**Unit-I**

**Introduction**

**Session-1 Date: 10.07.13 , 1st hour, Time: 9.15 am-10.05 am**

**Recap:** Control Systems

**Suggested Activity: Quiz**

1. **Classification of control systems:** Open loop and closed loop system
2. **System:** Effect or cause between two or more signals
3. **Difference between Open and closed loop system:** Feedback signal
4. **Transfer function:** L.T of Output/ L.T of input with zero initial conditions
5. **Basic elements of mechanical system:** Mass, dashpot and spring
6. **Basic elements of electrical system:** Resistance, inductance and capacitance

**Content:** Classification of Systems

* Continuous time system
* Discrete time system

**Suggested Activity: Odd man out**

**Suggested Activity: Odd man out**

1. Which of the following is not a system?

**i. Energy** ii. Continuous iii. Discrete iv. Linear

b. Which one of the following is not a discrete time system?

i. Static ii. Dynamic iii. Causal **iv. Power**

1. ECG gives information about the organ

i.Brain **ii. Heart** iii. Lungs iv. Kidney

1. EEG gives information about the organ

**i.Brain** ii. Heart iii. Lungs iv. Kidney

**Conclusion:** Classification of Systems

**Suggested Activity: Questions & Answers**

1. Define continuous time system.

Produces a continuous time output signal.

1. Define discrete time system.

Produces a discrete time output signal.

1. List the different types of signal.

a.One dimensional signal

b. Two dimensional signal

c. Multi dimensional signal

**Ref :** <https://digitalsignalp.wordpress.com/2011/10/30/linear-and-non-linear-time-invariant-and-variant-systems-in-dsp/>

**Session-2 Date: 10.07.13 , 4th hour, Time: 12.00 pm-12.50 pm**

**Recap:** Classification of Systems

**Suggested Activity: Quiz**

1. **Major classifications of systems:** Continuous and discrete time systems
2. **Types of signals:** One, two and multi dimensional signal
3. **System means:** Effect or cause between two or more signals

**Content:** Classification of Discrete time Systems

**Suggested Activity: Brainstorming**

1. **Static systems:** Output depends upon only present input
2. **Dynamic systems:** Output depends upon past & future samples of input
3. **Time invariant:** System characteristics does not change with time.
4. **Stable system:** Bounded input produces bounded output sequence.
5. **Unstable system:** Bounded input produces unbounded output sequence.

**Conclusion:** Classification of Discrete time Systems

**Suggested Activity: Questions & Answers**

1. **Define FIR system.**

Impulse response of the system is of finite duration.

1. **What is meant by IIR system**?

Impulse response of the system is of infinite duration.

1. **State the difference between Linear and non-Linear systems.**

A system satisfies the superposition principle is said to be a linear system.

A system that does not satisfy the superposition principle is said to be non-linear system.

**Ref :** <http://en.wikipedia.org/wiki/Continuous_signal>

**Session-3 Date: 11.07.13 , 1st hour, Time: 9.15 am-10.05 am**

**Recap:** Classification of Discrete time Systems

**Suggested Activity: Quiz**

* **Causal systems:** Output depends upon only on past and present input.
* **Difference between FIR & IIR systems:** Response is of Finite and infinite duration.
* **Time variant systems:** System characteristics changes with time.
* **Linear systems:** System that satisfies the superposition principle.

**Content:** Classification of Signals

**Suggested Activity: Group Activity**

The entire class is divided into totally five groups. Each group is assigned a specific topic and asked to discuss about various points involved in that topic.

* **Group-1: Continuous & Discrete time signal**

The first group is asked to discuss about Continuous & Discrete time signal.

Unit step, unit ramp, impulse, sinusoidal, real and complex exponential signal.

* **Group-2: Energy & Power signal**

The second group is asked to discuss about Energy & Power signal.

Energy signal: Total energy of the signal is finite & Power is zero.

Power Signal: Average power of the signal is finite & energy is infinity.

* **Group-3: Periodic & Aperiodic signal**

The third group is asked to discuss about Periodic & Aperiodic signal.

