EE321 First MidTerm Exam

Spring 2001

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Instructions: You are permitted to use a **self-prepared** pre–approved study–guide limited to one ($8\frac{1}{2}$" $\times$ 11") page (both sides). **Show all the intermediate steps for credits.**

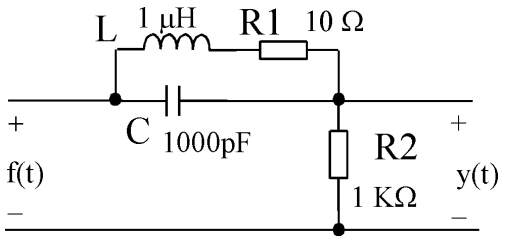
1. (15 pts.) A voltage signal $f(t) = 3\sin(240\pi t - \frac{\pi}{4})$ (V) is generated by a signal generator.
   (a) Find the period of the signal in seconds. What is the frequency of the signal in Hz?
   (b) Find the time delay of this signal compared with the $\cos(240\pi t)$.
   (c) Find the instantaneous power of this signal across a 1Ω resistor and its average power Pav and RMS voltage value.
   (d) What is the average power dissipation, if a 100 Ω resistor is used. Pick a proper power rating of the resistor from the following industry standards: 1/16, 1/10, 1/8, 1/4, 1/2 ... (W).
   (e) If voltage $x(t) = 10 \cdot f(t)$ is applied across a 100 Ω resistor, what is the average power dissipation on the resistor? What is your pick of the resistor power rating at this time?

2. (10 pts.) Determine the total energy of the following signals:
   (a) $f(t) = t \cdot [u(t-1) - u(t-5]$
   (b) $x(t) = 5 \cdot f(2t+1)$ where $f(\cdot)$ is the same function shown in part a).

3. (5 pts.) Find the expression of $x(t) = 2\sin(3\pi t - 1) + \cos(5\pi t + 0.5)$ in sum of complex exponentials.

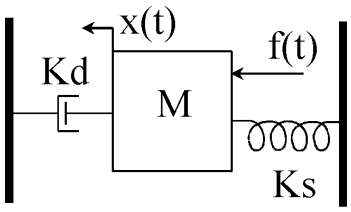
4. (10 pts.) Using the sampling properties of $\delta(t)$ to evaluate or simplify the following expressions. Show your work!
   (a) $\int_0^2 [\delta(t+1)\cos(\frac{\pi}{4}t) + \delta(t-1)\cos(\frac{\pi}{4}t)]dt$
   (b) $2e^{2x} \cdot \delta(x - 0.5)$
   (c) $\int_0^\infty 2\omega \cdot \delta(\omega - 5\pi) \cdot e^{-j\omega} d\omega$
   (d) $(t^2 + 2e^{2t}) \cdot \delta(t+1)$

5. (10 pts.) Given a LRC network circuit as follows,



find the system differential equation relating input voltage $f(t)$ and output voltage $y(t)$ and its polynomials $A(s)$ and $B(s)$ and transfer function $H(s)$. Is this system stable? Explain why?

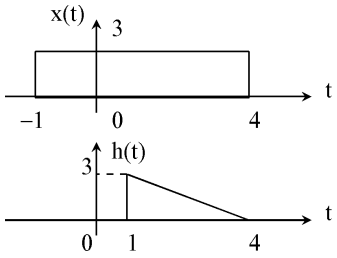
6. (10 pts.) Given the schematic of a mechanical system,



find the system differential equation relating input force $f(t)$ and output position $x(t)$ and its polynomial $A(s)$ and $B(s)$and transfer function $H(s)$.

7. (10 pts.) The impulse response of a LTI system is $h(t) = e^{-6t}u(t-1)$ and the input signal to the system is $f(t) = 2e^{-2(t+1)}u(t-3)$. Find the system's zero-state response $y(t)$.

8. (10 pts.) Find the zero state response of a LTI system with unit impulse response function $h(t)$ and input signal $x(t)$ illustrated in the figure.



9. (10 pts.) a). Sketch 2 periods of a full wave rectified sinusoidal current signal $i(t) = |4\cos(120\pi t - \frac{\pi}{3})|$ (A); b) Find the RMS current value of the signal; c) Find the average power dissipation of the current flowing through a 10 ohm resistor.

10. (10 pts.) Given an energy signal $f(t)$ with energy value E_f (J).

    (a) Show that the energy value of $f(t \pm t_0)$ is still the same, E_f (J).

    (b) Show that the energy value of $f(at)$ is $\frac{E_f}{a}$ (J).

11. (20 pts.) Matlab Problems:

    (a) Plot 4 periods of the full wave rectified sinusoidal current signal $i(t) = |4\cos(120\pi t - \frac{\pi}{3})|$ with 10 samples per period. Calculate the average power and RMS value comparing with your hand derived results.

    (b) Verify and plot the zero state response in the problem 8.

    (c) Plot the pole/zero diagram of the LTI system in problem 5.

Important note: You are expected to work out the Matlab problems independently. You need to protect your directory or only store your m-file on a diskette to prevent someone copying your file. Since I can not tell who copies from whom, I will not give credits to those m-files show evidence of copying. You must email your m-file as an attachment to me by 2:00 pm tomorrow (2:00pm, 4/18/01). I will not debug your m-file. I'll just run your m-file to view your presentation. Your grades depend on the information presented in the form of graphic plots and text (you can put "pause and echo on command" in front of the comments that you want me to read followed by "echo off command". Please test your m-file before mailing it to me. Only submit one m-file per student.