University of Tehran
School of Electrical and Computer Engineering

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<tr><td>Course:</td><td>8101144 – Signals and Systems</td></tr>
<tr><td>Course type:</td><td>
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<tr><td></td><td colspan="6">EE*</td><td colspan="3">CE*</td><td rowspan="4">Credit:
3</td></tr>
<tr><td></td><td>Com</td><td>E</td><td>P</td><td>B</td><td>Con</td><td>D</td><td>SW</td><td>HW</td><td>IT</td></tr>
<tr><td>Required</td><td>☒</td><td>☒</td><td>☒</td><td>☒</td><td>☒</td><td>☒</td><td>☒</td><td>☒</td><td>☒</td></tr>
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<tr><td>Level:</td><td>Undergraduate ■
Graduate ☐</td></tr>
<tr><td>Co-requisite(s):</td><td>None</td></tr>
<tr><td>Prerequisite(s):</td><td>Electric Circuits, Engineering Mathematics</td></tr>
<tr><td>Prerequisite by topic:</td><td>Calculus, Complex Analysis</td></tr>
<tr><td>Textbook(s):</td><td>[1] A. V. Oppenheim, A. S. Willsky and S. Hamid, Signals and Systems, 2nd ed. Pearson, 1996.</td></tr>
<tr><td>Coordinator:</td><td>Amirmasoud Rabiei, Assistant Professor</td></tr>
<tr><td>Goals:</td><td>The main objective of this course is to introduce students to the fundamentals of continuous- and discrete-time signals and systems. To this end, students will learn mathematical tools such as convolution, Fourier analysis, Laplace transform and Z-transform and their applications in signal processing and system analysis.</td></tr>
<tr><td>Outcome:</td><td>Upon successful completion of the course, students will be able to
1. Describe continuous- and discrete-time signals and their important properties.
2. identify system properties such as linearity, time-invariance, memorylessness, causality, stability and invertibility
3. understand the important role of the impulse response in linear and linear time-invariant (LTI) systems, and use the impulse response to obtain the output of these systems to an arbitrary input signal.
4. obtain the Fourier transform and Fourier series of continuous- and discrete-time signals and explain their relationship.
5. determine the transfer function of and LTI system and analyze LTI systems using Fourier transform.
6. evaluate the Laplace transform of continuous-time LTI systems and analyze these systems using Laplace transform.
7. describe the Nyquist's sampling theorem and its application in converting continuous-time signals to discrete-time and vice versa.
8. obtain the Z-transform of discrete-time signals and use it to assess properties such as causality and stability.</td></tr>
<tr><td>Topics:</td><td>1. Continuous-Time Signals
signal definition, power and energy of a continuous signal;</td></tr>
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	applying linear transformations to signals; some important continuous signals; Dirac delta function and its properties. 2. **Continuous-Time Systems** system definition and its properties (linearity, time-invariance, memorylessness, causality, stability and invertibility); time domain analysis of linear and LTI systems; convolution integral and its properties 3. **Fourier Analysis of Continuous-Time Signals** Orthogonal functions and Fourier series representation of periodic signals, Fourier series properties; Fourier transform and its properties, Fourier transform of important signals; Applications of Fourier transform, Fourier analysis of LTI systems, Filtering, modulation and Nyquist's sampling theorem 4. **Laplace Transform** Definition and properties, Region of convergence (ROC); Laplace transform of important signals; Analysis of LTI systems using Laplace transform, Causality and stability of the LTI systems defined by linear differential equations; Integrator/differentiator implementation of linear systems; Unilateral Laplace transform and its properties 5. **Discrete-Time Signals and Systems** Time average, power and energy, Important discrete-time signals; Linear transformation of discrete signals; linearity, shift-invariance, memorylessness, causality, stability and invertibility of discrete systems, Convolution sum and its properties; Discrete-time Fourier series and Fourier transform, Fourier analysis of discrete-time systems; Z-transform and its properties; Analysis of linear shift-invariant (LSI) system using Z-transform
Computer usage:	2-3 Computer assignments using MATLAB
Assignments:	5 assignments
Projects:	None
Grading:	Assignments and quizzes 20-25 % Midterm exam: 30-35% Final exam: 40-50 %
Further readings:	[1] S. Haykin and B. Van Veen, *Signals and Systems*, John Wiley and Sons, 2nd ed. 1999. [2] Rodger E. Ziemer, William H Tranter and D. R. Fannin, *Signals and Systems: Continuous and Discrete*, 4th ed. Pearson, 1998. [3] W. J. Rugh, Notes for Signals and Systems, available from: http://www.ece.jhu.edu/~cooper/courses/214/signalsandsystemsnotes.pdf
Prepared by:	Amirmasoud Rabiei
Date:	August 2017

*EE: Electrical Engineering	CE: Computer Engineering

Com	Communications	SW	Software
E	Electronics	HW	Hardware
P	Power	IT	Information Technology
B	Bioelectronics		
Con	Control		
D	Digital System		