

Signals, systems, acoustics and the ear: Coursework II

Handwriting is fine but must be legible. You may discuss these questions together, but please write your answers by yourself. **Show your work!**

- 1) Take two sinusoids of 1 kHz, both with a phase of 0° . Both have levels of 0.3 Pa. What would be their level (in dB SPL) if added? What if one had a phase of 180° while the other remained at 0° ? What level would the result be, in Pa and dB SPL? **(10 points)**

- 2) Suppose you had a system that multiplies each input amplitude value by 2. What change in dB does this correspond to? Draw input and output waveforms for 3 cycles of an input wave which is a sinusoid of peak amplitude 2 V and frequency of 400 Hz. Given what you've been told about the response of LTI systems to sinusoids, do you think this system is LTI? Why? Is this system homogeneous (sketch the input/output function)? Time-invariant? Give reasons for your answers. Where could such a system occur in daily life? **(20 points)**

- 3) Consider a full-wave rectifier, which simply takes the absolute value of all incoming signals (in other words, leaves the positive parts of the signal alone, while making the negative bits positive). Sketch its input and output waveforms for an electrical sinusoid of 5 kHz and a peak amplitude of 0.3 V. **Label axes!** What is the easiest way to show that this system is not LTI? Is a full-wave rectifier homogeneous? Additive? (*Hint*: consider as inputs two sinusoids of the same frequency and amplitude which differ in phase by 180°) Time-invariant? Give reasons for your answers. **(40 points total) This is not easy!**