EE103 HW#3 Oct. 18, 2017

[1]

3.32. **(a)** Consider the system of Figure P3.32. The input signal $x(t) = 5$ is applied at $t = 0$. Find the value of $y(t)$ at a very long time after the input is applied.

(i) $H(s) = \dfrac{4}{s+5}$ **(ii)** $H(s) = \dfrac{s+5}{s^2+2s+5}$

(b) Repeat Part (a) for the input signal $x(t) = e^{-3t}u(t)$.

[2]

4.4. A periodic signal $x(t)$ is expressed as an exponential Fourier series:

$$x(t) = \sum_{k=-\infty}^{\infty} C_k e^{jk\omega_o t}.$$

Show that the Fourier series for $\hat{x}(t) = x(t - t_o)$ is given by

$$\hat{x}(t) = \sum_{k=-\infty}^{\infty} \hat{C}_k e^{jk\omega_o t},$$

in which

$$|\hat{C}_k| = |C_k| \quad \text{and} \quad \angle\hat{C}_k = \angle C_k - k\omega_o t_o.$$

[3]

4.5. For a real periodic signal $x(t)$, the *trigonometric form* of its Fourier series is given by

$$x(t) = A_0 + \sum_{k=1}^{\infty}[A_k \cos k\omega_o t + B_k \sin k\omega_o t].$$

Express the exponential form Fourier coefficients C_k in terms of A_k and B_k.

[4]

4.6. This problem will help illustrate the orthogonality of exponentials. Calculate the following integrals:

(a) $\displaystyle\int_0^{2\pi} sin^2(t)dt$

(b) $\displaystyle\int_0^{2\pi} sin^2(2t)dt$

(c) $\displaystyle\int_0^{2\pi} sin(t)sin(2t)dt$

(d) Explain how the results of parts (a), (b), and (c) illustrate the orthogonality of exponentials.

$\left(\frac{1}{T_0}\int_{T_0} e^{jk\omega_0 t} \cdot e^{-jn\omega_0 t}\, dt = 0 \text{ for } k \neq n\right)$