Signals & Systems

Final Exam - SPRING 2021: Sec A Batch - 2

07, June, 2021

Instructions

1. Answer all questions. Include your roll no. and name on all pages. Please number the pages in your answer scripts
2. Total time for the exam: 90 min : −60min for descriptive and 30min for MCQs.
3. After the MCQ there will be an extra 10 min buffer time to scan and upload your scans.
4. Maximum Marks: $20(Desc) + 10(MCQ) = 30$.
5. Marks for each question is indicated in a parenthesis against each question
6. **This exam is closed book and closed internet**. You will need a computer and a few A4 sheets.
7. Please note that when you take the exam you are implicitly agreeing to not use any other means of support
8. Combine the scans of solutions and any sketches into a single pdf
9. Each of the plots or drawings can be rough sketches but should be drawn in a clean manner
10. Naming convention for the final zip: SS_Fin_Rollno; Roll no is your full roll number.
11. For uploading the pdf, a google form for file upload will be shared during the exam. Only files uploaded here will be evaluated.

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1 Fourier Transforms

- For the given spectrum, Using the time-frequency scaling property of the Fourier transform, determine the inverse Fourier transform and plot the signal. Assume that the non-linear function is a quadratic function.

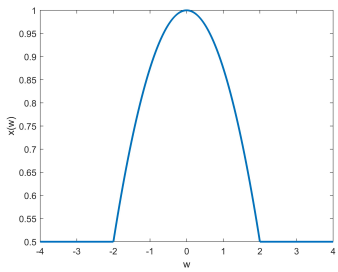

Figure 1: Expanded Spectrum

- Using the duality property on CTFT of $e^{-at}u(t)$ and given the impulse response of a system, determine and plot the magnitude spectrum

$$h(t) = \frac{2 - jt}{2 + jt}$$

2 Sampling

Consider a band-limited spectrum $X(\omega)$ of arbitrary shape and is sampled with the pulse train shown below. Plot the spectrum $X_p(\omega)$ of the sampled signal $x_p(t)$.

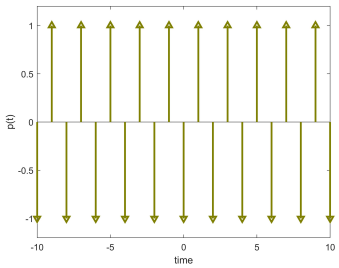

Figure 2: Impulse Train

3 Fourier Series

- Determine the signals $x(n)$, $h(n)$ corresponding to the coefficients a_k, b_k respectively and using the periodic convolution property of the discrete time Fourier Series, determine $y(n)$ corresponding to coefficients c_k. Assume that $y(n)$ is the periodic convolution of $x(n)$ and $h(n)$. Assume the signal time period $N = 7$.

$$a_k = jk \quad \text{for} \quad |k| \leq 3$$
$$b_k = k^2 \quad \text{for} \quad |k| \leq 3$$