332:345 – Final-Exam Review Topics – Fall 2009

- All review Topics for Exams 1 & 2.
- Cauchy-Schwarz inequality for time signals and for Fourier transforms.
- Uncertainty principle for a Fourier transform pair $f(t) \Leftrightarrow F(\omega)$.
- Fourier transform applications in communications. AM and QAM modulators and demodulators. Raised-cosine and square-root raised cosine pulse shaping filters. Matched filters.
- Design of analog audio parametric equalizer filters. Concepts of boost or cut gain, dB units, octave units, bandwidth, bandwidth gain.
- State-space realizations. Concepts of state-vector, state matrix, transition matrix. Solution of state-space equations in the time domain and by using Laplace transforms.
- Transfer function, $H(s) = C(sI - A)^{-1}B + D$, expressed in terms of state-space parameters.
- Impulse response, $h(t) = Ce^{At}B + D\delta(t)$, expressed in terms of state-space parameters.
- Calculating $\Phi(s) = (sI - A)^{-1}$ and $\phi(t) = e^{At}$ by hand for order-2 systems, and for higher-order, but diagonal, systems (i.e., obtained from the partial-fraction expansion of the transfer function)
- Deriving state-space forms from block diagram realizations of transfer functions. *Rule:* choose as states the outputs of the integrators that appear in the block diagram.
- State-space realizations obtained from the controller and observer canonical block-diagram realizations, and the diagonal state-space forms obtained from writing the transfer function in its partial-fraction expansion form.
- Transposed realizations. Applying the four transposition rules to obtain new block diagram realizations.
- Using the observability matrix to map the initial conditions for $y(t)$ into the initial conditions for the state-vector $\mathbf{x}(t)$.
- Solving for the output $y(t)$ for a given input $f(t)$ and given initial conditions for $y(t)$, in three different ways: (a) using Laplace transforms on the original high-order input/output differential equation, (b) using the modified form (discussed in Ch.7) of decomposing $y(t)$ into particular plus homogeneous solutions, and (c) using a state-space realization, after mapping the initial conditions for $y(t)$ into initial conditions for the state vector.

Reading Materials:

Primarily your class notes. All assigned sections from the textbook.

Practice Problems:

Examples in class and in text.
Sample exam problems (solutions are not available).
Textbook problems (assigned or not assigned).
Matlab programming ideas in labs 1–5.