Periodic signal: x(n+N) = x(n)

Aperiodic signal : x(n+N) **≠** x(n)

* **Group-4: Symmetric & Antisymmetric signal**

The fourth group is asked to discuss about Symmetric & Antisymmetric signal.

Symmetric signal: x(-n) = x(n)

Antisymmetric signal: x(-n) = -x(n)

* **Group-5: Causal & Noncausal signal**

The fifth group is asked to discuss about Causal & Noncausalsignal.

Causal signal: x(n) = 0, for n< 0

Noncausalsignal: x(n) **≠** 0, for n< 0

**Ref :**<http://www.diet.unina.it/giacinto.gelli/DSPcourse/Lecture1.pdf> -

**Conclusion: Classification of signals**

**Suggested Activity: Pick & Answer**

There are variety of questions based on the content of the session and any one of the learner is asked to pick the letter and the corresponding question to be answered**.**

1. Energy signal
2. Causal signal
3. Symmetric signal
4. Periodic signal
5. Types of signals
6. Example for signals

If the learner choose **letter e** then the question is **types of signals** and the answer is

**a. One dimensional signal b. Two dimensional signal c. Multi dimensional signal**

**Ref :** <http://cnx.org/content/m10057/latest/>

**Session-4 Date: 13.07.13 , 6th hour, Time: 2.20 pm-3.10 pm**

**Recap: Classification of signals**

**Suggested Activity: Remembering**

* **Symmetric** signals are also called as **Even** signals
* **Antisymmetric** signals are also called as **Odd** signals
* **Unit step signal:** u(t) = 1 for t ≥ 0, u(t) = 0 for t < 0
* **Unit ramp signal:** r(t) = t for t ≥ 0, r(t) = 0 for t < 0

**Content: Mathematical representation of signals**

**Suggested Activity:** Match the following

**Column-A Column-B**

1. Graphical Representation a. Sequence 4

2. Functional Representation b. Table 3

3. Tabular Representation c. Function 2

4. Sequence Representatio n d. Graph 1

**Ref:** <http://www.youtube.com/watch?v=He_Zokhmj8M>

**Conclusion: Mathematical representation of signals**

**Suggested Activity:** Recall by Keywords

* **Unit step sequence:** u(n) = 1 for n ≥ 0, u(n) = 0 for n < 0
* **Unit ramp sequence:** r(n) = n for n ≥ 0, r(n) = 0 for n < 0
* **Unit impulse response:** δ(n) = 1 for n = 0, δ(n) = 0 for n ≠ 0

**Ref:**<http://static.flipora.com/websearch.html?ref_type=ihome&src_type=tg&tv=7.304&t=7.304&u=8309201>

**Session-5 Date: 17.07.13 , 3rd hour, Time: 11.10 am-12.00 pm**

**Recap: Mathematical representation of signals**

**Suggested Activity:** Brain Storming

* Functional Representation:

X(n) = { 1 for n = -1

2 for n = 0,1

0.5 for n = 2

1.5 for n = 3

0 otherwise }

* Tabular Representation:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| n | -1 | 0 | 1 | 2 | 3 |
| X(n) | 1 | 2 | 2 | 0.5 | 1.5 |

**Ref:** <http://www.ipredict.it/Methods/DigitalSignalProcessing.aspx>

**Content: Spectral density & Operation on signals**

**Suggested Activity:** Match the following

**Column-A Column-B**

1. Shifting a. Sampling 3

2. Time Reversal b. Multiplication 4

3. Time Scaling c. Adder 5

4. Signal Multiplier d. Delay or advance 1

5. Signal Addition e. folding the sequence 2

Ref: <http://cnx.org/content/m10125/latest/>

**Conclusion: Spectral density & Operation on signals**

**Suggested Activity:** One word answer

* Shifting means y(n) = x(n-k)
* Time Reversal is denoted as **x(-n)**
* Time Scaling **y(n) = x(2n)**
* Signal multiplier **y(n) = x1(n)\* x2(n)**

Ref:<http://www.csee.wvu.edu/classes/ee327/resources/ct_signal_operations.pdf>

**Session-6 Date: 17.07.13 , 4th hour, Time: 12.00 pm-12.50 pm**

**Recap: Spectral density & Operation on signals**

**Suggested Activity:** Group Discussion

The entire class is divided into totally six groups. Each group is assigned a specific topic and asked to discuss about various points involved in that topic.

