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| **ECE 3300 Exam 4 Notes Sheet - Revision 11** | | | |
| Output from given input and impulse reponse:    Input of given output and impulse response    Impulse response given input and output    Fourier Transform | Fourier Transforms for Convolution Problems | | (5.1) Summary of Problem Solving Tips  **Tip #1**: Put each transform over a common denominator. Do not expand out the denominator; keep it as a product of terms.  **Tip #2**: Make factors have the form    **Tip #5 and #6**: Draw graphs when dealing with rects and expand terms when there is no fraction  **Tip #4**: Use the following as needed: |
| The **magnitude response** of a linear time-invariant system is defined as the magnitude of the Fourier transform of the impulse response.    Every LTI system adjusts frequency content via these equations! Every LTI system is a frequency-selective filter! | * An LTI system is **passive** if for all If the system is not passive it is **active**. * Every *active* LTI system must contain an auxiliary power supply. * A system is **distortionless** if for some a/a and b/m * A flat magnitude response **does not** guarantee the system is distortionless. * A flat magnitude response and linear phase response **does** guarantee the system is distortionless. * The delay of a distortionless system is equal to minus the slop the phase response. The linear phase results in a constant slope. * A system with linear phase response has a constant group delay. * **Amplification has no effect on group delay**   **FOURIER SERIES COEFFICIENTS**  To determine the s, use where is the Fourier transform . | | Magnitude Response Building Blocks |
| The phase response of a linear time-invariant system is defined as the phase of the Fourier transform of the impulse response | Group Delay  The group delay an LTI system is defined as minus the slope of the phase response: |
| A linear time-invariant system is said to be an ideal filter if  (1) its magnitude response, at every frequency , is either zero or one, and (2) its phase response is linear on the frequencies for which the magnitude response is one.   * If an input signal only has frequency content at the frequencies the magnitude is one, the output will be a distortionless (delayed) copy of the input. * If an input signal only has frequency content at the frequencies the magnitude response is zero, the output will be zero for all time. * Ideal filters can be used to separate out signals that overlap in time but not in frequency. | Problems with Ideal Filters   * Each of the four kinds of ideals filters are noncausal because the impulse response is not zero in negative time. * The group delay is *b,* and it must be made very large to obtain a good approximation because decreases very slowly to zero as a function of t. | | **Note**: The phase of a positive number is zero and the phase of a negative number is |
| \*Gaussian Filter Notes   * They are noncausal; decays very rapidly so can truncated accurately w/o excessive delay * Wide transition region, not flat in passband region * No ripples |
| Laplace Transform of Continuous-Time Signal    Z Transform of Discrete-time Signal | Laplace/Z Transforms Involving Unit Step    Laplace and Z transforms are note unique unless the ROC is included. They are not complete without them. | | * A continuous-time signal and its Laplace transform (including the ROC) form a unique pair. * A discrete-time signal and its Z transform (including the ROC) form a unique pair. * In general, the ROC of a Laplace transform depends on only. * In general, the ROC of a Z transform depends on only. |
| **Phase Response and**  **Group Delay** | | Useful for Group Delay:  *This equation was derived from an example problem, use with caution.* | Bandform template.svg |
| Decibel Conversions        **Key Approximation for Bode Phase Plots** | | **Key Approximation for Bode Plots**            For of , assume for |  |

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| Ideal Lowpass Filters | | | | | | | Ideal Lowpass Filters | | | | | | |
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| **Lowpass** | | | | **Highpass** | | | | | | | | | |
| Ideal Highpass Filters | | | | | | | Ideal Highpass Filters | | | | | | |
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| Ideal Bandpass Filters | | | | | | | | | | | | Gaussian Filter\* | |
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| Ideal Bandstop Filters | | | | | | Ideal Bandstop Filters | | | | | | | |
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| **Bandpass** | | | | | **Bandstop** | | | | | | | | | |
| Series Combonation of Filters | Series Combonation of Filters | | | | | Parallel Combonation of Filters | | | | | | | Parallel Combonation of Filters | |
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| Raised Cosine Filter | | | | | | | | | | | | |  | |
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| **Fourier System Analysis with Periodic Inputs** | | **Determining the Output of Periodic Inputs** | | | | | | | Q1,S2011: Suppose a Bode plot is such that is such that and the slope from is 40dB per decade. What is the value of the Bode approximation at ?  **(Delete this text box)**  This part should be handwritten if you are going to use it on your notes sheet! | | | | | |
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| Suppose has a period T0 = 4 and fourier series coefficients for all k. LTI system with impulse response . Determine Fourier series coefficeints . | | | | | | | | | | | | | | |
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| Graphically Working with Fourier Transforms | | | | | | | |  | | | | | | |
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