

6.300: Signal Processing

Final Exam Practice Problems #2

- Final Exam: [Johnson Track](#) on [Friday, 12/19](#) at 1:30 p.m.
- Bring three 8.5" \times 11.0" pages (six sides) of handwritten notes.

Fill out the survey on the course website.

<https://sigproc.mit.edu/fall25/survey>

Fill out a subject evaluation for this class.

<https://registrar.mit.edu/classes-grades-evaluations/subject-evaluation>

December 4, 2025

Recurring Delay

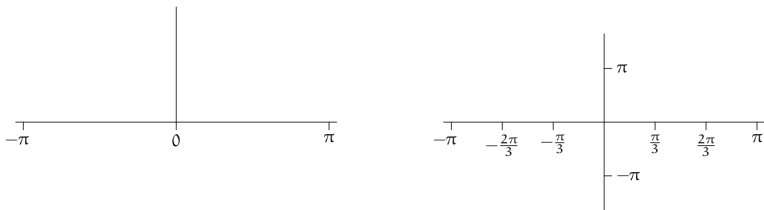
(a) A discrete-time LTI system has input $f[n]$ and output $g[n]$.

$$f[n] \rightarrow \boxed{\text{LTI}} \rightarrow g[n] = f[n] - \frac{1}{2}g[n-3]$$

Assume that $g[n] = 0$ for $n < 0$. Determine the impulse response.

$g[n] =$

(b) Sketch the magnitude and phase of the frequency response.



Periodic Extension

Suppose $f[n]$ is real. Let $g[n]$ represent a periodically-extended $f[n]$.

$$g[n] = \begin{cases} f[n] & 0 \leq n < N \\ f[n - N] & N \leq n < 2N \\ f[n - 2N] & 2N \leq n < 3N \\ \dots & \end{cases}$$

Let $F[k] = \text{DFT}_N\{f[n]\}$ and $G[k] = \text{DFT}_{2N}\{g[n]\}$.

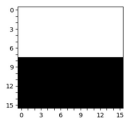
Determine expressions for $G[0]$, $G[1]$, and $G[k]$ in terms of $F[k]$ and familiar constants, such as π and e .

$$G[0] =$$

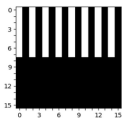
$$G[1] =$$

$$G[k] =$$

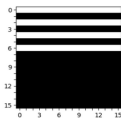
2D DFT Matching: Match signal $f_i[r, c]$ at the top to the corresponding 2D DFT magnitude $|F_i[k_r, k_c]|$. Choose **A**, **B**, ..., **O**.



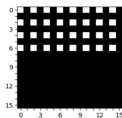
A



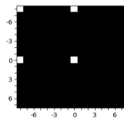
B



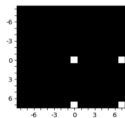
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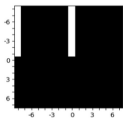
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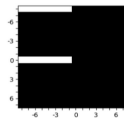
E



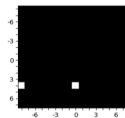
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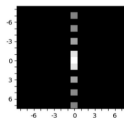
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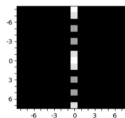
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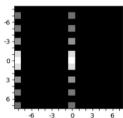
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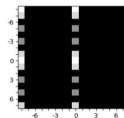
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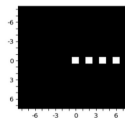
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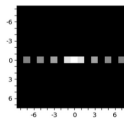
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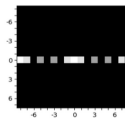
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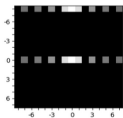
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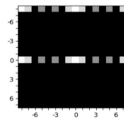
O



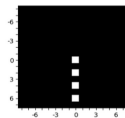
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Q



R



S