University of Tehran
School of Electrical and Computer Engineering

<table>
<tr><td>Course:</td><td>Digital Signal Processing</td></tr>
<tr><td>Course type:</td><td>
<table>
<tr><td></td><td colspan="6">EE*</td><td colspan="3">CE*</td><td rowspan="2">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><td></td></tr>
<tr><td>Elective</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td></td></tr>
</table>
</td></tr>
<tr><td>Level:</td><td>Undergraduate ■
Graduate ■</td></tr>
<tr><td>Co-requisite(s):</td><td>Mathematical Eng.,</td></tr>
<tr><td>Prerequisite(s):</td><td>Signals and systems, Probability and Statistics</td></tr>
<tr><td>Prerequisite by topic:</td><td>Mathematic description and analysis methods of the linear continuous time systems changeless with time and analog signals.</td></tr>
<tr><td>Textbook(s):</td><td>[1] Alan V. Oppenheim, Ronald W. Schafer, Discrete-Time Signal Processing, 2nd Ed., Prentice Hall, 1999.</td></tr>
<tr><td>Coordinator:</td><td>Mohammad Ali Akhaee, Assistant Professor</td></tr>
<tr><td>Goals:</td><td>To understand
1- The required Mathematics and techniques for analyzing the linear and discrete time invariant systems. Also random and determined discrete time signals.
2- The useful transform in signal processing like Fourier, Z, Hilbert, and Discrete Cosine Transform
3-The Increasing and decimation the rate of sampling and multi rate processing.
4- The structures of LTI systems realization
5- The design and analyze of digital filters (minimum phase, linear and nonlinear phase)</td></tr>
<tr><td>Outcome:</td><td>Upon successful completion of the course, students will be able to
1. Perform Fourier transform and inverse Fourier transform using the definitions, Tables of Standard Transforms and Properties
2. Plot and interpret magnitude and phase of LTI system frequency responses.
3. Perform Z and inverse Z using tables, Partial-Fraction Expansion, and power series expansion.
4. Design FIR and IIR filters by hand to meet specific magnitude and phase requirements.
5. Up-sampling/down-sampling, and processing of Poly-phase signals
6. Design and implement digital filters using Matlab software.
7. Use computers and MATLAB to create, analyze and process signals, and to simulate systems of audio and image synthesis and analysis.</td></tr>
</table>

Topics:	1. Discrete-time linear shift-invariant systems 2. Complex numbers and functions of a complex variable 3. One-sided z-transform 4. Convolution and unit-pulse response 5. Transfer function and block diagrams 6. Discrete-time Fourier transform (DTFT) 7. Digital frequency and frequency response 8. A/D and D/A conversion 9. Multirate systems 10. FIR and IIR filter design 11. Discrete Cosine transform (DCT) 12. Spectral analysis 13. Fast Fourier transform (FFT) 14. Applications to speech, medical imaging, communications, etc. (If time allows)
Computer usage:	Some parts of the course will be presented using PowerPoint.
Assignments:	Seven written assignments, three computer assignments.
Projects:	The project consists of the design and implementation of some of the course topics. The project differs for Communication and Biomedical Eng. Students.
Grading:	Assignments 15% Final Project 10% Quiz 5% Midterm exam: 30% Final exam: 40%
Further readings:	[1] John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, 4th Ed., Prentice Hall, New Delhi, 2006. [2] Sanjit K. Mitra, Digital Signal Processing: A Computer Based Approach, 2nd Ed., Mc. Graw Hill, Boston, 2002. [3] Manson H. Hayes, Digital Signal Processing, Schaums Outline, Mc. Graw Hill, New York, 1999.
Prepared by:	Mohammad Ali Akhaee
Date:	Aug, 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		