1. [100 pts] The signal $x(t)$ (shown in Figure PR-1 below) is equal to $e^{-2\pi t}$ in the interval $0 \leq t < 1$ and repeats periodically.

(a) What is the fundamental frequency of $x(t)$ in rad/sec? In Hz?

(b) What is the frequency of the fifth harmonic of $x(t)$ in rad/sec?

(c) Calculate the coefficients of the exponential form of the Fourier series of $x(t)$. 

Figure PR-1: Graph of $x(t)$
2. [100 pts] A certain real periodic signal, \( x(t) \), with fundamental frequency \( \omega_0 = 10 \text{ rad/sec} \) has Fourier series coefficients equal to

\[
C_k = \frac{20}{1 + jk}
\]

(a) What is the average value of \( x(t) \)?

(b) What are the amplitude and phase of the fundamental frequency component of \( x(t) \)?

(c) Use the grids provided below to sketch the line spectra (magnitude and phase) for \(-2 \leq k \leq 2\). Clearly label the height and location of each line.

![Magnitude Spectra of \( x(t) \)]

![Phase Spectra of \( x(t) \)]
3. [100 pts] Find the Fourier coefficients of the following waveforms.

(a) \( x(t) = 4 \cos(2t) + 8 \sin(4t) \)

(b) \( x(t) \) as shown in Figure PR-3b.

(c) \( x(t) \) as shown in Figure PR-3c.
4. [100 pts] A certain real periodic signal, \( x(t) \), with fundamental frequency \( \omega_0 = 10 \text{ rad/sec} \) has Fourier series coefficients equal to

\[
C_{kx} = \frac{20}{1 + jk}
\]

This signal is passed through a system with transfer function equal to

\[
H(s) = \frac{20}{s + 20}
\]

(a) What is the period of the output signal, \( y(t) \)?

(b) What is the average value of the output signal?

(c) What are the amplitude and phase of the fundamental frequency component of the output?

(d) Find an expression for the Fourier coefficients of the output signal.