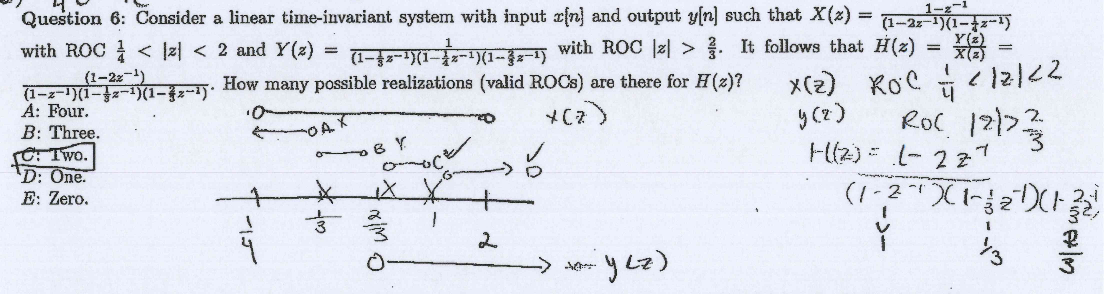
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| **ECE 3300 Exam 6 Notes Sheet — Spring 2017 — Revision 10** | | | | | |
| Convolution Property of the Laplace/Z Transform | | | If there is **no** pole-zero cancellation between the numerator and denominator factors in X and H, then the ROC of Y is equal to the intersection of the ROCs of X and H. | | If there **is** a pole-zero cancellation between numerator and denominator factors in X and H, then the ROC of Y is larger than the intersection of the ROCs of X and H. |
| Output given input and impulse response. (Can rearrange): | Application of Convolution Property for LTI Systems  If solving for the H(s) or X(s), the ROC must be chosen such that the ROC of Y(s) includes the intersection of the ROCs of H(s) and X(s). This applies for H(z) or X(z) as well. | | For a LTI system, the transfer function H(s)/H(z) is defined as the Laplace/Z transform of the impulse response h(t)/h[n]. | | The zeroes of H(s)/H(z) are the values of s/z for which H(s)=0/H(z)=0  The poles of H(s)/H(z) are the values of s/z for which H(s)/H(z) is infinite. |
| Rational Transfer Functions  The transfer function H(s)/H(z) is rational if it can be written as where N(s) and D(s) are polynomial functions of s.  **Causal** – Something larger than largest pole | It is proper if the degree of N(s)/N(z) is no greater than the degree of D(s)/D(z).  Any bounds for Re{s} are 0, it is **not** stable.  For |z| : If either bound(s) are 1 it is **not stable (?)**  **CAUSAL & STABILITY** | | If h(t)/h[n] is real, H(s) /H(z) does not depend on except through s/z.  A pole-zero diagram is a plot of the poles and zeroes of a transfer function in the complex plane. **Poles are indicated by “x” and zeroes by “o”** | | Transfer Functions and Causality    Given a proper rational transfer function H(s) or H(z), exactly one realization is causal, and at most one realization is stable.  If an ROC has the form , the corresponding realization is **causal**. If an ROC includes , then the corresponding realization is **stable**. |
|  | | | An LTI system with transfer function H(s)/H(z) is stable if and only if the ROC of H(s)/H(z) includes  Distances on Complex Plane  The quantity / is the distance from the complex point to the point / (on the axis/on the unit circle) in the complex plane. | |  |
| **Parallel Connection of LTI Systems** | **Series Conn. of LTI Systems**    **Distance between two points** | | Inverse LTI Systems:  **Oversampling**  If , a non-ideal low-pass filter can be used.    The percentage oversampling: | | Feedback Connection of LTI Systems  **Small Example (Unrelated)**  Single poles at *s=3* and *s=-3*, single zeroes at *s=1+j* and *s=1-j*; *H(0)=2*  , Solve for k to get:  **Note**: Poles on bottom, zeroes on top!  **Note 2:** For pole-zero diagrams, multiply whole equation by inverse of highest power. (e.g. \*) |
|  |  | |  | | Butterworth Low-Pass Filters |
| Chebyshev Type 1 Low-pass Filters | Chebyshev Type 2 Low-pass Filters | | Elliptic Low-pass Filters | | Sampling a Bandlimited Signal  If x(t) has max. frequency , then given below has this form:  The minimum for no overalp , is called the Nyquist sampling rate. |
| Sampling a Continuous-Time Signal  Suppose is a continuous-time signal. The associated sampled signal is defined as , where is the time between samples and is the sampling rate. | Fourier Analysis of a Sampled Signal  If has Fourier transform , then the associated sampled signal has fourier transform: | | Restoring a Continuous-Time Signal  If x(t) has a maximum frequency and the associated sampled signal has sampling rate , then x(t) can be perfectly recovered from via: | | Low-Pass Filter Implementation of Signal Restoration  If has max. frequency and the associated sample signal has sampling rate , then, if  is put trough an ideal low-pass filter with cutoff frequency , the result is . |
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| Pole-Zero Diagram  System: | | Input-Output Differential Equation  Impulse Response: | |  | |
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For 3 different LTI systems: , , . What are the realizations of the 3 different systems?