EE2353 Section 002: Syllabus Version 1 Draft (updated 8/25/20)
CONTINUOUS-TIME SIGNALS AND SYSTEMS
FALL 2020, Synchronous Online Course on Blackboard, Textbook by Ulaby and Yagle.

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OFFICE HRS.: **Monday, Wednesday (priority for EE2353)** TBD
Tuesday, Thursday Priority another class TBD
Friday (if no other meetings) 11:00 AM - 12:00 PM (send e-mail before to confirm)

CLASS TIME/PLACE: Section 2: Tuesday and Thursday 3:00 PM – 4:20 PM (CRN: 15344)

TEXTBOOKS WITH ONLINE TOOLS:
I- Signals & Systems: Theory and Applications by Ulaby and Yagle, Michigan Publishing, 2018, 666 pages.
Free download at https://services.publishing.umich.edu/publications/ee/
The book has a companion Web site at ss2.eecs.umich.edu
It has additional examples and problems, solutions to selected problems, Labview student edition download instructions for LabView Student Edition, Labview modules, Matlab modules, etc.
This same book is found in hardbound version under a slightly different name: Engineering Signals and Systems in Continuous and Discrete Time, Second Edition. National Technology & Science Press, 2016.

II- Continuous_Time_Signals_and_Systems (Edition 2.0) by Michael D. Adams - 366 pages
Free download from:
https://books.google.com/books/about/Continuous_Time_Signals_and_Systems_Edit.html?id=BWPXDwAAQBAJ
Or here: https://www.ece.uvic.ca/~frodo/sigsysbook/downloads/continuous_time_signals_and_systems-2013-09-11-uvic-v2.pdf

Course Catalog Description: Representation and analysis of continuous time signals; time and frequency analysis of linear time-invariant systems; convolution, differential equations, Laplace transform, Fourier series and transform, filters.

Pre-requisites: EE2351 Electric Circuits 2 with a minimum grade of "C".

Prerequisites by topic: calculus and differential equations; complex numbers and functions; basic time-domain, steady-state and transform domain Circuit Analysis; basic familiarity with MATLAB software tools.

Specific Outcomes for the Course. By the end of the semester the student will demonstrate the ability to:

- Carry out transformations of signals and characteristics of continuous-time (C-T) signals and systems.
- Apply convolution and its properties to solve Linear Time-Invariant (LTI) systems.
- Use Fourier series, Fourier transforms and their properties to analyze C-T signals and systems.
- Compute and use impulse and frequency responses of linear time invariant systems.
- Use the Laplace transform to analyze C-T systems.

IMPORTANT POLICY:
- Homeworks will be graded pass-fail to reduce incentive to copy, some problems will be solved in class, solutions or brief answers will be provided, this is where most of the learning takes place.

- Quizzes will be based on the homework problems expecting that each student attempted the homework. The approach will be open-book, open notes, open homework paper, solve by hand, with very limited time allowed during the class time period.
- Exams rules will be determined for each exam the weak prior to its offering subject to availability of UTEP proctoring services: the preferred approach would be face-to-face proctored exams with no access to computers, smartphones, electronic documents, etc. These exams are to be solved by hand with self-prepared, handwritten notes and paper copies of key textbook Tables allowed. If this is not possible, an approach that is methodologically similar will be set up to assess knowledge and understanding of concepts, solutions skills, and understanding of the applications illustrated.

COURSE GRADING TENTATIVE!!!!

- Two in-class Semester Exams (self-prepared notes, Tables allowed, partially oral,) **50%**
- Homeworks, LabView Projects, MATLAB Projects, and Quizzes. **50%**
- Make-up Exams (self-prepared notes, Tables allowed) **Final Exam time period**

USE OF E-MAIL: Each student is required to read their officially registered UTEP e-mail account often enough to monitor ongoing information related to this course including Blackboard announcements. For the most part, blackboard uploading of instructor produced documents replaces the use of direct e-mail delivery.

USE OF BLACKBOARD: This class is being offered synchronously at the official scheduled time via Blackboard including quizzes and exams solved mostly during the class time periods.

COMPUTER USAGE: The LabView and MATLAB software package (with many Toolkits and Toolboxes) is made available via download or a DVD or direct install on your laptop to all Engineering Students from the Engineering Technology Center (ETC)
http://etc.utep.edu/ Tel. (915)747-5223, E-mail: **etchelpdesk@utep.edu**

TOPICS TO BE COVERED BASED ON U-Y TEXTBOOK (the exact order, pages and/or sections and subsections will be listed in homework assignment handouts). Description of topics are slightly modified from the table of contents.

U-Y Chapter 1 Signals:
1-1 Types of Signals, define Systems;1-2 Signal Transformations;1-3 Waveform/Signal Properties;1-4 Basic Waveforms: steps, ramps, rectangles, impulses, exponentials, etc.;1-5 Signal Power and Energy;

Supplement from Adams Chapter 2: Continuous-Time Systems; Block Diagram Representation; Interconnection of Systems; Properties of Continuous-Time Systems Properties: Memory; Causality; Invertibility; Stability; Time Invariance; Linearity Examples.

