ECE-GY 6113 **Spring 2021**

HW 6

1) **Ideal fractional delay system** “ideal_fractional_delay_exercise.pdf”

2) **Notch filter** “notch_filter_exercise_3.pdf”

3) 3.8 (in DSP Exercises) Find a formula for G(z) in terms of H(z).
Find a formula for $G^f(\omega)$ in terms of $H^f(\omega)$.

4) **Ideal differentiator.** The ideal discrete-time differentiator has a frequency response of $H^f(\omega) = j\omega$ for $|\omega| < pi$.

a) Explain why this would be the frequency response of the ideal differentiator, considering input signals of the form $x(n) = \cos(\omega n)$. What might we expect the differentiator to produce as an output?

b) Without computing the impulse response h(n), determine from Hf(ω) if h(n) is real-valued or not. Explain.

c) Find the impulse response of the ideal differentiator.

d) Sketch the magnitude $|H^f(\omega)|$ and phase (angle) of the frequency response $H^f(\omega)$ of the ideal differentiator for ω from -2pi to 2pi.

e) Can the ideal differentiator be implemented as a difference equation? Explain.

5) **DTFT.** From the text book by Porat (see scan of pages)

2.27 (express $X^f(\omega)$ in terms of the sinc function)
2.29 (a, b, c, d, e) For (e) you need to use Parseval's theorem.
2.30
2.31