332:345 — Linear Systems and Signals — Fall 2014

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Class Home Page: http://www.ece.rutgers.edu/~gajic/345.html

Textbook: Zoran Gajic, *Linear Dynamic Systems and Signals*, Prentice Hall, 2003

Textbook Homepage: http://www.ece.rutgers.edu/~gajic/systems.html

Laboratory: See 332:347 Lab Syllabus on page 4.

Sakai: Exam and quiz results, and homework solutions will be posted on sakai.rutgers.edu.

MEETING	TOPICS	TEXT
1	System linearity and time invariance, system response, sampling, system classification	1.1, 1.2, 1.4
	Chapter 1 mandatory reading: pages 1–17 and 24–26.	
	Prerequisite Quiz: Monday Sept. 15 (**5% = 5 pts.** of the course grade.). Electrical circuit superposition principle. Solving linear constant coefficient differential equations, Section 7.1. Results from trigonometry, complex numbers, calculus, Appendix B.	
2–3	Common signals and impulse delta signal	2.1–2.3
	Chapter 2 mandatory reading: pages 33–58.	
4–5	Continuous-time convolution	6.1, 6.2
6	Discrete-time convolution	6.3, 6.4
	Chapter 6 mandatory reading: pages 270–305.	
7	**EXAM I** , **25% = 25pts.** of the course grade. Problems (**20 pts.**) and theoretical questions **(5 pts.**) from Chapters 1, 2, 6.	
8	Fourier series	3.1
9	Fourier series in linear system analysis	3.4
10–13	Fourier transform and its properties	3.2
14	Fourier transform in linear system analysis	3.3
	Chapter 3 mandatory reading: pages 73–123.	
15	**EXAM II** (**20% = 20pts.** of the course grade. Problems (**15 pts.**) and theoretical questions (**5pts.**) from Chapter 3)	
16	Laplace transform and its properties	3.5, 4.1
17	Inverse Laplace transform	4.2
18	Laplace transform in linear system analysis	4.3
	Chapter 4 mandatory reading: pages 143–179.	
19–20	The Z-transform and its properties	5.1–5.2
21	The Z-transform in linear system analysis	5.3
	Chapter 5 mandatory reading: pages 208–241.	
23	**EXAM III** (**25% = 25pts.** of the course grade. Problems (**20pts.**) and theoretical questions (**5pts.**) from Chapters 4 and 5.)	
22, 24	Discrete system response in the time domain	7.2-7.3, 7.6
25	Continuous system response in the time domain	7.4–7.5

26 Introduction to continuous and discrete system stability 7.7–7.8
Chapter 7 mandatory reading: pages 327–354 and 365–366.

27–28 Introduction to linear feedback systems 12.1–12.3
Chapter 12 mandatory reading: pages 569–584..

FINAL EXAM (**25% = 25 pts.** of the course grade. Problems (**20 pts.**) and theoretical questions (**5 pts.**) from Chapters 7 and 12 and Selected Topics from Chapters 2–6.)

Grading:
Prerequisite Quiz **5%**.
Exam I (Chapters 1–2, 6) = **25%**
Exam II (Chapter 3) = **20%**
Exam III (Chapters 4–5) = **25%**,
Final Exam (Chapters 7, 12, selected areas from Chapters 2–6) = **25%**,

Grading Scale:

$A \geq 90,\ B^+ \geq 82,\ B \geq 75,\ C^+ \geq 67,\ C \geq 60,\ D \geq 50.$

Homework Problems:

1.2, 1.6, 1.9, 1.10, 1.14, 1.19. (6)
2.4, 2.6, 2.8, 2.20, 2.21, 2.22, 2.26, 2.29, 2.30, 2.38. (10)
6.2, 6.4, 6.5, 6.6, 6.9, 6.12, 6.14, 6.15, 6.16. (9)

3.1, 3.3, 3.6, 3.8, 3.10, 3.11, 3.12, 3.18, 3.20, 3.23, 3.24, 3.25, 3.34, 3.37, 3.39, 3.41 (16)

4.7, 4.8, 4.9, 4.11, 4.13, 4.14, 4.16, 4.20, 4.22, 4.25, 4.26, 4.27, 4.28, 4.30, 4.33, 4.37, 4.39, 4.40 (18)
5.4, 5.5, 5.6, 5.7, 5.8, 5.11, 5.12, 5.13, 5.14, 5.15, 5.21, 5.23, 5.24, 5.25, 5.29, 5.33, 5.34, 5.38 (18)

