1. What are the roots of the polynomial $p(z) = z^N + 1$.

2. Textbook, Problem 8.5, p. 311.

3. Textbook, Problem 8.6, p. 312.

4. Textbook, Problem 8.11 (a) and (c), p. 313.


   
   Also sketch (or copy) the frequency response function $\mathcal{H}(\hat{\omega})$ for (E) at the bottom of p. 316 and indicate, on the frequency axis of $\mathcal{H}(\hat{\omega})$, those frequencies where the system function $H(z)$ has a pole (by $\times$) or a zero (by $\circ$) nearby.


8. (This problem is similar to Problem 7 on Homework Set 10) Find a causal IIR filter such that the magnitude of the response to a discrete-time sinusoid with frequency $0.02\pi$ is at least 30 times larger than the magnitude of the response to any discrete-time sinusoid with frequency in the range $0.8\pi$ to $\pi$. As your answer give:
   
   (a) the coefficients of your filter,
   (b) its order,
   (c) a plot of the magnitude frequency response,
   (d) the values of the magnitude frequency response at $0.02\pi$ and $0.8\pi$, and
   (e) the ratio of the magnitude frequency response at $0.02\pi$ and the maximum magnitude frequency response in the range $0.8\pi$ to $\pi$.

Note: Like Problem 7 on Homework set 10, this is an open ended design problem, representative of what an engineer would need to solve. It is not intended to be difficult or tricky in any way. There are many approaches you might take and many possible solutions. For example, some approaches might involve theoretical formulas and some might use Matlab. However, you should solve this problem on your own without help or suggestions from the staff or other students. Solving this problem may take some trial and error, where the “trials” might involve experimentation with a method you have chosen, and if this is not successful, with another approach. In problems where there are many possible solutions, engineers generally look for the simplest solution. 10 points extra credit to whoever finds a filter with the smallest order.