EE230   **Signals and Systems Analysis**   **Spring 2020**

Catalog Description   Emphasis on continuous linear systems; time domain analysis, convolution, Laplace transform, Fourier series, Fourier integral. Introduction to discrete systems, sampling, filters. Use of MATLAB will support this course. Required course.

Prerequisites   EE223 – Electrical Circuit Analysis II

Textbook   *Fundamentals of Electric Circuits* by Alexander & Sadiku, 4th ed., McGraw Hill, ISBN: 978-0-07-352955-4
Optional: *FE Handbook*, available from www.ncees.org, $14. Free pdf on my Angel website
           LTspice: free circuit simulation software from analog.com
           Matlab: free installation from the VMI cadet helpdesk in barracks

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Office hours: stop-ins welcome, or by appointment, or on Mon, Fri from 1400 – 1500.

Course schedule   NEH 428 TR   0925 – 1040

Course Objectives[1]
1. Develop a basic intuition and ability to quantitatively analyze first-order and second-order circuits and non-electrical systems as linear constant coefficient differential equations and transfer functions [A,B,C]
2. Develop the skills necessary to design filters and other systems that solve real-world, relevant problems [A,B,C,E]
3. Develop individual working and communication skills [B,C,D]

[1] Letters in brackets correspond to Electrical Engineering program objectives

Performance Criteria
for Objective 1:
a. Students will be able to explain what linear systems are from a practical perspective
b. Students will be able to determine the Laplace transforms and differential equations of linear circuits
c. Students will be able to predict the time and frequency domain output of a circuit given an input of exponentially-decaying and/or oscillating signals of arbitrary amplitude, decay rate, and frequency using Fourier methods (for dual-sided waveforms) and Laplace methods (for single-sided waveforms)
d. Students will be able to model non-electrical engineering phenomena using electrical engineering analogs (e.g. mechanical, hydraulic and thermal analogies) and analyze them using frequency-domain methods
e. Students will demonstrate an aptitude with computer-aided design tools including LTSpice and Matlab to analyze and test circuits they have designed

for Objective 2:
a. Students will be able to specify and design circuits containing resistors, capacitors, and inductors to meet a given transfer function
b. Students will be able to determine the Bode plot of an arbitrary system
c. Use laboratory instruments including DMMs, oscilloscopes, frequency counters, frequency generators, and power supplies to verify the construction of a filter

for Objective 3:
a. Students will demonstrate the ability to prepare and deliver extemporaneous briefings to the class explaining how particular problems were solved
b. Students will be able to document their laboratory work

Topics
Laplace transform (chap 15)
    definition, properties, pairs
    partial fraction expansion
    convolution
    integrodifferential equations vs. Laplace transform
Circuit analysis using the Laplace transform (chap 16)
    circuits in the s-domain
    transfer functions
    poles and stability/ initial and final value theorems
Frequency response (chap 14)
    Frequency response function
    Decibel scale and bode gain
Filter Design Lab
Fourier series and transform (chap 17)
    Trigonometric Fourier series
    Exponential Fourier series
    Circuit analysis using Fourier Series
Fourier transform
    Fourier transform properties
    Applications of Fourier Transforms

Work for Grade Policy Your course grade will be a direct average as shown to in the table to the right. No curves are applied. I will drop your lowest homework and quiz grades.

Homework and labs	20%
Test I	25%
Test II	25%
Final Exam	30%
Total	100%

Homework Grading Homework grading is: 2 = correct answer, 1 = substantial effort but incorrect, 0 = not a substantial effort or no work shown. Many problems have solutions in the text so you must show your work. When you acknowledge help received, estimate how much is your own work (e.g. "CDT Jones showed me how to set up the node equation matrix when a diode is present. 90% is my own work"). Homework must be completed individually but you may receive help from others. **Regardless of whether or not you decide to break the previous rule, you must acknowledge help from all sources (excluding myself and your textbook) including all classmates, other professors, other current or past cadets' notes, old homework solutions, and books.**

Late policy I do not accept late homework. Homework is due at the start of class. The only authorized exceptions are by direction of the superintendent, hospitalization, or in the case of extenuating circumstances, by *prior* arrangement with me. **Attending a scheduled guard duty does not exempt a cadet from turning in the assignment on time, either by directly giving it to me (under my door in advance of the class) or to a classmate before the class begins.**

Tests Tests are closed book and notes, however you may hand-write (not photocopy) notes onto both sides of a 3x5" notecard for each test. Requests for re-evaluation will be submitted NLT one week after the graded event. Calculators are authorized for all homework, quiz, and examination problems. A TI-85 or higher will see you through EE230 and the remaining engineering courses at VMI; a TI-83 will not. Students with learning disabilities who wish special test accommodations must meet with me at the start of the semester and again at least 72 hours before each scheduled test and exam.

Professional Component 3 credits of Engineering Topics (specifically, Engineering Science and Design)

Relationship Of Course To Program Outcomes primarily department program outcomes 1, 5, 11, and 14.

