Hints for Set #1

1. In part (a) consider notes Chapter 2 Example 2.4 as the approach for starting with just $N = 5$ and for waveform sketching consider the table method found in the convolution extras document under course materials. For part (b) again start with the waveform sketching but follow Example 2.4 to find two non-zero solution intervals and two zero solution intervals that together cover $-\infty < n < \infty$. For the non-zero intervals you have to sum arithmetic series as opposed to geometric series in Example 2.14. I see two good options, (i) and (ii), to take. With option (i) you can sum the series using just the first sum formula in the exam tables document under course materials. Some ingenuity is required, i.e., in particular note that for $0 < a < b$
$$\sum_{k=a}^{b} g[k] = \sum_{k=0}^{b} g[k] - \sum_{k=0}^{a-1} g[k],$$
which avoids reindexing the table sum formula. With option (ii) you sum each of the complete argument non-zero interval series using wxMaxima, and/or Wolfram Alpha, or similar. I have now posted a wxMaxima notebook and a pdf rendering of it to show you how you might sum the series. Also for part (c) I include how to evaluate the piecewise function you finally obtain in (b) to a numerical list of values for $y[n]$, when $N = 10$. Finally, also the stem function plot for part (d). Similarly for Python I evaluate a piecewise function into a list and a stem function plot in Jupyter and rendered to pdf.
2. [2.18 b, c, and e] Since the systems are known to be LTI, causality can be established by see if the impulse response $h[n] = 0$ for $n < 0$. See Causal_LTI.pdf, found on the course Web Site, for more detail on why this condition must be true.
3. [2.19 b, c, and e] In a sense this problem is a continuation of 2.18 in that the systems are again assumed to be LTI. Here you are checking stability. The LTI system theorem of notes page 2–27 is the ticket here.
4. [2.20] This problem is a variation of the familiar first-order difference equation $y[n] = ay[n-1] + x[n]$, which has impulse response $a^n u[n]$. You may want to consider a recursion as was done in the notes for the above LCCDE. A classical LCCD solution also works, but is not the only route to take.
5. [2.23b & d] Carefully work through the four definitions. You cannot initially assume the systems are LTI.
6. [2.26] This problem requires you to think through the behavior of LTI systems. Parts (a) and (b) are similar in that the inputs are both exponential. When you input a sinusoid to an LTI system and consider the steady-state output, is it possible to produce a signal at a different frequency or *mode*? In part (c) transient response is considered. Think when you input a transient at particular mode (exponential decay rate), can you excite modes of the system, and output signals at the system modes?
7. [2.30] This problem a convolution analysis and simulation problem. Feel free to simulate the system as described in the Set #1 sample Python or Julia IPYNB files found on the Web Site.