U-Y Chapter 2 Linear Time-Invariant Systems
2-1 Linear Time-Invariant (LTI) Systems; 2-2 Impulse Response and Step Response;2-3 Convolution derivation;2-4 Graphical Convolution evaluation;2-5 Properties of the Convolution operation;2-6 Causality and BIBO Stability of LTIs;2-7 LTI Sinusoidal Response; EE Examples: Circuits, communications, averaging filters, etc. ~~2-8 Impulse Response of Second-Order LCCDEs; 2-9 Example LTI: Car Suspension System~~

U-Y Chapter 3 Unilateral Laplace Transform Review and Extensions
3-1 Definition of the (Unilateral) Laplace Transform;3-2 Poles and Zeros;3-3 Properties of the Laplace Transform;3-4 Circuit Analysis Example;3-5 Partial Fraction Expansion;3-6 Transfer Function **H(s)**;3-7 Poles and System Stability;~~3-8 Invertible Systems;~~3-9 Bilateral Transform for Continuous-Time Sinusoidal Signals;~~3-10 Interrelating Different Descriptions of LTI Systems;3-11 LTI System Response Partitions;~~

U-Y Chapter 4 Applications of the Laplace Transform

4-1 ~~s-Domain Circuit Element Models;~~4-2 ~~s-Domain Circuit Analysis;~~4-3 ~~Electromechanical Analogs;~~4-4 ~~Biomechanical Model of a Person Sitting in a Moving Chair;~~4-5 ~~Op-Amp Circuits;~~4-6 ~~Configurations of Multiple Systems;~~4-7 ~~System Synthesis;~~4-8 Basic Control Theory;4-9 Temperature Control System;~~4-10 Amplifier Gain-Bandwidth Product~~;4-11 Step Response of a Motor System;4-12 Control of a Simple Inverted Pendulum on a Cart.

U-Y Chapter 5 Fourier AnalysisTechniques
5-1 Phasor-Domain Technique; 5-2 Fourier Series Analysis Technique;5-3 Fourier Series Representations; 5-4 Computation of Fourier Series Coefficients; 5-5 Circuit Analysis with Fourier Series; 5-6 Parseval's Theorem for Periodic Waveforms; 5-7 Fourier Transform; 5-8 Fourier Transform Properties; 5-9 Parseval's Theorem for Fourier Transforms; 5-10 Additional Attributes of the Fourier Transform; 5-11 Phasor vs. Laplace vs. Fourier; 5-12 Circuit Analysis with Fourier Transform; 5-13 The Importance of Phase Information;

U-Y Chapter 6 Applications of the Fourier Transform
6-1 Filtering a 2-D Image; 6-2 Types of Filters; 6-3 Passive Filters; 6-4 Active Filters; 6-5 Ideal Brick-Wall Filters; 6-6 Filter Design by Poles and Zeros; 6-7 Frequency Rejection Filters; 6-8 Spectra of Musical Notes; 6-9 Butterworth Filters; 6-10 Denoising a Trumpet Signal; 6-11 Resonator Filter; 6-12 Modulation; 6-13 Sampling Theorem.

Supplement from Adams Chapter 6: ~~Bilateral Laplace Transform: Introduction; Motivation Behind the Laplace Transform; Definition of the Laplace Transform;~~ Relationship Between Laplace Transform and Continuous-Time Fourier Transform; Laplace Transform Examples; Region of Convergence for the Laplace Transform; Properties of the Laplace Transform; ~~Linearity Time-Domain Shifting; Laplace-Domain Shifting; Time-Domain/Laplace-Domain Scaling; Conjugation;~~ Time-Domain Convolution; ~~Time-Domain Differentiation; Laplace-Domain Differentiation;Time-Domain Integration; Initial Value Theorem Final Value Theorem;~~ More Laplace Transform Examples; Determination of the Inverse Laplace Transform; Characterizing LTI Systems Using the Laplace Transform System Function and System Properties; Causality; Stability; Invertibility; Systems and Differential Equations; Interconnection of LTI Systems; ~~Unilateral Laplace Transform; Solving Differential Equations Using the Unilateral Laplace Transform.~~

EFFORT, PARTICIPATION, ETIQUETTE and DECORUM: (adjusted for online delivery and Pandemic)

- Students that are clearly not doing the homeworks, are failing quizzes, and who fail Exam 1 (significantly below the average) are advised to drop the course before Drop Day or to ask me to submit a faculty drop.
- **Raise your hand, write in the chat, or turn on your microphone and speak** for asking questions or giving comments.
- Use of laptop/smartphone during class is encouraged for the purposes of accessing the e-book, Connect, lecture slides, handouts, solutions, etc.
- **Fairness statement** (version 3): the key fairness criterion for this course is equal opportunity for all students to receive feedback, help, information, scores, handouts, etc., individual requests cannot be accommodated. Difficulty variation for quizzes and exams is adjusted by curving the scores before entering into the final semester score formula. Typically, this means obtaining a score on a scale of 100% by dividing the raw score by a constant S=approximately the 3rd highest score in the class on that Exam or for the total score for all homeworks+quizzes. Grades are not negotiable individually but fair adjustments can be made for the whole class.