Prepared by James C. Squire, Professor, 01/10/20

Lecture Schedule

Lecture	Date	Description	Read
Chapter 15		**Laplace Transform**	
1	16 Jan	LT by integrals	1,2
2	21	LT by tables	3
3	23	Inverse LT	4
4	28	Convolution	5
Chapter 16		**Applications of Laplace**	
5	30	Circuit elements	1-2
6	4 Feb	Circuit analysis	3
7	6	Transfer functions	4
8	11	State variables	5
Test Block 1		**Laplace Transform**	
9	13	Review	
10	18	Test 1	
Chapter 14		**Frequency Response**	
11	20	Transfer function	1-2
12	25	Bode plots	3-4
Lab		**Filter Design**	
13	27	Lab 1	lab
14	3 Mar	Lab 2	lab
Chapter 17		**Fourier Series**	
15	5	Trigonometric FS	1-2
16	10	Symmetry	3
17	12	Circuit applications	4
18	24	Average, RMS power	5
19	26	Exponential FS	6
Test Block 2		**Fourier Series**	
20	31	Review	
21	2 Apr	Test 2	
Chapter 18		**Fourier Transform**	
22	9	FT by integrals	1-2
23	14	FT by tables	3
24	16	Circuit applications	4
25	21	Parseval, FT vs. LT	5-6
Review			
26	23	Final Exam review	
27	28	Admin	
28	30	Extra T - DNF	
Final Exam	6 May 0830	Comprehensive	

Appendix A: Institute Work For Grade Policy

"**Work for grade**" is defined as any work presented to an instructor for a formal grade or undertaken in satisfaction of a requirement for successful completion of a course or degree requirement. All work submitted for grade is considered the cadet's own work. "**Cadet's own work**" means that he or she has composed the work from his or her general accumulation of knowledge and skill except as clearly and fully documented and that it has been composed especially for the current assignment. No work previously submitted in any course at VMI or elsewhere will be resubmitted or reformatted for submission in a current course without the specific approval of the instructor.

In all work for grade, failure to distinguish between the cadet's own work and ideas and the work and ideas of others is known as **plagiarism**. Proper documentation clearly and fully identifies the sources of all borrowed ideas, quotations, or other assistance. The cadet is referred to the VMI-authorized handbook for rules concerning quotations, paraphrases, and documentation.

In all written work for grade, the cadet must include the words "**HELP RECEIVED**" conspicuously on the document, and he or she must then do one of two things: (1) state "none," meaning that no help was received except as documented in the work; or (2) explain in detail the nature of the help received. In oral work for grade, the cadet must make the same declaration before beginning the presentation. Admission of help received may result in a lower grade but will not result in prosecution for an honor violation.

Cadets are prohibited from discussing the contents of a quiz/exam until it is returned to them or final course grades are posted. This enjoinder does not imply that any inadvertent expression or behavior that might indicate one's feeling about the test should be considered a breach of honor. The real issue is whether cadets received information, not available to everyone else in the class, which would give them an unfair advantage. If a cadet inadvertently gives or receives information, the incident must be reported to the professor and the Honor Court.

Each cadet bears the responsibility for familiarizing himself or herself thoroughly with the policies stated in this section, with any supplementary statement regarding work for grade expressed by the academic department in which he or she is taking a course, and with any special conditions provided in writing by the professor for a given assignment. If there is any doubt or uncertainty about the correct interpretation of a policy, the cadet should consult the instructor of the course. There should be no confusion, however, on the basic principle that it is never acceptable to submit someone else's work, written or otherwise, formally graded or not, as one's own.

The violation by a cadet of any of these policies will, if he or she is found guilty by the Honor Court, result in his or her being dismissed from VMI. Neither ignorance nor professed confusion about the correct interpretation of these policies is an excuse.

Appendix B: Department Work For Grade Policy

Tutoring (e.g. Writing Center, Academic Center, athletic tutors, private tutors): The ECE Department supports and encourages cadet use of learning aids as offered by the VMI Writing Center, VMI Academic Center, and tutors. All assistance from these, and other similar aids, must be explicitly described in the statement regarding help received.

Peer Collaboration: Peer collaboration policies, including policies on critical comments, will be established by the individual faculty of the ECE Department, and may vary from assignment to assignment. Each ECE faculty member will clearly indicate the appropriate collaboration policy for each assignment. Policy regarding laboratory groups, team cooperation, interaction between teams, etc. will be established by the individual faculty. All assistance from such peer collaboration must be explicitly described in the cadet statement regarding help received.

Computer Aids (including calculators, translators, spelling, style, and grammar checkers): The ECE Department supports and encourages cadet use of computer aids, including calculators, translators, spelling, style, and grammar checkers to improve the quality of the cadets' work. The use of such computer aids does not constitute help received.

Appendix C: Learning Disability Statement
If you have a documented disability and want accommodations in my class, please register with the Office of Disabilities Services, Caroll Hall, 464-7667, and provide me with an Accommodations Letter outlining your accommodations. I will be glad to meet with you privately to discuss your needs. Accommodations must be arranged with me at least 72 hours prior to the graded activity.