Test #2 Overview

Related Textbook Material

Ch. 1, Sect. 1-4, 6-8 and Ch. 2, Sect. 1-8 in *Linear Signals & Systems, 2nd Ed.* by Lathi
Ch. 13, Sect. 6 in *Electric Circuits, 9th Edition* by Nilsson

Related Assignments

Homework Assignments #4-5

Related Powerpoint Presentations

Lectures #7 - 11

Test Format

No books, no notes
All calculators allowed
Multiple-choice, True/False problems (especially for signal & system properties)
Calculation-oriented problems
Graphing problems (convolution, signal operations)

Signals & Systems

Energy and power signals:
- Determine whether a signal is an energy signal, a power signal, or neither.
- Calculate energy, power, and RMS values

Signal operations:
- Time-shifting, time-scaling (compression & expansion), time-reversal
- Sketching or identifying shifted, scaled, and/or reversed signals
- Expressing a waveform in terms of other waveforms

Classification of signals: (Be able to identify given a function or graph)
- Continuous-time and discrete-time signals
- Analog and digital signals
- Periodic and aperiodic signals
- Energy and power signals
- Deterministic and probabilistic signals

Useful signal models:
- $\delta(t)$, $u(t)$, e^{st}
- Sifting property – evaluate functions or integrals

Classification of systems: (Be able to identify given a function, circuit, or graph)
- Linear and non-linear systems: Determine if a given function is linear using two key tests:
  1. Linearity: $kf(x) = f(kx)$
  2. Additivity: $f(x_1 + x_2) = f(x_1) + f(x_2)$
- Time-invariant (or constant parameter) and time-varying systems
- Static (instantaneous or memoryless) or dynamic (with memory) systems
- Causal and noncausal systems
- Continuous-time and discrete-time systems
- Analog and digital systems
- Invertible and noninvertible systems

- Stable and unstable systems

Representation and Analysis of Systems
1. Differential equations
   - Find the D.E. (review from EGR 260)
   - Find the unit step response, USR, or the impulse response, h(t) from a D.E. (review)
   - Given the USR, find the impulse response = h(t) = d/dt[USR(t)]
   - Find H(s) from the D.E.
2. Transfer functions
   - Find the transfer function using Laplace transforms (review - covered on Test #1)
   - Use the transfer function to find h(t), USR, or y(t) for any x(t) (review – covered on Test #1
3. **Convolution** (major topic – perhaps 40% - 50% of test)
   - $$\text{Definition}: \ f(t)*g(t) = \int_{-\infty}^{\infty} f(\tau)g(t-\tau)d\tau$$
   - Graphical approach only
   - Include accurate sketches to illustrate the solution.
     - Clearly list range of t where each intersection occurs
     - Clearly list the corresponding limits of integration
   - Convolution integral properties - for example, g(t)*f(t) = f(t)*g(t)
     - So you can delay and shift either signal. Delay and shift the simplest signal!
   - Length of the convolution of two signals = sum of the lengths of the individual signals