DSP final 2023 Spring

1. (40%) It is known that a system is BIBO stable if and only if its impulse response $h[n]$ is absolutely summable. Show the following:

ⓐ If a causal system is BIBO stable, then $h[n]$ is absolutely summable.

ⓑ If $h[n]$ of a system is absolutely summable, then $H(e^{j\omega})$ exists.

ⓒ If $H(e^{j\omega})$ exists, the ROC of $H(z)$ includes the unit circle.

ⓓ Given ⓐ, ⓑ, ⓒ above and the fact that the ROC of a causal system is $|z| > |\lambda_{max}|$, show that a causal BIBO stable system must have all poles strictly inside $|z|=1$.

2. (10%) Try to compare IIR and FIR in as many aspects as possible, such as advantages and disadvantages, design methods, ... etc.

3. ⓐ Identity all poles of $h[n] = -3, 2, 7, 5, 3$ (10%)

ⓑ Show that a causal FIR with finite samples is always stable. (10%)

ⓒ A type 3 FIR is of even degree and has odd number of samples. Show that a type 3 FIR must have at least one zero at $z=-1$ and at least one zero at $z=1$. (15%)

ⓓ Identify all poles and zeros of $H(z) = \frac{1}{1+0.5z^{-1}}$ If ROC of $H(z)$ is $|z| > 0.5$, use long division method to find out the inverse zT of $H(z)$. (15%)