Assignment #3 EE, Signals & Systems 1393-94

Due: Monday 18 Esfand

Q1. Find the Laplace transform and region of convergence for the following functions.

a) $x(t) = e^{-at}u(t) + 5\,cos(4t)e^{4t}u(t)$
b) $\mathrm{x(t)} = \mathrm{t}\frac{\mathrm{d}}{\mathrm{dt}}(\sin(\mathrm{t})\,\mathrm{u(t)})$
c)
d) $x(t) = |t|e^{-5|t|}$
e) $\begin{cases} t & 0 \le t < 1 \\ 2 - t & 1 \le t < 2 \end{cases}$

Q2. Find all the possible x(t)s assuming different ROCs

a) $X(s) = \ln(\frac{s^2+1}{s(s+1)})$
b) $X(s) = \frac{d}{ds}(\frac{s^3+s}{(s(s-1)^2})$

Q3. We know h(t) is the impulse response of a real LTI system witch exactly two poles and no finite zeros. One of the poles is located at s=-1+2j. Moreover the signal $e^{2t}x(t)$ is not absolutely integrable. And we know that H(0)=4. Find the transfer function H(s) and ROC of the system.

Q4. An LTI system is described by the differential equation

$$2\frac{d^2y}{dt^2} + \frac{dy}{dt} - 10y = \frac{dx}{dt}$$

Find H(s) then find h(t) that satisfies the following conditions

a) System is stable
b) System is causal
c) System is neither causal nor stable

Q5. Using the properties of the Laplace transform, find the Laplace transform and ROC's of the following function:

$x(t) = \frac{tdx}{dt} a(t) + \int_{-\infty}^{t} b(\tau - 3) d\tau$ where: $a(t) = e^t u(-t) \quad b(t) = \sin(t)\, u(t)$

Q6. An LTI system has a transfer function in the form of $H(s) = k\frac{s-a}{s+b}$ where $a \geq 0$ and $b > 0$. If we know that the response of the system to $x(t) = \cos(t)$is equal to $y(t) = \sin(t)$, what values can a and b take?