dean, and/or by the Executive Vice President and Provost.

Rebelmail

Rebelmail is UNLV’s official email system for students and by University policy, instructors and staff should only send emails to students’ Rebelmail accounts. Rebelmail is one of the primary ways in which students receive official University communications, information about deadlines, major Campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the University. Sending emails within WebCampus-Canvas is also acceptable.

Title IX

UNLV is committed to providing an environment free of all forms of unlawful discrimination including sexual and

gender-based discrimination, harassment, and violence like sexual assault, intimate partner violence, and stalking. If you, or someone you know, has experienced or is experiencing these types of behaviors, know that you are not alone. Resources and support are available. To learn more or to report an incident, please visit the [Office of Equal Employment and Title IX website](https://www.unlv.edu/compliance) at <https://www.unlv.edu/compliance>. Please be aware that as an instructor, I am not a confidential resource, and I will need to report incidents of sexual misconduct to UNLV's Title IX Coordinator. You can also report concerns directly using the [online reporting form](https://cm.maxient.com/reportingform.php?UnivofNevadaLasVegas&layout_id=18), at https://cm.maxient.com/reportingform.php?UnivofNevadaLasVegas&layout_id=18, or [via email](mailto:titleixcoordinator@unlv.edu) at titleixcoordinator@unlv.edu or 702-895-4055. For confidential support in matters of sexual violence, relationship/family violence, or stalking, contact [the Care Center](https://www.unlv.edu/carecenter) at <https://www.unlv.edu/carecenter> or 702-895-0602.

Tutoring and Coaching

The Academic Success Center (ASC), at the Claude I. Howard Building, provides tutoring, academic success coaching, and other academic assistance for all UNLV undergraduate students. For information regarding tutoring subjects, tutoring times, and other ASC programs and services, please visit the [ASC website](https://www.unlv.edu/asc), <https://www.unlv.edu/asc>, or call 702-895-3177. The ASC is located across from the Student Services Complex (SSC). Academic success coaching is located on the second floor of SSC A, Room 254. Drop-in tutoring is located on the second floor of the Lied Library, and on the second floor of the College of Engineering building (TBE A 207).

UNLV Writing Center

One-on-one or small group assistance with writing is available free of charge to UNLV students at the [Writing Center](https://writingcenter.unlv.edu/), <https://writingcenter.unlv.edu/>, located in the Central Desert Complex, Building 3, Room 301 (CDC 3–301). Walk-in consultations are sometimes available, but students with appointments receive priority assistance. Students may make appointments in person or by calling the Center, telephone 702-895-3908. Students are requested to bring to their appointments their Rebel ID Card, a copy of the instructions for their assignment, and two copies of any writing they have completed on their assignment.

988 FREE 24/7 SUICIDE & CRISIS LIFELINE

In addition to campus resources such as the [Counseling and Psychological Services \(CAPS\)](https://www.unlv.edu/caps) website at <https://www.unlv.edu/caps>, visiting the [YOU@UNLV website](https://you.unlv.edu/) at <https://you.unlv.edu/>, and [Early Alert](https://www.unlv.edu/graduatecollege/academy/early-alert) (for graduate students, at <https://www.unlv.edu/graduatecollege/academy/early-alert>), you may now [call or text 988](https://988lifeline.org) or [chat at 988lifeline.org](https://988lifeline.org) if you or someone you know is in crisis and in need of support.

OPTIONAL BUT RECOMMENDED STATEMENTS FOR INCLUSION:

Diversity Statement

As an institution of higher learning, UNLV represents a rich diversity of human beings among its faculty, staff, and students, and is committed to cultivating a campus environment that values diversity, practices inclusion, and actively promotes equitable experiences and outcomes. Accordingly, the University supports understanding and appreciation of all members of its community, regardless of race, sex, age, color, national origin, ethnicity, creed, religion, disability, sexual orientation, gender, gender identity, marital status, pregnancy, genetic information, veteran status, or political affiliation. Please see [University Statements and Compliance](https://www.unlv.edu/about/statements-compliance), <https://www.unlv.edu/about/statements-compliance>.

A successful learning experience requires mutual respect and trust between the students and the instructor. Accordingly, the instructor asks that students be willing to listen to one another's points of view, acknowledging that there may be disagreements, keep discussion and comments on topic, and use first person, positive language when expressing their perspectives.

UNLV Land Acknowledgement

UNLV is situated on the traditional homelands of Indigenous groups, including the Nuwu or Nuwuvi, Southern

Paiute People, descendants of the Tudu, or Desert People. We honor and offer gratitude for those who have stewarded the land; for the land itself; and for the opportunity to cultivate a thriving, diverse, inclusive, and just scholarly community here today that works for a better tomorrow for all.