Exam 1 Information — 332: 345 — Fall 2003

Exam 1 results are posted on WebCT. The average is 17.5/35.

Exam 1 solutions are on reserve reading in SERC Library.

Exam 1 books are in Professor Gajic's office, ELE 222.

Students may look at and pick up exams during Professor Gajic's office hours, M3, Th3. Once the exam book is taken out from Professor Gajic's office, no complains about grading will be considered.

GRADING POLICY:

The total number of points for an A will be somewhere in between 80 and 90, to be decided when all three exams are completed. Hence, 90 points and above guarantees an A.

The total number of point for a D is somewhere in between 40 and 50, to be decided when all three exams are completed. Hence, 50 points guarantees a D.

Other grades will be evenly distributed beetwen D and A.

Exam I will be based on the material from Chapters 1, 2, and 3 covered in class and outlined in the course syllabus.

Closed book and notes. No calculators allowed.

Tables 3.3 and 3.4 will be distributed to students before the exam.

Study Guide:
Do all homework problems and read the study guides given in chapter summaries. No proofs of the Fourier transform properties.

Exam Time:
Monday Oct 27, 2003; 8:10–9:30am (during regular class hours)

Place:
SEC 111, **A-L** (115 students)
SEC 210 **M-R** (52 students)
SEC 117, **S-Z** (57 students)

Attachments:
Table 3.3
Table 3.4
Sample Exam I, Fall 1999 (This year Exam 1 will also include some minor and simple problmes from Chapter 1 similar to Homework Problems assigned from Chapter 1, dealing with linearity, time invariance, and system response.

Point distribution for Exam 1: (35pointe = 35% of the course grade)
Chapter 1: 6 points (6%)
Chapter 2: 12 points (12%)
Chapter 3: 17 points (17%)

SERC Library:
Copies of all solutions to homework problems from Chapters 1, 2, and 3 and Exam 1 Information are *also* on reserve reading in the SERC Library.

	Time	*Frequency*
1	$\alpha_1 x_1(t) \pm \alpha_2 x_2(t)$	$\alpha_1 X_1(j\omega) \pm \alpha_2 X_2(j\omega)$
2	$x(t - t_0)$	$e^{-j\omega t_0} X(j\omega)$
3	$x(at)$	$\frac{1}{\|a\|} X\left(\frac{j\omega}{a}\right)$
2&3	$x(at - t_0)$	$\frac{1}{\|a\|} e^{-j\left(\frac{\omega}{a}\right)t_0} X\left(\frac{j\omega}{a}\right)$
4	$t^n x(t)$	$(j)^n \frac{d^n}{d\omega^n} X(j\omega)$
5	$x(t)e^{j\omega_0 t}$	$X(j(\omega - \omega_0))$
6	$x(t)\cos(\omega_0 t)$ $x(t)\sin(\omega_0 t)$	$\frac{1}{2}[X(j(\omega + \omega_0)) + X(j(\omega - \omega_0))]$ $\frac{j}{2}[X(j(\omega + \omega_0)) - X(j(\omega - \omega_0))]$
7	$\frac{d^n}{dt^n} x(t)$	$(j\omega)^n X(j\omega)$
7a	$(-jt)^n x(t)$	$\frac{d^n X(j\omega)}{d\omega^n}$
8	$x_1(t) * x_2(t)$	$X_1(j\omega) X_2(j\omega)$
9	$x_1(t) x_2(t)$	$\frac{1}{2\pi} X_1(j\omega) * X_2(j\omega)$
10	$x(-t)$	$X(-j\omega)$
11	$X(jt)$	$2\pi x(-\omega)$
11a	$X(-jt)$	$2\pi x(\omega)$
12	$\int_{-\infty}^{t} x(\tau) d\tau$	$\frac{1}{j\omega} X(j\omega) + \pi X(j0)\delta(\omega)$
Parseval's Theorem	$\int_{-\infty}^{\infty} \|x(t)\|^2 dt$	$\frac{1}{2\pi} \int_{-\infty}^{\infty} \|X(j\omega)\|^2 d\omega$

