Practice Problems for EE-318 – A Brief Review

1. Assume a given signal \( x(t) \) has the waveform shown in figure below. Plot \( x(2t - 3) \).

2. The impulse response of a given LTI system is

\[
h(t) = e^{-(t+3)}u(t-2)
\]

Which of the below properties seen below are valid for this system?

- [ ] Has Memory
- [ ] Memoryless
- [ ] Causal
- [ ] Noncausal
- [ ] BIBO Stable
- [ ] BIBO Unstable
- [ ] Linear
- [ ] Nonlinear

3. Evaluate the following integral:

\[
\int_{0}^{2\pi} \cos(kx - wt)\delta(t - 0.5\pi)dt
\]

4. Over what range of \( t \) is the function \( x(t) = u(6 + 3t) - u(-4 - 5t) \) nonzero?

5. Assume the signal \( x(t) \) is a triangle function that is nonzero over the range \( 0 < t < 10 \) and zero elsewhere. Find the fundamental period of the following signal:

\[
f(t) = \sum_{k=-\infty}^{\infty} [x(t - 10k) + x(t - 15k)]
\]

6. The output of an LTI system is given as \( y(t) = 5e^{-t}u(t-1) \) when the input to the system is \( x(t) = 10u(t) \). Find the output of the system when the input is \( x(t) = 20u(t-2) + 5u(t-4) \).
7. Block diagram of an LTI system is given in figure below:

Find the output of the system $y(t)$ in terms of the input $x(t)$ and impulse responses of each subsystem. Also find the overall impulse response of the system.

8. Give a complete mathematical expression for the signal shown in the figure:
9. Using mathematical evaluation of the convolution integral, find the output $y(t)$ of an LTI system with the following input signal $x(t)$ and impulse response $h(t)$. Plot $y(t)$.

\[ x(t) = \sum_{n=1}^{\infty} (-1)^n \sin(40\pi nt) \]

Which of the below are valid for this signal, based on your knowledge of its Fourier series:

- Even Function
- Periodic
- Energy Signal
- Continuous Frequency Spectrum
- Real-valued

10. Repeat the previous problem using graphical convolution.

11. A signal $x(t)$ has the Fourier series in trigonometric form given as

\[ x(t) = \sum_{n=1}^{\infty} (-1)^n \sin(40\pi nt) \]

Which of the below are valid for this signal, based on your knowledge of its Fourier series:

- Odd Function
- Aperiodic
- Power Signal
- Discrete Frequency Spectrum
- Complex-valued

12. What is the fundamental period of signal in Problem 11.
13. Exponential Fourier series of signal \( f(t) \) is given by:

\[
f(t) = 0.3 + \sum_{n=-2}^{2} \frac{j(-1)^n}{n|n|} e^{j6280nt}
\]

a. What is the total normalized power of the signal?
b. What percentage of the total power in the signal lies below 1200 Hz?
c. What is the time-average value of the signal?
d. What is the phase (in radians) of each coefficient in the Fourier series?

14. Find the Fourier transform of the following signal:

\[
f(t) = e^{-at} \cos(w_o t) u(t)
\]

15. Find the Fourier series coefficients for the following periodic signal which can be expressed as

\[
f(t) = \sum_{n=-\infty}^{\infty} 5e^{-2(t-n)} \text{rect} \left[ \frac{t - 1 - 2n}{2} \right]
\]