University of Illinois

ECE210 - Small Study Session

1. Determine the Laplace transform $\hat{F}(s)$, and the ROC, of the following signals $f(t)$. In each case identify the corresponding pole locations where $|\hat{F}(s)|$ is not finite.
   (a) $f(t) = u(t) - u(t-8)$
   (b) $f(t) = te^{2t}u(t)$
   (c) $f(t) = te^{-4t} + \delta(t) + u(t-2)$
   (d) $f(t) = e^{2t}\cos(t)u(t)$.

2. For each of the following Laplace transforms $\hat{F}(s)$, determine the inverse Laplace transform $f(t)$.
   (a) $\hat{F}(s) = \frac{s+3}{(s+2)(s+4)}$
   (b) $\hat{F}(s) = \frac{s^2}{(s+2)(s+4)}$
   (c) $\hat{F}(s) = \frac{s^2+2s+1}{(s+1)(s+2)}$

3. Sketch the amplitude response $|H(\omega)|$ and determine the impulse response $h(t)$ of the LTIC systems having the following transfer functions:
   (a) $\hat{H}(s) = \frac{s}{s+10}$
   (b) $\hat{H}(s) = \frac{s}{s^2+3s+2}$

4. Determine the zero-state responses of the systems defined in the previous problem (3) to a causal input $f(t) = u(t)$. Use $y(t) = h(t) * f(t)$ or find the inverse Laplace transform of $\hat{Y}(s) = \hat{H}(s)\hat{F}(s)$, whichever is more convenient.

5. Given the frequency response $H(\omega)$, below, determine the system transfer function $\hat{H}(s)$ and impulse response $h(t)$.
   (a) $H(\omega) = \frac{j\omega}{(1+j\omega)(2+j\omega)}$
   (b) $H(\omega) = \frac{j\omega}{1-\omega^2+j\omega}$.

6. Determine whether the LTIC systems with the following transfer functions are BIBO stable and explain why or why not.
   (a) $\hat{H}_1(s) = \frac{s^3+1}{(s+2)(s+4)}$
   (b) $\hat{H}_2(s) = 2 + \frac{s}{(s+1)(s-2)}$
   (c) $\hat{H}_3(s) = \frac{s^2+4s+6}{(s+1+j6)(s+1-j6)}$
   (d) $\hat{H}_4(s) = \frac{1}{s^2+16}$
   (e) $\hat{H}_5(s) = \frac{s-2}{s^2-4}$.