7.6, 7.7, 7.8, 7.10, 7.13, 7.14, 7.19, 7.21, 7.23, 7.24, 7.25, 7.28, 7.29, 7.32, 7.33 (14)
12.1, 12.2, 12.3, 12.4, 12.9, 12.10, 12.12a,c, 12.13, 12.14, 12.15 (10)

General Class Recommendations

Linear Systems and Signals class is useful for almost all courses in Electrical and Computer Engineering since almost all dynamic systems in Electrical Engineering are linear time invariant systems. You are advised to maintain the following files (not only for the purpose of mastering the *Linear Systems and Signals* course, but also for a future reference (junior and senior year courses, graduate school courses, future professional work):

1) One sheet with useful *mathematical formulas* (complex numbers, trigonometry, basic differential and difference equations, basic calculus formulas, ...).

2) One sheet with *Linear Systems and Signals terminology, concepts* such as:
— delta impulse signal, step signals, ramp signal, sinc signal;
— signal convolution, signal energy, signal power;
— system transfer function, impulse response, step response;
— steady state response, transient response;
— zero-state response, zero-input response, complete response;
— system zeros, system poles;
— .....

3) *Tables* of the Fourier, Laplace, and Z-Transforms: properties and common pairs
(Those tables are available at the textbook website)

4) One sheet with *formulas specific for Linear Systems and Signals* such as:
— properties of the delta impulse signal, generalized derivatives;
— Fourier series coefficients;
— system response to periodic signals;
— system response to sinusoidal signals
— .....
— convolution formulas;
— feedback system formulas.

5) *Homework* and detailed *solutions* to all homework problems.

6) *Exams* and detailed *solutions* to all exams.

332: 347 — Linear Systems and Signals Laboratory (1 cr.) — Fall 2014

Lab Supervisor: Professor Zoran Gajic, ELE 222, phone 5–3415, email: gajic@ece.rutgers.edu

Textbook: Zoran Gajic, *Linear Dynamic Systems and Signals*, Prentice Hall 2003.

Lab's websites: http://www.ece.rutgers.edu/~gajic/347.html

MATLAB Codes can be downloaded from the textbook homepage
http://www.ece.rutgers.edu/~gajic/systems.html

Teaching Assistants: to be announced

Experiments and Time Schedule

09/08/2014–09/14/2014

Review of MATLAB. *Mandatory Reading*: Appendix C, pages 622–632.

09/15/2014–09/28/2014

Experiment #1: Signals in Linear Systems, Section 2.4, page 58.
Mandatory Reading: Examples 2.1 (page 40), 2.11, 2.12 (download the MATLAB codes for these examples from the textbook homepage).

09/29/2014–10/12/2014

Experiment #2: Continuous- and Discrete-Time Convolution, Section 6.6.2, page 310.
Mandatory Reading: Section 6.5 and Examples 6.16–6.17 (download the MATLAB codes).

10/13/2014–10/26/2014

Experiment #3: Linear System Frequency Domain Analysis, Section 3.6, page 127.
Mandatory Reading: Examples 3.1, 3.18, 3.19 (download the MATLAB codes).

11/03/2014–11/16/2014

Experiment #4: Linear System Response via Laplace Transform, Section 4.5, page 191.
Mandatory : Examples 4.20–4.24, and 4.3.5 Case Studies (download the MATLAB codes).

11/17/2014–11/30/2014 (Submission of the lab reports for experiment #5 will be in the week 12/01–12/04/2014).

Experiment #5: Linear System Response via The Z-Transform, Section 5.6, page 262.
Mandatory Reading: Examples 5.20–5.21, 5.24, and 5.3.4 Case Study.

The Lab starts in the week of September 8, 2014. It meets in EIT (Engineering Information Technology) Lab, located in Engineering Building, in rooms EN–D110 and EN-B125.. All experiments will be performed using MATLAB during the first week of the time period in which the lab experiment is scheduled. Attendance of the lab experiments is mandatory. (Students will have to go to the lab only six weeks during the semester, one week for MATLAB review, and five weeks for lab experiments). The students should hand in the lab reports during the lab periods. The reports may be also handed in person either to Teaching Assistants or Professor Gajic during their regular office hours or after the class lectures. The students may work either in ELE103–105 Lab or EIT-D110 or EN-B125 Labs any time when there are available seats, but we advise that you complete your lab assignments during the scheduled lab hours. Teaching Assistants will hold their office hours *every week* during the periods when the labs are scheduled.