South Dakota School of Mines & Technology
Signals and Systems, Fall, 2023
EE 313-M01 (3-0) 3 credits

Instructor Information

Instructor's Name- Thomas Montoya

Instructor's Contact Information- (605) 394-1219, Thomas.Montoya@sdsmt.edu, EEP 314

Instructor Office Hours- 8-9 am & 3-4 pm MWF, or when available (open door policy).

As I do not always notice voicemails in a timely fashion, e-mails or in person are the preferred contact methods. Unless I am traveling or it arrives after 5 pm, I typically respond to e-mails the same day.

Course Information

Course Start/End Dates- 8/21/2023 to 12/13/2023

Course Meeting Times and Location- MWF from 2-2:50 pm in EEP 254

Course Delivery Method- The course will be delivered in-person for lectures, quizzes, and exams. The syllabus and link to my webpage http://montoya.sdsmt.edu will be posted on D2L. This webpage will be used for posting assignments, examples, solutions, etcetera. E-mail will be used to notify students of course-related information/events (**check daily**) using your first.last@Mines.sdsmt.edu address.

Course Description

Characterization of continuous and discrete time signals and systems (linear and time-invariant). Analysis methods, techniques, and topics will include both transform- or frequency-based (e.g., Fourier, discrete Fourier, and z-) and time-based (e.g., differential and difference equations) approaches.

Course Prerequisites- EE 221/221L completed with a minimum grade of "C".

Student Learning Outcomes

Student Outcomes (SOs)

Student Outcomes are defined in ABET's accreditation standards for engineering programs:

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

Course Learning Outcomes (CLOs)

Upon completion of this course, students should demonstrate the ability to:

A. Apply fundamental continuous-time and discrete-time signal properties such as causality, linearity, and time-invariance to signals. (SO 1)

B. Solve linear discrete-time difference equations using recursion and/or finding total solutions when possible. (SO 1)

C. Apply or use the convolution representation for linear, time-invariant continuous-time and discrete-time systems to find the system response to input signals. (SO 1)

D. Be able to perform convolution on continuous-time and discrete-time signals. (SO 1)

E. Be able to compute the Fourier series for simple periodic continuous-time signals and Fourier transform (and inverses) for simple aperiodic continuous-time signals. (SO 1)

F. Apply frequency domain analysis (e.g., Fourier series and transforms) to find the response of systems to periodic and aperiodic continuous-time signals. (SO 1)

G. Apply the properties of ideal filters to find the output of the filter to input signals. (SO 1)

H. Apply the principles of sampling and the resulting consequences in the frequency domain. (SO 1)

I. Be able to compute both the discrete-time Fourier transform (DTFT) and discrete Fourier transform (DFT) and their inverses for discrete-time signals. (SO 1)

J. Be able to compute both the z-transform and inverse z-transform of discrete-time signals. (SO 1)

K. Be able to compute the z-transform transfer function of discrete-time systems. (SO 1)

L. Apply or use frequency-domain analysis (i.e., DTFT, DFT, and z-transforms) to find the response of discrete-time systems to discrete-time signals. (SO 1)

Course Goals

The objective of this course is to provide students a basic understanding of how to analyze and characterize continuous-time and discrete-time signals and systems in both the time domain (e.g., convolution and difference/differential equation representations) and in the frequency domain (e.g., Fourier series/transform & analysis, discrete-time Fourier transform (DTFT) & analysis, discrete Fourier transform (DFT) & analysis, and z-Transform & analysis).

Course Materials

Required Textbook(s) and Materials

Fundamentals of Signals and Systems, Using the Web and MATLAB, 3rd Edition, Kamen and Heck, 2007, ISBN 0-13-168737-9. Text web page is http://users.ece.gatech.edu/~bonnie/book3/.

Technology Equipment Needed for the Course

The course requires use of a computer and a scientific calculator (capable complex number and linear algebra operations).

Technology Skills Needed for the Course

MATLAB will be heavily utilized. Ability to navigate D2L and internet, upload/download files (e.g., pdf files), using MS-Office programs, communicating via email, and **possibly, depends on COVID,** connecting audio/video and using tools such as Zoom.

Course Grading

Coursework

- Course instruction will be delivered in lectures.

