Midterm #1 of ECE301, Prof. Wang's section

8–9pm Thursday, September 8, 2011, EE 170,

1. Please make sure that it is your name printed on the exam booklet. Enter your student ID number, e-mail address, and signature in the space provided on this page, **NOW!**
2. This is a closed book exam.
3. This exam contains multiple choice questions and work-out questions. For multiple choice questions, there is no need to justify your answers. You have one hour to complete it. The students are suggested not spending too much time on a single question, and working on those that you know how to solve.
4. There are 10 pages in the exam booklet. Use the back of each page for rough work.
5. Neither calculators nor help sheets are allowed.

Name:

Student ID:

E-mail:

Signature:

Question 1: [20%, Work-out question, Outcome 3] $x(t)$ is $e^{(1+j)t}$ if $-2 \leq t \leq 1$, and $x(t) = 0$ otherwise. Compute the expression of

$$y(t) = \int_{-\infty}^{\infty} x(s)x(t-s)ds.$$

Question 2: [15%, Work-out question, Outcome 4] $x[n] = 1$ if $10 \leq n \leq 30$, and $x[n] = 0$ otherwise. Compute the expression of

$$g(\omega) = \sum_{n=-\infty}^{\infty} x[2-n] e^{j\omega n}.$$

Hint: The geometric series formula is

$$\sum_{k=1}^{K} a_1 r^{k-1} = \frac{a_1(1 - r^K)}{1 - r}.$$

Question 3: [10%, Work-out question, Outcome 4] Compute the following partial fractions:

$$\frac{1}{-2+3z+5z^2} = \frac{a}{b+c\cdot z} + \frac{d}{e+f\cdot z}.$$

Namely, find the real-valued coefficients a, b, c, d, e, and f.

Compute the following partial fractions:

$$\frac{1}{-2+3z+5z^2} \times \frac{1-z}{1+z} = \frac{a}{b+c\cdot z} + \frac{d}{e+f\cdot z} + \frac{g}{(b+c\cdot z)^2}.$$

Namely, find the real-valued coefficients a, b, c, d, e, f, and g.

Question 4: [15%, Work-out question, Outcome 1] We know that $x(t)$ is a continuous-time period signal with period 3. We also know that

$$x(t) = \begin{cases} t+1 & \text{if } -1 \leq t < 0 \\ \cos(2t) + j\sin(2t) & \text{if } 0 \leq t < 1 \\ 0 & \text{if } 1 \leq t < 2 \end{cases} \tag{1}$$

Find the *overall power* of this signal.

Question 5: [20%, Work-out question, Outcome 1] Consider a linear system. We know that for this system if the input $x(t)$ is an even signal, then the output $y(t)$ is always zero, that is, $y(t) = 0$. We also know that if the input $x(t)$ is an odd signal, the output $y(t)$ is always $y(t) = x(t-2)$.

Question: Plot the output $y(t)$ for the range $-4 \leq t \leq 4$ when the input is

$$x(t) = \begin{cases} 2 & \text{if } t \geq 0 \\ 0 & \text{if } t < 0 \end{cases}. \tag{2}$$

If you do not know the answer to the above question, you can assume $x(t) = \sin(2t) + j\cos(3t)$ and plot the corresponding $y(t)$. You will get still get 14 points if your answer is correct.

Question 6: [20%, Multiple Choices] The following questions are multiple-choice questions and there is no need to justify your answers. Consider two continuous-time signals:

$$\begin{aligned} x_1(t) &= e^{(\cos(t)+j\sin(t))} \\ x_2(t) &= \frac{\sin(t)}{e^t + e^{-t}} \end{aligned}$$

and two discrete-time signals:

$$\begin{aligned} x_3[n] &= \cos(\pi n^2) + j\sin(\pi n) \\ x_4[n] &= e^{(1+j)n}. \end{aligned}$$

1. [10%, Outcome 1] For $x_1(t)$ to $x_4[n]$, determine whether it is periodic or not, *respectively.* If it is periodic, write down the fundamental period. Please state explicitly which signal is periodic and which is not.

2. [10%, Outcome 1] For $x_1(t)$ to $x_4[n]$, determine whether it is even or odd or neither of them, respectively. Please state explicitly which signal is even, which is odd, and which is neither.