

Rutgers University, Department of Electrical and Computer Engineering

332:345 — Linear Systems and Signals — Fall 2007

Instructor: Zoran Gajic, ELE-222, tel. 445-3415, emai: gajic@ece.rutgers.edu

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

Office Hours: M3, Th3

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

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

Teaching Assistants: See 332:347 Lab Syllabus

Laboratory: See 332:347 Lab Syllabus

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. Introductory reading: Section 7.1 (solving linear constant coefficient differential equations) and Appendix B (useful results from trigonometry, complex numbers, calculus) Chapter 1 Quiz , Th. Sept. 13 (2% of the course grade. Theory. Closed-book.)	
2–3	Common signals and impulse delta signal.....	2.1–2.3
	Chapter 2 mandatory reading: pages 33–58. Chapter 2 Quiz Th. Sept. 20 (2% of the course grade. Theory. Closed book.)	
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 , Th. Sept. 27 20% of the course grade. Problems from Chapters 1, 2, 6. Open-book Chapter 6 Quiz Th. Oct. 4 (2% of the course grade. Theory. Closed-book.)	
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. Quiz Chapter 3 Th. Oct. 18 (2% of the course grade. Theory. Closed-book.)	
15	EXAM II Th. Oct. 25 (20% of the course grade. Problems from Chapter 3. Open-book)	
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. Chapter 4 Quiz Th. Nov. 8 (2.5% of the course grade. Theory. Closed-book.)	

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.	
	Chapter 5 Quiz Th. Nov. 15 (2.5% of the course grade. Theory. Closed-book.)	
23	EXAM III Th. (Tu) Nov. 20 (25% of the course grade. Problems from Chapters 4 and 5. Open-book)	
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.	
	Chapter 7 Quiz Th. Dec. 6 (2% of the course grade. Theory. Closed-book.)	
27–28	Introduction to linear feedback systems	12.1–12.3
	Chapter 12 mandatory reading: pages 569–584..	
	FINAL EXAM Dec. 14 (20% of the course grade. Problems from Chapters 7 and 12. Open-book)	

Grading Scale:

Exam I (Chapters 1–2, 6) = **20%**

Exam II (Chapter 3) = **20%**

Exam III (Chapters 4–5) = **25%**,

Final Exam (Chapters 7, 12) = **20%**,

Quizzes **15%**.

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

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 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;
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- 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
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 - 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 2007

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 — Instructors:

Sections 1 (M5,6) and 2 (W5,6): Mr. Song Liu, liusong9@eden.rutgers.edu, EE-224, 5-4996.

Section 3 (Th 4,5): Mr. Dhurjatiprasad Nath, dhnath@eden.rutgers.edu, EE-224, 5-4996.

Experiments and Time Schedule

09/10/2007–09/16/2007

Introduction to MATLAB. *Mandatory Reading:* Appendix C, pages 622–632.

09/17/2007–09/30/2007

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).

10/01/2007–10/14/2007

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).

10/15/2007–10/28/2007

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).

10/29/2006–11/11/2007

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).

11/12/2007–11/28/2007

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.

All experiments will be performed using the MATLAB package for computer aided system design. The Lab will start in the week of September 10, 2007 and be held every other week in EIT (Engineering Information Technology) Lab, located in Engineering Building, D110. Attendance of the labs is mandatory. The students should hand in 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 Lab any time, but we advise that you complete lab assignments during the scheduled lab hours. **Teaching Assistants will be during their office hours (EVERY WEEK two periods per section) either in EIT-D110 or ELE103–105 or in their offices listed above.** Note that MATLAB can be also accessed via DSV/EIT server login to dsv.rutgers.edu using ssh.