

ECE 3793

Homework 2

Spring 2017

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Hint: In problems 1.10, 1.26(d), and 1.26(e), you will be asked to determine if the sum of two signals is periodic. Here's some help with that. First, if one or both of your signals is *not periodic*, then the sum is also *not periodic*.

Therefore, let's assume that you have two signals that are both periodic. Assume that the fundamental period of the first one is A and the fundamental period of the second one is B . The sum will be periodic if there are positive integers m and n such that $mA = nB$. Then, m periods of the first signal will exactly line up with n periods of the second signal. Adding these two groups together will produce a pattern of values that will be repeated periodically in the sum signal.

For example, if $3A = 5B$ so that $m = 3$ and $n = 5$, then three periods of first signal will exactly line up with five periods of the second signal. The sum will be periodic with a period of $T = 3A = 5B$.

The fundamental period of the sum is given by the *lowest common multiple* of A and B . This is when m and n take the smallest possible integer values such that $mA = nB$.

For a discrete-time periodic signal, the fundamental period is always a positive integer. So, when you add two discrete-time periodic signals, A and B will both be integers and there will always be a lowest common multiple $\text{lcm}(A, B)$. Thus, the sum of two discrete-time periodic signals is always periodic.

For two continuous-time periodic signals, it is possible that A and B might not have any common integer multiples. In that case, the sum is not periodic. For example, if $A = \pi$ and $B = 2$ then there are no positive integers m and n such that $mA = nB$. So the sum is not periodic in this case. But if $A = 12\pi$ and $B = 21\pi$, then the sum *is* periodic with fundamental period $84\pi = 7A = 4B$.

1. Text problem 1.6, part (c) **only**.
2. Text problem 1.10.
3. Text problem 1.17, **plus** (c) is the system stable?, (d) is the system time invariant?

4. Text problem 1.18, parts (a) and (b) **only**. **Plus:** (c) show that the system is stable; (d) is the system causal?
5. Text problem 1.19, parts (a) and (c) **only**.
6. Text problem 1.25, parts (b) and (d) **only**.
7. Text problem 1.26, parts (c), (d), and (e) **only**.
8. Text problem 1.27, parts (b) and (d) **only**.

DUE: 2/13/2017