SYLLABUS: SIGNAL AND SYSTEM 1

Date / Revision August 22, 2017 / 22.08.17 /MaS
Faculty Engineering
Study Programm Mechatronics

SUBJECT: Signal and System 1

1 Basic Information

1.01	**Subject Name**	**Signal and System 1**
1.02	**Semester**	4
1.03	**Level**	1
1.04	**SKS**	2
1.05	**Mandatory / Curriculum**	D-08
1.06	**Subject Code**	SSYS
1.07	**Subject Code**	MTE-D-4108
1.08	**Year**	2017 (7)
1.09	**Quality Control**	Final Test, see evaluation
1.10	**Limitations**	Min 12 and Max 32 students in one class
1.11	**Combined with**	ELE, BME
1.12	**Perquisite**	Applied Mathematics
1.13	**Responsible**	Dean of Engineering Faculty
1.14	**Revision**	22-08-2017/MaS

2 Description of Subject

The concepts of signals and systems arise in a wide area of science and technology of communications, aeronautics, circuit design, acoustics, seismology, biomedical engineering, energy generation and distributions system, chemical process control and speech processing. The technology development and algorithms of this subject grow rapidly. This course is an introduction to the basic concepts and theory of analog and digital signal processing. Students need to have a basic background of calculus as well as some experience in manipulating complex numbers and some exposure to differential equations. Prior exposure to the fundamentals of circuits for electrical engineers is helpful.

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3 Objectives

- Introduces the concept of signals and systems
- introduce the Continuous- Time- and Discrete-Time Signals and their properties
- introduce the method of analysing of CT- and DT-Signals.

4 Competency

After having the course, students are expected have to:

- Have ability in parallel the methods of analysis for continuous-time and discrete-time signals and systems
- Have equal familiarity with techniques suitable for analyzing and synthesizing both continuous-time and discrete-time systems
- Develop insight and intuition the similarities and differences between continuous-time and discrete-time systems
- Understand the concept of frequency-domain analysis of signals and systems using Fourier analysis and the basic applications of filtering, sampling, communications, and feedback system

5 Learning Approach / Methodology

- Lectures/ Class contact (time-tabled) supplemented with interactive questions and answers;
- Discussion, sample problem, group work;
- Student Study Effort: homework/assignment; preparation for test/quizzes/ examination.

6 Evaluation

5.1	**Absence maximum**	25%
5.2	**Participation in Discussion**	05 Points
5.3	**Homework / Classwork**	05 Points
5.4	**Presentation /Simulation**	10 Poins
5.5	**Daily Quiz**	20 Points
5.6	**Final Examination**	60 Points
	Total	100 Points

7 Text Book and Reference

1	**Main Text Book:** "Signals and Systems, 2nd Edition, 1998", Authors: Alan V. Oppenheim, Publisher: rentice-Hall International.

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2	**Supplementary Text books:** • "Signals and Systems, 1st Edition, 2014", Authors: Mahmood Nahvi, Publisher: McGraw Hill.

8 Content / Topics of Lecture

Week	Content/ Topics of Lecturing	Text Book	Remark
1	**Signals and Systems** Introduction, Continuous-Time and Discrete-Time Signals, Transformations of the Independent Variable, Exponential and Sinusoidal Signals, The Unit Impulse and Unit Step Functions, Continuous-Time and Discrete-Time Systems, Basic System Properties	Ch1[1], 1[2]	
2	**Linear Time-Invariant (LTI) Systems** Discrete-Time LTI Systems (The Convolution Sum), Continuous -Time LTI Systems (The Convolution Integral), Properties of Linear Time-Invariant Systems, Casual LTI Systems Described by Differential Equations	Ch2[1], 13[2]	
3-4	**Fourier Series Representation of Periodic Signals** The Response of LTI Systems to Complex Exponentials, Fourier Series Representation of Continuous-Time Periodic Signals, Convergence of the Fourier Series, Properties of Continuous-Time Fourier Series, Fourier Series Representation of Discrete-Time Periodic Signals, Properties of Discrete-Time Fourier Series, Fourier Series and LTI Systems, Filtering, Examples of Continuous- Time and Discrete-Time Filters described by Difference Equations	Ch3[1], 7[2]	Q1
4	**Momentum Analysis of Flow Systems:** Newton's Laws; Choosing a Control Volume; Forces Acting on a Control Volume; The Reynolds Transport Theorem; The Linear Momentum Equation.	Ch13[1]	
5	**The Continuous-Time Fourier Transform** Representation of Aperiodic Signals: The Continuous-Time Fourier Transform, The Fourier Transform for Periodic Signals, Properties of the Continuous-Time Fourier Transform, The Convolution Property, The Multiplication Property	Ch4[1]	Q2
6	**The Discrete-Time Fourier Transform** Representation of Aperiodic Signals: The Discrete-Time Fourier Transform, The Fourier Transform for Periodic Signals, Properties of the Discrete-Time Fourier Transform, The Convolution Property, The Multiplication Property, Duality	Ch5 [1]	
7	**Time and Frequency Characterization of Signals and Systems** The Magnitude-Phase Representation of the Fourier Transform, The Magnitude-Phase Representation of the Frequency Response of LTI Systems, Time-Domain Properties of Ideal Frequency- Selective Filters, Time-Domain and Frequency-Domain Aspects of Nonideal Filters, First-Order and Second-Order Continuous-Time Systems, First-Order and Second-Order Discrete-Time Systems, Examples of Time- and Frequency-Domain Analysis of Systems	Ch6[1]	Q3

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8	**MIDTERM SEMESTER BREAK**		
9	**Sampling** Representation of a Continuous-Time Signal by its Samples: The Sampling Theorem, Reconstruction of a Signal from Its Samples Using Interpolation, The Effect of Undersampling: Aliasing, Discrete-Time Processing of Continuous-Time Signals, Sampling of Discrete-Time Signals	Ch7[1]	
10	**Communication Systems** Complex Exponential and Sinusoidal Amplitude Modulation, Demodulation for Sinusoidal AM, Frequency-Division Multiplexing, Single-Sideband Sinusoidal Amplitude Modulation, Amplitude Modulation with a Pulse-Train Carrier, Pulse-Amplitude Modulation, Sinusoidal Frequency Modulation, Discrete-Time Modulation	Ch8[1]	
11-12	**The Laplace Transform** The region of Convergence for Laplace Transforms, The Inverse Laplace Transform, Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot, Properties of the Laplace Transform, Some Laplace Transform Pairs, Analysis and Characterization of LTI Systems Using the Laplace Transform, System Function Algebra and Block Diagram Representations, The Unilateral Laplace Transform	Ch9[1], 6[2]	Q4
13	**The Z-Transform** Introduction of The Z-Transform, The Region of Convergence for the Z-Transform, The Inverse Z-Transform, Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot, Properties of the Z-Transform, Some Common Z-Transform Pairs, Analysis and Characterization of LTI Systems Using Z-Transforms, System Function Algebra and Block Diagram Representations, The Unilateral Z-Transform	Ch10[1], 15[2]	
14	**Linear Feedback Systems** Introduction to Linear Feedback Systems, Some Applications and Consequences of Feedback, Root-Locus Analysis of Linear Feedback Systems, The Nyquist Stability Criterion	Ch11[1]	Q5
15	**Rehearsal and Tutorial:** Rehearsal of all topics and students can ask for more detail		
15	**Rehearsal and Tutorial:** Rehearsal of all subject and students can ask for more detail.		
16	**Final Examination**		

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