

MICHIGAN STATE UNIVERSITY  
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

*ECE 466: Digital Signal Processing*

Spring Semester, 2019

Course website: <https://d2l.msu.edu/d2l/home/660511>

**INSTRUCTOR & CONTACT INFORMATION** .....

J.R. Deller, Jr., Professor of Electrical & Computer Engineering

3209 Engineering Building  
353-8840  
deller@egr.msu.edu ⇒⇒⇒⇒⇒⇒⇒⇒

*Please send all email through the D2L email facility to avoid having your message buried in the queue of many others I receive each day. -jd*

**OFFICE HOURS** .....

TBD - posted on D2L calendar (in 3209 EB)  
By appointment. Discuss after class; follow up by email.

**STUDY MATERIALS** .....

Resource	Purpose
<b>Textbook:</b> J.R. Deller, Jr., <i>Discrete-Time Signal Processing with Speech Processing Motivations, Vol. 1: Deterministic Signals</i> , ©Author, 2016 – Posted on class web site	Primary reading source. Covers all topics covered in course and to appear on exams.
<b>Published Textbooks:</b> A list of some of the commonly used texts for similar courses is posted on the course D2L site	Secondary reading sources. There is, in principle, no reason to buy, or even refer to, these books. Different perspective on topics. Further examples. Independent study and review. Advanced topics. Pursuit of further applications.
<b>Class Periods</b> ⇒ “In-class” Notes	Assimilate and illustrate materials in reading sources. Answer questions on reading. “Mini-lectures” on certain difficult topics. Problem examples and discussion. Application examples and discussion.
<b>DSP software package (MATLAB)</b>	Support computer-based homework and application examples.

**Prerequisites**

The student is assumed to have a solid background in continuous-time (CT) linear signal and systems analysis, typical of courses taught in the junior year in most electrical engineering curricula. Of particular importance is the Fourier transform and series, and spectral analysis. At Michigan State University, these topics are covered in ECE 366. The student must also have basic training in the analysis of discrete-time (DT) systems including topics such as discrete convolution and discrete system properties — linearity, time invariance, causality and stability. At MSU, these topics are also covered in ECE 366. Finally, background in the theory and use of the Laplace transform is also necessary in this course. This material is covered in ECE 313 at MSU.

**Course Content and Use of Study Materials**

- What is covered in the course?

The temporal schedule of coverage of the material, along with correlative reading in the Deller text appears in the *Topic & Reading Schedule* attached to this syllabus. For the sections covered in the text, the corresponding *Table of Contents* (TOC) can be used as an outline of topics to be covered in the course.

- What is D2L?

D2L is interactive course management software used by MSU for the AY 2019. If you do not know what D2L is, that is OK. We will discuss it on the first day of class.

Almost all materials, announcements, assignments, due dates, and other course information will be posted on the course D2L site for download.

**\*** ↔↔↔↔ Please make it a habit to check the D2L CALENDAR regularly as all scheduling (due dates, exam times, special office hours, etc.) will be posted on the calendar. When materials are posted, these will be noted on the calendar as well. The D2L CALENDAR information supersedes any schedule information given in this syllabus.

**\*** ↔↔↔↔ Please send all email through the D2L email facility to avoid having your message buried in the queue of many others I receive each day.

- How is the course structured and what should be the focus of my studies?

There are two primary sources of “delivered” information in this class. The first is the “textbook” posted on the class web site. The second source is the discussion and other proceedings in the two weekly class meetings. To a large extent, the *assigned readings in the “textbook”* represent the (expanded) texts of “lectures” that would be delivered in class under the more traditional academic system.

The second source of “delivered” information is the content of the class time. This time will be used to (1) assimilate and illustrate materials in reading, (2) answer questions on the reading, (3) present “mini-lectures” on certain difficult topics, (4) to work problem examples, and (5) to present application examples. You’ll probably want to have a notebook to take informal notes on all of the above. (A pen or pencil will also be useful for this purpose.)

