Networks, Signals, and Systems: Quiz 1

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Monsoon-2024　　　　　　　　　Marks: 15　　　　　　　　　Time : 40 minutes

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- Clearly state the assumptions (*if any*) made that are not specified in the questions. All steps should be justified in detail.

- Any attempt at plagiarism will result in ZERO for the exam, apart from other academic consequences.

- TAs will upload the solutions (some solutions may not be elaborate but gives essential ideas). This will be treated as the master document for evaluation. Appeals on the marks obtained should be done strictly only after verifying this master solution document.

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1. (7 marks)

    (a) (3 marks) Consider the pulse $p(t)$ as shown in Fig. 1a.
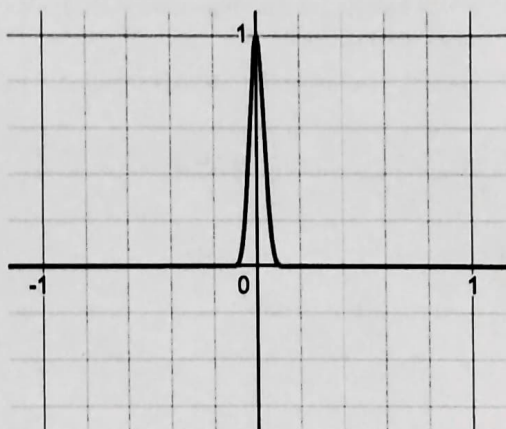

Figure 1: The pulse signal $p(t)$

Now, consider $x(t)$ as shown in Fig. 1a.

Reading the plots carefully, express $x(t)$ as a sum of possibly time-shifted, time-scaled, and amplitude-scaled signals of the pulse $p(t)$.

    (b) (3 marks+ 1 marks) Suppose the pulse $p(t)$ is given as an input to an LTI system, resulting in an output signal $cos^2(t^2 - 5) + 2t$, for $t \in [-2, 4]$ (and the output is 0 for all other t). What would the output signal be if the input to the LTI system is $3p(t - 2) + p(t + 3)$? [Note: You don't need to reduce your answer to the simplest form.]. Can you prove or disprove if this system is bounded or causal with the information given?
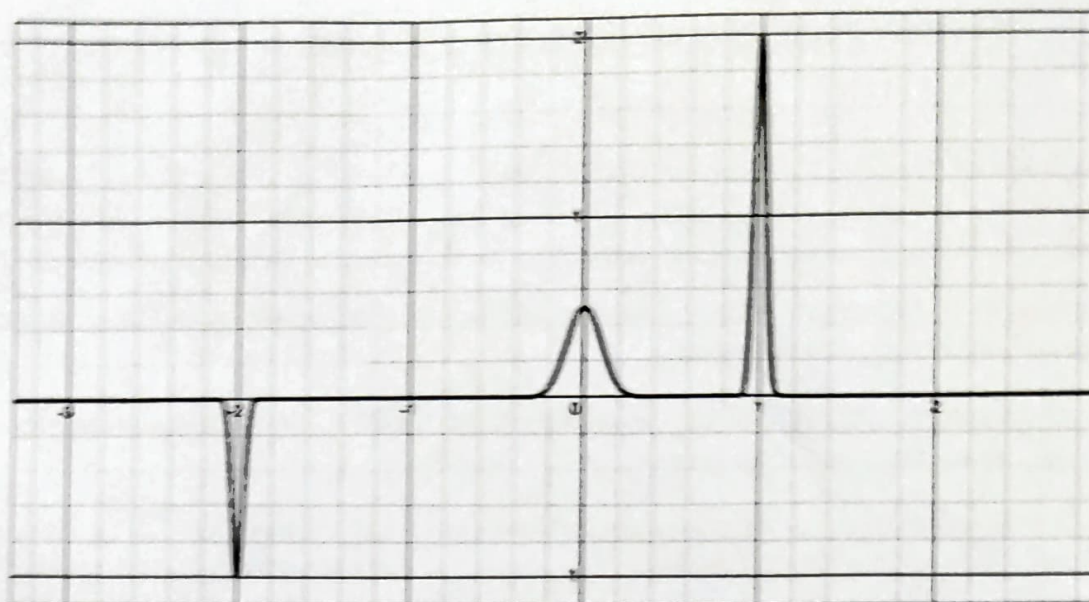
2. (8 marks)

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Figure 2: The signal $x(t)$

(a) (2+1+1) What is the fundamental period of the signal $10e^{j(240\pi t)}$ (note that $j \triangleq \sqrt{-1}$)? What is the (fundamental) angular frequency? What is the (fundamental) frequency?

(b) (2 marks) Give expressions for the first and second harmonics of this sinusoid (positive frequencies are sufficient).

(c) (2 marks) Calculate the (total) energy of this signal and the (average) power.