* **Group-1:** Shifting

It takes the input sequence and shift the values by an integer increment.

* **Group-2:** Time Reversal

It is obtained by folding the sequence about n = 0.

* **Group-3:** Time Scaling

It is accomplished by replacing n by λn in the sequence x(n)

* **Group-4:** Scalar multiplication

X(n) is multiplied by a scale factor a.

* **Group-5:** Signal Multiplier

Multiplication of two signal sequences to form another sequence.

* **Group-6:** Signal Addition

Two signals can be added by using an adder.

**Content: Sampling techniques**

**Suggested Activity:** Brainstorming

* Sampling period: Time interval between successive samples.
* Sampling rate : Reciprocal of sampling period.
* Sampling or Decimation: Process of reducing sampling rate.

Ref: <http://wiki.answers.com/Q/Sampling_techniques_in_signal_processing>

**Conclusion: Sampling techniques**

**Suggested Activity:** Question & Answers

1. Give the function of sampling period.

X(nT) = x(n), -∞ < n < ∞

1. Give the expression for sinusoidal signal.

X(t) = SinΩt

Ref:"<http://en.wikibooks.org/w/index.php?title=Digital_Signal_Processing/Sampling_and_Reconstruction&oldid=2498653>"

**Session-7 Date: 18.07.13 , 1st hour, Time: 9.00 am-10.05 am**

**Recap: Sampling techniques**

**Suggested Activity:** Group Discussion

The entire class is divided into totally three groups. Each group is assigned a specific topic and asked to discuss about various points involved in that topic.

* **Group-1:** Sampling period

Time interval between successive samples.

* **Group-2:** Sampling rate

Reciprocal of sampling period.

* **Group-3:** Sampling or Decimation

Process of reducing sampling rate.

Ref: <http://wiki.answers.com/Q/Sampling_techniques_in_signal_processing>

**Content: Quantization & Quantization error**

**Suggested Activity:** Group Activity

The entire class is divided into totally two groups. Each group is assigned a specific topic and asked to discuss about various points involved in that topic.

* **Group-1: Quantization**

Quantization is the process of representing the analog voltage from the sample-and-hold circuit by a fixed number of bits. The input analog voltage (or current) is compared to a set of pre-defined voltage (or current) levels.

* **Group-2: Quantization error**

The process rounds the analog voltage to the nearest level, which means that the digital representation is an approximation to the analog voltage. There are a few methods for quantizing samples.

**Conclusion: Quantization & Quantization error**

**Suggested Activity:** Quiz

1. **Quantization means** the process of representing the analog voltage.
2. **Quantization error-** approximation to the analog voltage.
3. **Quantization noise:** Difference between the quantized value and actual sample.

Ref: <http://en.wikibooks.org/wiki/Digital_Signal_Processing/Sampling_and_Reconstruction>

**Session-8 Date: 19.07.13 , 2nd hour, Time: 10.05 am-10.50 am**

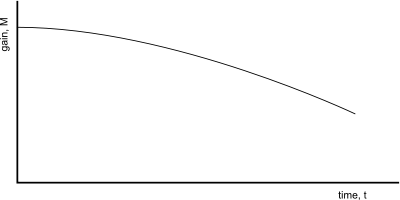
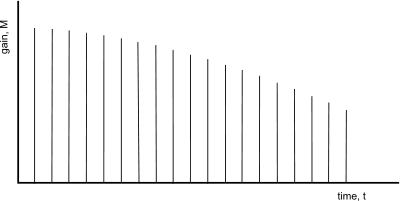
**Recap: Quantization & Quantization error**

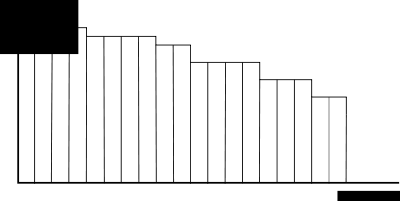
**Suggested Activity:** Quiz

1. Converting discrete time continuous signal to discrete time discrete signal- **Quantization**
2. xq(n)-x(n) = e(n): **Quantization noise**
3. Quantization noise- Difference between the quantized value and actual sample.