- Bring notes, text, and calculator to every class. Most quizzes will be unannounced and most require a calculator (no smartphones, no computers/tablets). Occasionally a quiz may be open book/notes (no borrowing, no computers/tablets).
- To facilitate grading, homework shall meet the following specifications (see example on course web page):
  (a) Use the front side (i.e., single-sided) of 8.5" × 11" engineering graph paper or plain white paper (NO pages torn from spiral notebooks) for assignments. Hardcopy only!
  (b) At the top of **each** page should be the date, course number, problem number(s), your name, and the page numbering (i.e., page *x* of *y* or *x*/*y* formats in the right-hand corner). Ensure problems & pages are in order.
  (c) All work exceeding one page should be stapled - no paper clips, folded corners, or folders.
  (d) Write-out problem descriptions, copy/draw figures, and **show all** work so it can be understood without the text. No work (i.e., "magic" answer) → no credit.
  (e) Reference equations derived in the text (e.g., equation number and/or page number). Fundamental equations (e.g., Maxwell's equations, Ohm's Law ...) are excluded from this requirement.
  (f) Use notation and conventional engineering units & prefixes (i.e., MKS) as given in class and text. Answers with incorrect notation and without applicable units are incomplete/incorrect.
  (g) Writing/figures/graphs must be legible and large enough to read → illegible = no credit.
  (h) Answers should be boxed/double underlined, in **decimal format** (if numbers), and the variables, values & units (if any) included. For example, $d = 3.4896\ \text{m}$ and ***NOT*** $d = 7\sqrt{42}/13\ \text{m}$. Use lead zeros for fractional answers, e.g., 0.4 not ".4". Typically, 4-5 significant digits are used.
  (i) Work problems sequentially in a **single** vertical column with subparts clearly labeled, e.g., a), b) ... Leave a space (e.g., 1/2") between consecutive parts of a problem, and draw a line across the page at the end of each problem if there is more than one. No 'checker boarding'.
  (j) **No** more than **two** problems on any single page.

Attendance Policy

Attendance is required. Notify instructor in advance (when possible) if you will be absent from class.

Late/Make-up Assignment Policy

- Homework (HW) is due at the beginning of class on the specified days (up to 20% penalty for being late w/out doctor's note, etcetera). If you know that you will be missing a class, it may be turned in early. HW will **not** be accepted or graded after solutions are posted on the course web page.
- Missed quizzes will **not** be made up. If you know that you will be missing a class for a school-related activity (athletic travel, etcetera), you may stop by the day before and ask to take a quiz early (if available). Make-ups for exams only allowed for school-sponsored events, documented illness, …
- If 2/3 of quizzes and 2/3 of HW are completed at a **passing** level, the lowest HW grade and lowest two quiz grades will be dropped (no questions asked). If not, **all** quizzes and HW will count (no drops). The drops are meant to cover any absences, including those due to illness, interviews, trips…

Academic Integrity

South Dakota Mines is committed to academic honesty and scholarly integrity. The South Dakota Board of Regents Policy 2:33 provides a comprehensive definition of "Academic Dishonesty", which include cheating and plagiarism. All Instructors at South Dakota Mines are required to report allegations of academic misconduct to the Student Conduct Officer. The South Dakota Board of Regents Policy 3:4 provides detailed information regarding key definitions, policy information, prohibited conduct, and the Student Conduct process adhered to at South Dakota Mines. Any student suspected of violating academic

integrity standards will be reported in accordance with the process outlined on the South Dakota Mines website.

- Students are encouraged to discuss homework with classmates in general terms. However, direct copying/plagiarism … is not acceptable and will be penalized (e.g., grade of zero).

Grading and Assessment

Student learning is assessed by a combination of in-person exams, quizzes, homework, and projects.

Description	Percent
Three (3) Hourly exams	30%
Quizzes	20%
Homework	15%
Computer Projects	15%
Final exam	20%
TOTAL	**100%**

Grading Scale- 100 > A > 90, 89 > B > 80, 79 > C > 70, 69 > D > 60, F < 60.

Academic Freedom Statement

Academic Freedom is the cornerstone upon which higher education is built. Academic freedom, as defined by BOR policy 1:11, is fundamental to the advancement of truth, development of critical thinking, promotion of civil discourse, and contribution to the public good. Each course includes the freedom to discuss relevant matters and present various scholarly views in the classroom, as determined by the subject-matter expertise of the instructor. Students are encouraged to develop the capacity for critical thinking and to pursue the truth, debate ideas, express and evaluate their opinions, and draw conclusions. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.[1]

[1] *Language adapted from the American Association of University Professors "Joint Statement on Rights and Freedoms of Students".*

Complaint Process

While we hope that every student has a meaningful and positive experience at South Dakota Mines, should a concern arise, students are encouraged to first attempt to resolve their concern directly with the person or office directly involved. Following that attempt, should the concern remain unresolved, students are encouraged to reach out to the Dean of Students office at DeanOfStudents@sdsmt.edu or 605.394.2416. Additionally, students may access the online form to submit their complaint, appeal, or grievance.

Grade Appeal Policy

In alignment with BOR Policy 2:9, students who wish to appeal their final course grade shall first discuss the matter with the course instructor. If the concerns are unresolved following that discussion, students may utilize the online form to submit "Appeal – Academic" for a "Grade Dispute".

