

Signals and Systems (BEC 403)

Unit-5

Sampling and Reconstruction of Signals

Atul Kumar Dwivedi^{©1}



DEPARTMENT OF ELECTRONICS AND
COMMUNICATION

BUNDELKHAND INSTITUTE OF ENGINEERING AND
TECHNOLOGY, JHANSI (U. P.), INDIA

¹Disclaimer : The content is prepared by Dr. Atul Kumar Dwivedi for teaching/academic purpose only. If it is to be used for research or commercial purpose, a due permission should be taken from original authors of the content. Further, content of this document is under review. Suggestions/Corrections with line number and page no, will be appreciated. Suggestions/corrections/comments can be sent to atul.ece@bietjhs.ac.in.

Chapter 1

Sampling

₁ 1.1 Syllabus:

₂ Sampling, reconstruction

₃ 1.2 Signal Reconstruction Using Kth Order ₄ Hold

₅ The rectangular function is given by

$$\text{rect}(t) = \begin{cases} 0 & \text{if } |t| > \frac{1}{2} \\ \frac{1}{2} & \text{if } |t| = \frac{1}{2} \\ 1 & \text{if } |t| < \frac{1}{2}. \end{cases} \quad (1.1)$$

₆ The triangular function is defined as

$$\text{tri}(t) = \begin{cases} 1 - |t|, & |t| < 1 \\ 0, & \text{otherwise} \end{cases} \quad (1.2)$$

₇ It is the convolution of two identical unit rectangular functions:

$$\text{tri}(t) = \text{rect}(t) * \text{rect}(t) = \int_{-\infty}^{\infty} \text{rect}(\tau) \cdot \text{rect}(t - \tau) d\tau \quad (1.3)$$

8 Zero-order hold is given by:

$$x_{\text{ZOH}}(t) = \sum_{n=-\infty}^{\infty} x(n) \text{rect}(t - n) \quad (1.4)$$

9 for First-order hold

$$x_{\text{FOH}}(t) = \sum_{n=-\infty}^{\infty} x(n) \text{tri}(t - n) \quad (1.5)$$

10 for First-order hold. Since $\text{tri}(t) = \text{rect}(t) * \text{rect}(t)$. This can be extended to
11 second order hold as

$$x_{\text{SOH}}(t) = \sum_{n=-\infty}^{\infty} x(n) \text{par}(t - n) \quad (1.6)$$

12 where $\text{par}(t) = \text{rect}(t) * \text{rect}(t) * \text{rect}(t)$ and third order hold can be given as

$$x_{\text{TOH}}(t) = \sum_{n=-\infty}^{\infty} x(n) x_{\text{th}}(t - n) \quad (1.7)$$

13 where $x_{\text{th}}(t) = \text{rect}(t) * \text{rect}(t) * \text{rect}(t) * \text{rect}(t)$. In this way K_{th} order hold
14 can be written as

$$x_{\text{KOH}}(t) = \sum_{n=-\infty}^{\infty} x(n) x_{\text{k}}(t - n) \quad (1.8)$$

15 where $x_k(t)$ is obtained by

$$x_k(t) = (\text{rect}(t) * \text{rect}(t)) * (\text{rect}(t) * \text{rect}(t)) * \text{rect}(t) \dots k+1 \text{ times.} \quad (1.9)$$