ECE 333: Signals and Systems III (3 credits, 3 contact hours)

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Textbook: F. T. Ulaby and A.E. Yagle, *Engineering Signals and Systems in Continuous and Discrete Systems*, 2nd Edition, National Technology & Science Press, 2016; ISBN 978-1-934891-24-7.

Reference Textbooks:

H.P. Hsu, *Signals and Systems*, 2nd Edition. Schaum's Outlines, McGraw-Hill, 2011; ISBN 978-0-07-163472-4.

Course Description: A continuation of circuits and systems. Topics include signal models, system representations and properties, convolution, unilateral Laplace transforms, Fourier series, Fourier transforms, sampling, discrete-time signals, unilateral Z-transforms, discrete-time Fourier series, discrete time Fourier transforms and the discrete Fourier transform.

Prerequisites:

ECE232, Math222

Specific Course Learning Outcomes (CLO):

The student will be able to:

1. understand the effect of various signal transformations, such as time-shift, time scaling, etc.
2. understand the properties and responses of LTI systems to input signals such as impulses, steps, ramps, etc.
3. understand how the Laplace transform is used to solve time domain problems
4. understand how Fourier analysis techniques are used to solve time domain problems for time periodic and non-periodic signals
5. understand discrete-time signals, the Z- transform, the discrete-time Fourier series, and the discrete- time Fourier transform

Relevant Student Outcomes:

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (CLO1,2,3,4,5)

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies (CLO 1,2,3,4,5)

COURSE OUTLINE: ECE333 Signal and Systems III

(Section numbers are the same in 1st and 2nd Editions, but page, equation, example and figure numbers are slightly different in each edition.)

Week	Chapter/ Pages	Topics	Problems
1	Ch.1/Sect. 1-1 to 1-5/ pp.1-24.	Continuous-time signals	1.6, 16, 19, 28, 29, 33.
2-3	Ch.2 /Sect.2-1 to 2- 6 /pp.30-61.	Linear time-invariant (LTI) systems: definitions, impulse response and convolution, causality and stability	2.2, 5, 6, 12, 16, 22, 23.
	Ch.2 /Sect.2-7 /pp.61-65.	Sinusoidal response	2.29, 30, 38. {See hints below for 2.29 and 2.38}
4-5	Ch.3/Sect. 3-1 to 3-7 /pp.85-111. Ch. 3/Sect. 3-9, 10 /pp.113-117.	Unilateral Laplace Transforms: poles and zeros, partial- fraction expansions, transfer functions, stability	3.3,6,10,13, 15b, 21(19), 27(25), 33 (30). **Note that the problem number in parenthesis is in 1st Edition. Use only problem numbers in 2nd Edition to identify your HW problem solutions to be graded.**
	Ch.4/Sect. 4-1 to 4-2/pp. 131-140.	Circuit analysis	4.3.
6	Ch.5/Sect. 5-1 to 5-5/pp. 192-216.	Phasor analysis Fourier Series	5.5. Verify in Table 5-4 #2, #4; 5.6, not 5.6e; 5.28(5.27).
7	Ch.5/Sect. 5-7, 5-8, /pp. 218-230. 50(49),	Fourier Transforms	5.40(39), 42(41), 46(45), 52(51), 54(53).
8	Ch.5/Sect. 5-6, 5-9, 5-11/pp.216-218, 230-232, 235-236. Ch.5/Sect.5.12/pp.236-238.	Parseval's Theorems Circuit analysis with Fourier transform	5.65(58). 5.68a(61a).
9-10	Ch.7 /Sect.7-1 to 7-5/ pp.346-366.	Discrete-time signals	7.1,3, 5, 6(a, b, c), 10 (a, b).
11-12	Ch.7/Sect.7-6 to 7-8/ pp.366-378. Ch.7/ Sect.7-10 to 7-12/ pp. 380-389.	Unilateral Z Transforms Transfer function and frequency response	7.15(c, d), 17b, 24 (23), 29(27).
13-14	Ch.7/Sect.7-13,7-14,7-15 /389-407.	Discrete-time Fourier Series Discrete-time Fourier Transform Discrete Fourier Transform	7.39(36), 45(42), 50(47), 53(50).

Hints for 2.29 and 2.38:

For problem 2.29 (a,b,c,f), use eq.2-120 on page 64 in 2nd Ed (page 63 in 1st Ed). Note that an input x(t) that is equal to a constant has zero frequency and zero phase so that you know the output y(t) if you know the $H(\omega)$ which is given.

For problem 2.29 (d,e), you have to find h(t) that gives the known $H(\omega)$. h(t) can be determined by referring to ex.2-11 on page 62 in 2nd Ed (page 61 in 1st Ed) and equation 2.17 on page 37 in both editions. You have to show that $h(t) = \exp(-3t)\, u(t)$ gives the known $H(\omega)$. We do not know how to find h(t) directly from $H(\omega)$ so we find h(t) as a guess using the information in the text book.

For problem 2.38, you again use the h(t) you found for 2.29 to solve problem.

Grade Breakdown: Two class examinations: 50%
Final examination: 45%
Quizzes, homework and class participation: 5%

Attendance is required at class lectures and problem solving sessions.
Lateness to class is unacceptable.
Cellular phones and beepers are to be shut off or in quiet mode. They are to be placed in your zippered backpack during exams.

Formula Sheets: 1 side of 8.5"x11" page for Exam I; 2 sides of 8.5"x11" page for Exam II; 3 sides of 8.5"x11" page for Final
Format: in own handwriting, no derivations, no worked out examples, no calculations, no illustrative examples
Permitted: definitions, units, formulas, geometry that define parameters in formulas, equivalent circuits
Allowed on exams are copies of all tables and chapter summaries in text, but not the list of all the textbook equations. Allowed is a mathematical handbook of formulas, such as the one published by Schaum's Outlines.

Office Hours: to be announced.

Homework Policy:
The problems will be assigned, checked and accepted only when due. List assigned HW problems in the upper right hand corner and start each new problem on a new page and use only one side of a page for your work. Students are expected to solve all assigned problems. Solutions will be provided and discussed in class. The text contains numerous examples. Students are encouraged to study these examples for practice. If your HW is not done by yourself , i.e., if your HW is done with help such as by working in a group, by help from another instructor, by access to the solutions manual or to copies of the solutions, etc., then a signed statement to that effect must be included with your submitted HW.

NJIT Honor Code:
The NJIT Honor Code will be upheld and any violation will be brought to the immediate attention of the Dean of Students.

Missing Examinations Policy:
Check finals week schedule and do not make any plans to be away for the final examination dates. You will receive an automatic failure for missing the final examination unless for hospitalization or death in immediate family and documentation is required. No make-up for class examinations and no excuse is acceptable for missing class examinations unless hospitalization or death in immediate family and documentation is required.