

EEE 304, Test 2Name: SOLUTIONS

Closed book-closed notes, transform tables and calculators allowed, 30'

Problem 1:

For the continuous-time causal system with transfer function $H(s) = \frac{(0.1s)}{(s+2)}$ write an expression for its frequency response (magnitude and phase).

$$|H(j\omega)| = \frac{0.1\omega}{\sqrt{\omega^2 + 2^2}}$$

$$\angle H(j\omega) = \frac{\pi}{2} - \tan^{-1} \frac{\omega}{2}$$

Problem 2:

For the continuous-time causal system with transfer function $H(s) = \frac{(0.1s)}{(s+2)}$ compute the discrete-time equivalent, say $G(z)$, using the Forward Euler Approximation and a sampling interval of $T = 0.1s$.

$$G(z) = \frac{0.1 \left(\frac{z-1}{T} \right)}{\left(\frac{z-1}{T} \right) + 2} = \frac{z-1}{10z-8}$$

Problem 3:

For the discrete-time causal system with transfer function $H(z) = \frac{(0.1z-0.1)}{(z-0.8)}$ compute the steady-state response to the sinusoid $x(n) = \sin[0.2(n-2)]u(n-1) - 2u(n-2)$

$$y(n) = |H(e^{j\Omega})| \sin(\Omega n - 0.4 + \angle H(e^{j\Omega})) - 2|H(e^{j0})| \cos(0n + \angle H(e^{j0}))$$

$$y(n) = |H(e^{j0.2})| \sin(0.2n - 0.4 + \angle H(e^{j0.2})) - (2)(0) \cos(0n + 0)$$

$$y(n) = \frac{0.1\sqrt{(\cos 0.2 - 1)^2 + (\sin 0.2)^2}}{\sqrt{(\cos 0.2 - 0.8)^2 + (\sin 0.2)^2}} \sin\left(0.2n - 0.4 + \tan^{-1} \frac{\sin 0.2}{\cos 0.2 - 1} + \pi - \tan^{-1} \frac{\sin 0.2}{\cos 0.2 - 0.8}\right)$$

$$y(n) = 0.0745 \sin(0.2n - 0.4 + 47.9^\circ) = 0.0745 \sin(0.2n + 0.4363)$$

$$= 0.0745 \sin(0.2n + 25^\circ)$$