Table 3.3: Properties of the Fourier transform

	Time	*Frequency*
1	$\delta(t)$	1
2	$e^{-at}u_h(t),\ \ a>0$	$\frac{1}{a+j\omega}$
3	$p_\tau^h(t)$	$\tau\mathrm{sinc}\left(\frac{\omega\tau}{2\pi}\right)=\tau\frac{\sin(\omega\tau/2)}{\omega\tau/2}$
4	$\Delta_\tau(t)$	$\frac{\tau}{2}\mathrm{sinc}^2\left(\frac{\omega\tau}{4\pi}\right)$
5	1	$2\pi\delta(\omega)$
6	const	const $\times\ 2\pi\delta(\omega)$
7	$\cos(\omega_0 t)$	$\pi[\delta(\omega+\omega_0)+\delta(\omega-\omega_0)]$
8	$\sin(\omega_0 t)$	$j\pi[\delta(\omega+\omega_0)-\delta(\omega-\omega_0)]$
9	$\mathrm{sgn}(t)$	$\frac{2}{j\omega}$
10	$u_h(t)$	$\frac{1}{j\omega}+\pi\delta(\omega)$
11	$e^{-\alpha\lvert t\rvert},\ \ \alpha>0$	$\frac{2\alpha}{\alpha^2+\omega^2}$
12	$e^{j\omega_0 t}$	$2\pi\delta(\omega-\omega_0)$
13	$\sum_{n=-\infty}^{\infty}X_n e^{jn\omega_0 t},\quad \omega_0=\frac{2\pi}{T}$	$2\pi\sum_{n=-\infty}^{\infty}X_n\delta(\omega-n\omega_0)$
14	$\sum_{n=-\infty}^{\infty}\delta(t-nT_0)$	$\omega_0\sum_{n=-\infty}^{\infty}\delta(\omega-n\omega_0),\quad \omega_0=\frac{2\pi}{T_0}$

Table 3.4: Common Fourier transform pairs

330:345 Linear Systems and Signals — Exam 1 — Fall 1999

#1a) Using the properties of the impulse delta function simplify the following expressions

$$(i)\quad e^{-2t}\sin(\pi t)\delta(t-0.5), \qquad (ii)\quad \int_{-\infty}^{+\infty} e^{-2t}\sin(\pi t)\delta(t-0.5)dt$$

$$(iii)\int_{-\infty}^{+\infty} e^{-2t}\sin(\pi t)\frac{d^2\delta(t-0.5)}{dt^2}dt, \qquad (iv)\quad \int_{0}^{0.5} e^{-2t}\sin(\pi t)\delta(t-0.5)dt$$

#1b) Find the generalized derivative of the signal

$$f(t) = e^{-2t}\cos(\pi t)u(t-1)$$

#1c) Plot the graph of the signal represented in terms of unit step and unit ramp signals as

$$f(t) = u(t) - r(t-1) + r(t-3) + u(t-5)$$

#2a) Find the Fourier series of a periodic signal represented by

$$f(t) = f(t+2) = \begin{cases} t+1, & -1 \le t \le 0 \\ -t+1, & 0 \le t \le 1 \end{cases}$$

#2b) Consider a periodic signal whose Fourier series coefficients are given by

$$F_n(n\omega_0) = \begin{cases} \frac{(-1)^n}{n}, & n = 1, 2, ..., \qquad \omega_0 = 2 \\ 0, & n = 0 \end{cases}$$

This signal is the input to a linear time invariant system whose transfer function is given by $H(j\omega) = j\omega/(2 + j\omega)$. Find the output signal and sketch its line spectra (magnitude and phase).

#3a) Using the tables of common pairs and properties of the Fourier transform find Fourier transforms of the following signals:

$$(i)\quad te^{-2|t|}, \qquad (ii)\quad e^{-2t}u_h(t)\cos(t), \qquad (iii)\quad \int_{-\infty}^{t} \frac{1}{\tau}d\tau$$

#3b) Find the inverse Fourier transform of the signals

$$(i)\quad p_4(\omega), \qquad (ii)\quad \Delta_2(\omega)$$