Assignment - 2

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***Abstract*—This document contains the solution to Exercise 2.26(a) of Oppenheim.**

Problem 1. Which of the following discrete-time signals could be eigenfunctions of any stable LTI system ?

$$\text{(a)}5^n u[n] \ \text{(b)}e^{j2wn} \ \text{(c)}e^{jwn} + e^{j2wn} \ \text{(d)}5^n e^{j2wn} \tag{1}$$

Solution: Eigenfunction of a system is an input signal which appears at the output of the system scaled by a complex constant

$$y[n] = \sum_{k=-\infty}^{\infty} h[k]x[n-k] \tag{2}$$

$$= \sum_{k=-\infty}^{\infty} h[k]5^{n-k}u[n-k] \tag{3}$$

$$= 5^n \sum_{k=-\infty}^{n} h[k]5^{-k} \tag{4}$$

Because the summation depends on n, $x[n]$ is not an eigenfunction.