EEN 340	FALL 2000	NDU
SIGNALS &	TEST 3	EE & CCE DEPT.
TRANSFORMS	60 MINUTES	S.C. ELMURR

NOTE 1: OPEN BOOK, OPEN NOTES.
NOTE 2: SHOW ALL WORK IN ORDER TO RECEIVE FULL CREDIT.
NOTE 3: START EACH PROBLEM ON A NEW PAGE.

1. 30 Pts. A causal LTI system S with impulse response h(t) has its input x(t) and output y(t) related through a linear constant-coefficient differential equation of the form

$$\frac{d^3 y(t)}{dt^3} + (1+\alpha)\frac{d^2 y(t)}{dt^2} + \alpha\ (\alpha+1)\frac{dy(t)}{dt} + \alpha^2 y(t) = x(t)$$

(a) If

$$g(t) = \frac{dh(t)}{dt} + h(t)$$

how many poles does G(s) have?

(b) For what real values of the parameter α is S guaranteed to be stable?

2. 35 Pts. Consider a continuous-time LTI system for which the input x(t) and output y(t) are related by the differential equation

$$\frac{d^2 y(t)}{dt^2} - \frac{dy(t)}{dt} - 2y(t) = x(t)$$

Let X(s) and Y(s) denote Laplace transforms of x(t) and y(t), respectively, and let H(s) denote the Laplace transform of h(t), the system impulse response.

(a) Determine H(s) as a ratio of two polynomials in s. Sketch the pole-zero pattern of H(s).
(b) Determine h(t) for each of the following cases:
   1. The system is stable.
   2. The system is casual
   3. The system is *neither* stable *nor* causal.

3. 35 Pts. The system function of a causal LTI system is

$$H(s) = \frac{s+1}{s^2+2s+2}$$

Determine and sketch the response y(t) when the input is

$$x(t) = e^{-|t|} \quad , \quad -\infty < t < \infty$$