List of topics for ECE 565 midterm exam

ECE 565, Spring 2008

(Presented in class on 3 April 2008)

1 Introduction and review

1. What is a signal?
2. What is a continuous-time signal, a discrete-time signal, a period signal, an aperiodic signal?
3. How can you create a DT signal from a CT signal?
4. Basic signals: unit impulse (CT and DT), unit step (CT and DT), exponential signals.
5. Understand and be able to apply the sifting property of the unit impulse (CT and DT).
6. Basic complex algebra: Euler's formula, real and imaginary part, magnitude and phase, conjugate complex
7. What is a system (from the theoretical/mathematical point of view)?
8. Understand the definitions of and be able to distinguish between basic system categories (CT and DT): memoryless systems, time-invariant systems, causal system, LTI systems, BIBO-stable systems
9. What is the impulse response of an LTI system?
10. What is the frequency response of an LTI system?
11. What is the step response of an LTI system?
12. Understand relationship between input, output, and impulse response for LTI systems.
13. What is a transform? Understand the definitions of and the relationships between (CT) Fourier series, (CT) Fourier transform, DT Fourier series, and DT Fourier transform.
14. What is a system function or transfer function?
15. Be able to use tables of transform properties and transform pairs in order to perform basic mathematical operations (delay, difference/differentiation, convolution, conjugation, etc.) in the transform domain.

2 The z transform

1. Understand the definitions and relationships between Laplace transform and z transform.
2. Understand that Laplace transform and z transform are generalizations of (CT) Fourier transform and DT Fourier transform.

3. Understand the relevance of the $j\Omega$-axis in the Laplace domain and of the unit circle in the z-domain in the context of system stability.
4. Be able to find the frequency response of a given CT or DT system if the system function is given.
5. Understand and be able to use tables of transform pairs.
6. Understand the importance of the region of convergence (ROC) of a DT system function.
7. Be able to use tables of transform properties and transform pairs in order to perform basic mathematical operations (delay, difference/differentiation, convolution, conjugation, etc.) in the transform domain.
8. Be able to use z-transform properties and z-transform pairs to find the impulse response of basic recursive LTI systems.
9. Be able to use linearity and convolution property of z-transform to rearrange LTI system combinations.
10. Understand and be able to apply basic properties of the ROC of z-transforms.

3 Transform analysis of signals and systems

1. Demonstrate a mathematical and a practical understanding of impulse response, step response, and frequency response.
2. Frequency responses of some basic systems, including ideal delay system, averaging system, and backward difference system.
3. Be able to read and create Bode plots.
4. Use of the DTFS for spectral analysis of sampled data
5. The DTFS is the DTFT sampled at discrete normalized frequencies ω.
6. Understand the relationships between (physical) frequencies (or CT frequencies) f and Ω and the normalized frequency (or DT frequency) ω.
7. Understand the phenomenon of DTFS leakage.
8. The DTFS of a rectangular pulse.
9. Time-domain zero-padding.
10. Stability and causality.
11. Rational DLTI systems. Partial fraction expansion.