ECE 3337: Signals & Systems Analysis, Class Worksheet 17

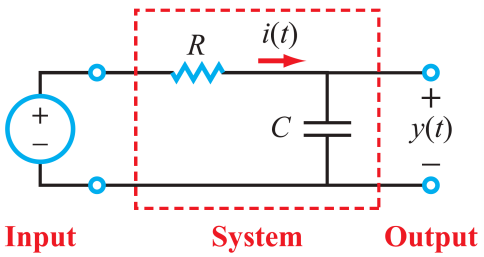
1. (20 points) Draw a minimal op-amp circuit that realizes the following transfer function:

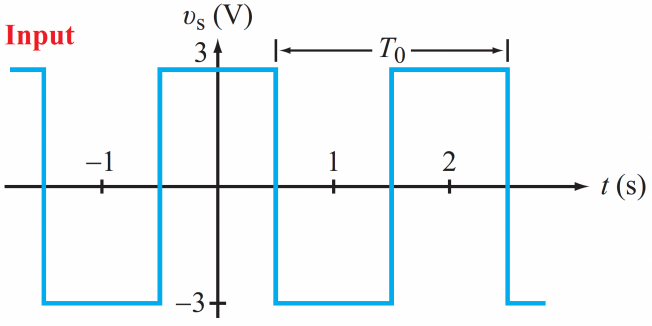
$$\mathbf{H(s)} = \frac{3\mathbf{s}^2 + 4\mathbf{s} + 5}{\mathbf{s}^2 + 6\mathbf{s} + 7}$$

2. (30 points) Write down the phasor representation for each of the following signals:
   a. (5 pts) $x_1(t) = 12\cos(2t)$
   b. (5 pts) $x_2(t) = 20\cos(3t + 45^o)$
   c. (5 pts) $x_3(t) = 10\sin(2t + 30^0)$
   d. (5 pts) $x_4(t) = 35\cos(2t) + 22\sin(2t + 45^o)$
   e. (10 pts) $x_5(t) = \frac{d}{dt}\{35\cos(2t) + 22\sin(2t + 45^o)\}$. Please also express the result in the time domain.
   f. (10 pts) $x_6(t) = \int [35\cos(2\tau) + 22\sin(2\tau + 45^o)]d\tau$. Please also express the result in the time domain.

3. (20 points) Given two phasor voltages $\mathbf{V}_1 = 10e^{j60^o}$, and $\mathbf{V}_2 = 5e^{j45^o}$, calculate the following quantities:
   a. $\mathbf{V}_1 + \mathbf{V}_2$
   b. $\mathbf{V}_1 - \mathbf{V}_2$
   c. $\mathbf{V}_1\mathbf{V}_2$
   d. $\frac{\mathbf{V}_1}{\mathbf{V}_2}$

4. (30 points) calculate the first 3 terms of the output voltage, at $(\omega_0, 3\omega_0, 5\omega_0)$ for the following RC circuit (RC = 1) when the input shown below is applied:





Use the Fourier series expansion in equation 5.13 of the textbook:

$$v_s(t) = \frac{12}{\pi}\left(\cos\omega_0 t - \frac{1}{3}\cos 3\omega_0 t + \frac{1}{5}\cos 5\omega_0 t - \cdots\right), \quad (5.13)$$