ACADEMIC INTEGRITY: Please review the statements below and UTEP's Web page on Policy on Academic Integrity at: **https://www.utep.edu/student-affairs/osccr/student-conduct/academic-integrity.html**

SAVE THIS LIST: The list of topics from second book (by Adams) USE THIS FOR CUT AND PASTE TOPICS

1 Introduction
Dimensionality of Signals; Continuous-Time and Discrete-Time Signals; Notation and Graphical Representation of Signals; Examples of Signals; Systems; Classification of Systems; Examples of Systems; Why Study Signals and Systems.

2 Continuous-Time Signals and Systems 7
2.1 Transformations of the Independent Variable; Transformations of the Dependent Variable; Amplitude Scaling; Amplitude Shifting; Combining Amplitude Scaling and Shifting; Signal Properties Even and Odd Signals; Periodic Signals; Support of Signals; Signal Energy and Power Elementary Signals; Real Sinusoidal Signals; Complex Exponential Signals; Unit-Step Function; Unit Rectangular Pulse; etc. Unit Triangular Pulse; Cardinal Sine Function; Unit-Impulse Function Representation Using Elementary Signals; Continuous-Time Systems; Block Diagram Representation; Interconnection of Systems; Properties of Continuous-Time Systems Properties: Memory; Causality; Invertibility; Stability; Time Invariance; Linearity Examples.

3 Continuous-Time Linear Time-Invariant Systems 45 3.1 Introduction; Continuous-Time Convolution; Properties of Convolution; Commutative Property; Associative Property; Distributive Property; Representation of Continuous-Time Signals Using Impulses; Continuous-Time Unit-Impulse Response and Convolution Integral Representation of LTI Systems; Unit-Step Response of LTI Systems; Block Diagram Representation of Continuous-Time LTI Systems; Interconnection of Continuous-Time LTI Systems; Properties of Continuous-Time LTI Systems; Memory; Causality; Invertibility; Stability; Response of Continuous-Time LTI Systems to Complex Exponential Signals; Problems

4 Continuous-Time Fourier Series 77 4.1 Introduction; Definition of Continuous-Time Fourier Series; Determining the Fourier Series Representation of a Continuous-Time Periodic Signal; Convergence of Continuous-Time Fourier Series;Properties of Continuous-Time Fourier Series;Linearity Time Shifting Time Reversal; Fourier Series and Frequency Spectra; Fourier Series and LTI Systems; Filtering.

5 Continuous-Time Fourier Transform: Introduction; Development of the Continuous-Time Fourier Transform; Definition of the Continuous-Time Fourier Transform; Convergence of the Continuous-Time Fourier Transform; Properties of the Continuous-Time Fourier Transform; Linearity;Time-Domain Shifting Frequency-Domain Shifting;Time- and Frequency-Domain Scaling Conjugation Duality Time-Domain Convolution Frequency-Domain ConvolutionTime-Domain Differentiation; Frequency-Domain Differentiation;Time-Domain Integration Parseval's Relation; Continuous-Time Fourier Transform of Periodic Signals; Fourier Transforms; Frequency Spectra of Signals Bandwidth of Signals; Frequency Response of LTI Systems Frequency Response and Differential Equation Representations of LTI Systems; Energy Spectral Density; Power Spectral Density; Filtering; Sampling and Interpolation; Sampling; Interpolation and Reconstruction of a Signal From Its Samples; Sampling Theorem;Amplitude Modulation; Modulation With a Complex Sinusoid; DSB/SC Amplitude Modulation SSB/SC Amplitude Modulation; Equalization;

6 Laplace Transform: Introduction; Motivation Behind the Laplace Transform; Definition of the Laplace Transform;Relationship Between Laplace Transform and Continuous-Time Fourier Transform;Laplace Transform Examples; Region of Convergence for the Laplace Transform; Properties of the Laplace Transform; Linearity Time-Domain Shifting; Laplace-Domain Shifting; Time-Domain/Laplace-Domain Scaling; Conjugation; Time-Domain Convolution; Time-Domain Differentiation; Laplace-Domain Differentiation;Time-Domain Integration; Initial Value Theorem Final Value Theorem; More Laplace Transform Examples; Determination of the Inverse Laplace Transform; Characterizing LTI Systems Using the Laplace Transform System Function and System Properties; Causality; Stability; Invertibility; Systems and Differential Equations; Interconnection of LTI Systems; Unilateral Laplace Transform; Solving Differential Equations Using the Unilateral Laplace Transform.