Material in text that you are specifically asked to read will be emphasized on examinations. If it’s not in the text material, and you haven’t been specifically asked to study a textbook topic “on your own,” then it won’t be “on the test.” The class experience will assimilate the reading material, develop related problems skills, and help pare down the content to salient topics.

This course will use speech processing as a motivating application for the learning of general (one-dimensional) SP. Speech processing provides an interesting and very important current application of the theories and techniques of SP, and considerable expertise in the speech field exists in the ECE Department at MSU. In previous semesters, students have appreciated having the application integrated

into the material to illustrate the use of the theory. Being able to talk with job recruiters about this “hot” area has also been cited as a benefit of this approach.

ECE 466 is *not* a course in speech processing *per se*. (If you want to formally study modern speech processing, consider enrolling in ECE 966A.) However, it will be necessary to cover some material about the speech application area that might not appear in a “conventional” SP course. To do so, we need to deviate a bit from the “classical” syllabus of topics for a SP course. Historically, “filter design” was the ultimate goal and application area of such a course. Although we will briefly examine this classical design area, most related SP tasks are accomplished using widely-available software packages, so we will shorten this area of study considerably to make room for the more modern application.

## Course Requirements (Graded Stuff)

### ❶ Homework Quizzes

- Assignments and problems posted on D2L roughly bi-weekly. Six sets planned. Typical routine will be the following, but *watch the D2L calendar for the specific schedule*:
  - Tuesday of week  $k$  – HW  $n$  posted
  - Tuesday of week  $k + 1$  – Solutions to HW  $n$  posted
  - Thursday of week  $k + 1$  – Short quiz on HW  $n$  on a concept taken directly from the assignment
- Given the semester schedule, it is likely that only five quizzes will be given. Your four best quiz scores will be used in computing your final grade. Each quiz is worth 10 points. You may miss one quiz without penalty.

### ❷ Special Homework to be Submitted

In addition to the written problem assignments which will not be submitted but quizzed [item ❶], two small computer assignments will require the use of MATLAB to explore a signal-processing topic. These assignments will be submitted and graded with possible scores of 15 points each. Details will be discussed in class and posted on D2L.

### ❸ Sitcoins

Beginning Thursday January 10, each time you attend a scheduled class (except exam periods), you are awarded 1 sitcoin. This sitcoin will be yours to cherish and to help your final grade as long as you do not play with your smart phone during class (see next paragraph). All sitcoins accumulated during the semester will be converted to points and recorded as bonus points to be used in figuring your final grade. You may miss three classes and simply not collect sitcoins for those days. However, the  $m^{\text{th}}$  class you miss, where  $m = 4, 5, 6, \dots$ , will cost  $(2)^{m-3}$  sitcoins to be deducted from your account. When your balance reaches 0, it will be closed.

***Smart-phone play time.*** Roughly midway through each class we will have a 3-5 minute “Smart-phone play time” so that people who are compelled to check their screens may do so. Those without such needs may wish to take a short walk, use the restroom, or get a cup of coffee. Those with multitasking abilities may do some subset of these activities. ***The appearance of a smart-phone at any other time during the class will cost 1 sitcoin (each incidence).***

### ❹ Examinations

The two Midterm Exams and Final Exam are each worth 150 points. Dates are shown on the course schedule to follow, and will also be posted on the D2L calendar. Example problems from previous ECE 466 exams will be made available.

## ⑥ COURSE GRADE SUMMARY

Course grades based on a curve of total points as follows:

3 exams	150 points each	450
Homework (quizzes)	Best 4 scaled to 50 points	50
2 computer homework assignments	15 points each	30
<b>TOTAL possible points</b>	<b>530</b>	<b>530</b>
Sitcoins	Approx. 25 points possible	+25

### Other Course Information

- Makeup exams

A student may take the makeup exam only if a legitimate case of illness or personal emergency arises which is documented by a physician or other appropriate official. A student who finds it necessary to miss a midterm should contact the professor *before* the exam to explain the circumstances if at all possible. No makeup quizzes will be given.