**Content: Nyquist rate, aliasing effect**

**Suggested Activity:** Board Activity

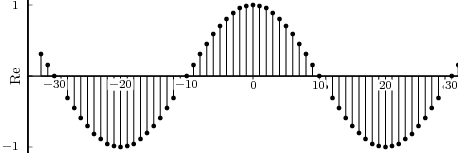
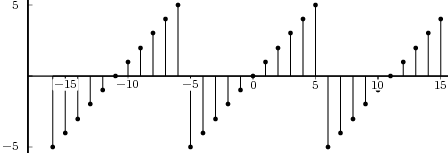
[](http://en.wikibooks.org/wiki/File:Analog_Waveform.svg)[](http://en.wikibooks.org/wiki/File:Sampled_Waveform.svg)

[](http://en.wikibooks.org/wiki/File:Reconstructed_Waveform.svg)

1. **Aliasing** is a common problem in digital media processing applications
2. The **Nyquist Sampling Rate** is the lowest sampling rate that can be used without having aliasing.
3. **Anti- Aliasing** The sampling rate for an analog signal must be at least two times as high as the highest frequency in the analog signal in order to avoid aliasing.

**Conclusion: Nyquist rate, aliasing effect**

**Suggested Activity:** Tit for Tat



**Ref:** <http://en.wikibooks.org/wiki/Digital_Signal_Processing/Sampling_and_Reconstruction>

**Session-9 Date: 20.07.13 , 6th hour, Time: 2.20 pm-3.20 pm**

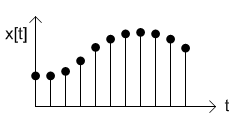
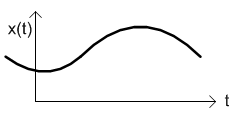
**Recap: Nyquist rate, aliasing effect**

**Suggested Activity:** Unspoken word

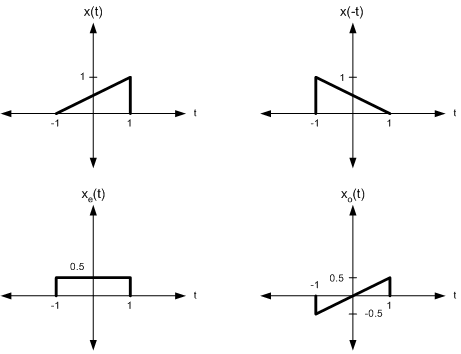
1. **Reconstruction:** Process of creating an analog voltage (or current) from samples.\
2. **Aliasing** is a common problem in digital media processing applications.
3. **Nyquist Sampling Rate** is the lowest sampling rate that can be used without having aliasing.

**Content: Digital signal representation**

**Suggested Activity:** Board Activity



Continuous time signal Discrete time signal

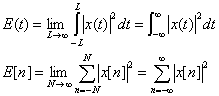


**Energy and Power Signals**

**Conclusion: Digital signal representation**

**Suggested Activity:** Show & Tell Activity

Energy signals representation



**Ref:** <http://www.youtube.com/watch?v=G-J4FG2L_yc>

**Ref:** <http://www.songho.ca/dsp/signal/signals.html>

**Session-10, 11, 12**

**Content: Tutorial based on classification of signals**

**Suggested Activity:** Board Activity- Problem Solving

**Ref:** <https://digitalsignalp.wordpress.com/2011/10/30/linear-and-non-linear-time-invariant-and-variant-systems-in-dsp/>

**Ref:** <http://www.dspguide.com/ch6.htm>

**Ref:** <http://www.youtube.com/watch?v=G-J4FG2L_yc>