Opportunity for All - Student Success Services and Support

Students are provided a one-stop source for information regarding all the services and supports to ensure success. Visit the Opportunity for All page to access service and department information including ADA accommodations, Career Services, Counseling, Office for Inclusion, Slide Rule (math support), Student Success, Title IX, Tutoring, and Veterans Services, to name a few.

South Dakota Board of Regents Required Syllabus Statements

The following statements may be found online in South Dakota Board of Regents Academic Affairs Council Guideline 5.3.A:

- Freedom in Learning
- Americans with Disabilities Act
- Academic Dishonesty and Misconduct
- Acceptable Use of Technology
- Emergency Alert Communications

Electronic Devices Policy

Please silence/turn off your cell phone before class starts. No text messaging or headphones in class. You may use a laptop/tablet in class for purposes of note taking (NOT allowed for exams or quizzes). No other use of any other electronic/computer media, other than calculators, is allowed during class time.

Topics/Course Schedule: All or parts of chapters 1-5, and 7, see attached schedule (subject to revision).

Tentative Course Schedule

Class | Date	Topics/Activities	Reading/Text
1 | 8/21/23 2 | 8/23/23 3 | 8/25/23 4 | 8/28/23	**Fundamental Concepts-** continuous- & discrete-time signals, continuous-time (CT) & discrete-time (DT) signals cont., systems & examples, basic system properties	• 1.1 • 1.1 • 1.2 • 1.3 - 1.6
5 | 8/30/23 6 | 9/1/23 **9/4/23** 7 | 9/6/23 8 | 9/8/23 9 | 9/11/23 10 | 9/13/23 11 | 9/15/23 12 | 9/18/23	**Time-Domain Models of Systems-** Input/Output (I/O) representation of discrete-time (DT) systems, convolution of DT signals, difference equation models, differential equation models, solution of differential equations, convolution representation of continuous-time systems	• 2.1 • 2.1 - 2.2 **Holiday** • 2.2 - 2.3 • 2.3 • 2.3 - 2.4 • 2.4 - 2.5 • 2.5 • 2.6 - 2.7
13 | 9/20/23 14 | 9/22/23 15 | 9/25/23	**The Fourier Series & Fourier Transform-** signals in terms of frequency components, trigonometric & complex exponential Fourier Series (periodic signals)	• 3.1 - 3.2 • 3.2 - 3.3 • 3.3
16 | 9/27/23	**Exam #1**- Covers material from Chapters 1 and 2	
17 | 9/29/23 18 | 10/2/23 19 | 10/4/23 20 | 10/6/23 **10/9/23**	**The Fourier Series & Fourier Transform cont.-** Fourier Transform (aperiodic signals), spectral content of common signals, properties of the Fourier Transform, generalized Fourier Transform	• 3.4 • 3.5 - 3.6 • 3.6 - 3.7 • 3.7, 3.9 **Holiday**
21 | 10/11/23 22 | 10/13/23 23 | 10/16/23 24 | 10/18/23 25 | 10/20/23 26 | 10/23/23	**Fourier Analysis of Discrete-Time Signals-** Discrete-Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), DFT of truncated signals, Fast Fourier Transform (FFT)	• 4.1 • 4.1 - 4.2 • 4.2 • 4.2 - 4.4 • 4.4 • 4.4, 4.6
27 | 10/25/23 28 | 10/27/23	**Fourier Analysis of Systems-** Fourier analysis of continuous-time systems, response to periodic and nonperiodic inputs	• 5.1 • 5.1 - 5.2
29 | 10/30/23	**Exam #2**- Covers material from Chapters 3 and 4	
30 | 11/1/23 31 | 11/3/23 32 | 11/6/23 33 | 11/8/23 **11/10/23**	**Fourier Analysis of Systems cont.-** response to periodic and nonperiodic inputs cont., analysis of ideal filters, sampling, Fourier analysis of discrete-time systems	• 5.2 - 5.3 • 5.3 - 5.4 • 5.4 - 5.5 • 5.6 - 5.7 **Holiday**
34 | 11/13/23 35 | 11/15/23 36 | 11/17/23 37 | 11/20/23 **11/22 - 11/24** 38 | 11/27/23 39 | 11/29/23	**The z-Transform and Discrete-Time Systems-** z-Transform of a discrete-time signal, z-Transform properties, inverse Z-Transform, transfer function representation, system analysis using transfer function representation	• 7.1 - 7.2 • 7.2 • 7.3 • 7.4 **Holiday** • 7.4 - 7.5 • 7.5 – 7.6
40 | 12/1/23	**Exam #3**- Covers material from Chapters 5 and part of Chapter 7	
41 | 12/4/23	Catch up. Review for Final	
	Final Exam- Wednesday, December 13, 2023 from 3-4:50 pm, EEP 254	