- Withdrawing from the course

- The last day to drop a class with a tuition refund is Fri., 02/01/2019
- The last day to drop a class without a grade reported is Wed., 02/27/2019 (8:00 p.m.)

- Academic conduct

MSU has well-documented policies concerning the rights and responsibilities of both students and instructors in maintaining a fair and productive learning environment. One important source of information on these policies is the website of the University Ombudsman - in particular, see

[http : //www.msu.edu/unit/ombud/honestylinks.html](http://www.msu.edu/unit/ombud/honestylinks.html)

It is the responsibility of each student to know the policies concerning academic conduct. Academic dishonesty (a.k.a. “cheating”) in any form will not be tolerated in this course.

..... **ECE 466 - SCHEDULE & READING ASSIGNMENT CHART - Spring Semester, 2019**

**\*\*\*LAST UPDATED 01/06/2019\*\*\***

*Note: "Case Studies" in the text will be integrated into the course as time permits. The reading for these special topics will be posted on the D2L site. Test questions will not be based on these topics unless otherwise noted.*

WEEK(S)	TOPICS AND READING ASSIGNMENTS	NOTES
Weeks of Jan. 07 and Jan. 14	<b>Topics:</b> Introduction, Signal Concepts, Sampling Theorem <b>Textbook:</b> Chs. 0,1 [Review of ECE 366 material]	Class Handouts 1, 2 & 3
Weeks of Jan. 21 and Jan. 28	<b>Topics:</b> Fourier Techniques - DTFT, Pf. of Sampling Theorem <b>Textbook:</b> Secs. 2.1-2.3	Class Handouts 4, 5 & 6
Week of Feb. 04	<b>Topics:</b> Practical Issues DTFT – Windows, Frames, stDTFT <b>Textbook:</b> Sec. 2.4	Class Handout 7
Weeks of Feb. 11 and Feb. 18  <i>***Midterm 1</i>	<b>Topic:</b> DFT / FFT <b>Textbook:</b> Secs. 2.5 – 2.8  <b>Special event: <i>Midterm 1, in class, Thursday Feb 14</i></b>	Class Handouts 8 & 9 Case Study III  Format, content of exam described on D2L site
Week of Feb. 25	<b>Topic:</b> Elementary Concepts Speech Science <b>Textbook:</b> Ch. 3	Class Handout 10 Case Studies IV thru VIII
Week of Mar. 04	<b>Special event: <i>No classes, Spring Break</i></b>	
Week of Mar. 11	<b>Topic:</b> z-Transform <b>Textbook:</b> Secs. 4.1 – 4.4	Class Handouts 11, ... Key examples in text
Week of Mar. 18	<b>Topic:</b> z-Transform (cont'd) <b>Textbook:</b> Secs. 4.5 – 4.7	Case Studies IX & X
Weeks of Mar. 25 and Apr. 01  <i>***Midterm 2</i>	<b>Topic:</b> DT System Concepts <b>Textbook:</b> Ch. 5 (selected sections) [Review ECE 366 material]  <b>Special event: <i>Midterm 2, in class, Thursday Apr 04</i></b>	Format, content of exam described on D2L site
Week of Apr. 08	<b>Topic:</b> Design of DT Filters (Lite) <b>Textbook:</b> Ch. 6 (selected sections)	
Weeks of Apr. 15 and Apr. 22	<b>Topics:</b> Topics in LSE Signal Processing - Speech Analysis <b>Textbook:</b> Secs. TBD	
Week of Apr. 29  <i>***Final Exam</i>	<b>Final Exam Week</b>  <b>Special event: <i>Final Exam, Tuesday Apr 30, 7:45-9:45 a.m.</i></b>	Format, content of exam described on D2L site