Name:

Problem	Points	Score
1a	10	
1b	10	
1c	10	
2a	10	
2b	10	
2c	10	
2d	10	
3a	10	
3b	10	
3c	10	
Total	100	

Notes:

1. The exam is closed books/closed notes - except for one page of notes.

2. Please show ALL work. Incorrect answers with no supporting explanations or work will be given no partial credit.

3. Please indicate clearly your answer to the problem. If I can't read it (and I am the judge of legibility), it is wrong. If I can't follow your solution (and I get lost easily), it is wrong. All things being equal, neat and legible work will get the higher grade:)
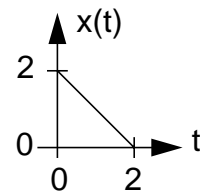
Problem No. 1: Fourier Series

(a) For the system below, compute the Fourier series of the output.

$$x(t) = A\cos(\omega_0 t) \longrightarrow \boxed{y(t) = x^2(t)} \longrightarrow y(t) = ???$$
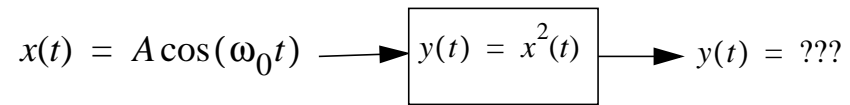
(b) Compute the energy and power of the output. (Comment: Think about orthogonality before you write the answer that is most obvious.)

(c) Now assume x(t) is as shown to the right. Compute the energy and power of y(t).

Problem No. 2: Time-Domain Solutions

(a) For the circuit shown, using concepts developed in this class, sketch the output
signal, $y(t)$, if x(t) is the unit step function. Explain.
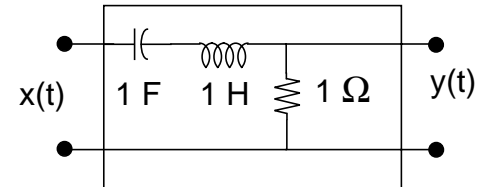
(b) Sketch the output if x(t) is a unit pulse. Explain.

(c) Sketch the output if x(t) is a periodic sequence of unit pulses with a period of 10 secs.

(d) Suppose the period in (c) is decreased to 0.1 secs. How does this affect the shape of the output?

Problem No. 3: The dreaded thought problem...

(a) Using concepts developed in the first three chapters of the book, characterize the cruise control circuit in an automobile as a system.

(b) If this system were a linear time-invariant system, design the impulse response of a "good" system. Explain how you might implement this in a circuit.

(c) It is well-known that cruise controls are not optimal for terrain that is mountainous (such as ski country in Colorado). Why (explain this in terms of concepts discussed in this class)? What modifications would you need to make (again, explain this in terms of concepts such as causality)?