Signals and Systems

Systems and their classifications-I

Static and Dynamic Systems

(Memory less & Memory Systems)

Systems

- Broadly speaking, a system is anything that responds when stimulated or excited
- The systems most commonly analyzed by engineers are artificial systems designed and built by humans
- Engineering system analysis is the application of mathematical methods to the design and analysis of systems

Feedback Systems

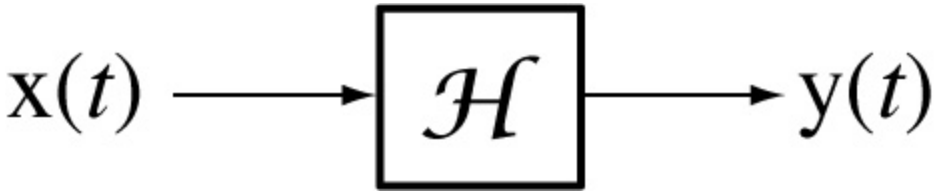
In a **feedback** system the response of the system is "fed back" and combined with the excitation is such a way as to optimize the response in some desired sense. Examples of feedback systems are

1. Temperature control in a house using a thermostat
2. Water level control in the tank of a flush toilet.
3. Pouring a glass of lemonade to the top of the glass without overflowing.
4. A refrigerator ice maker which keeps the bin full of ice but does not make extra ice.
5. Driving a car.

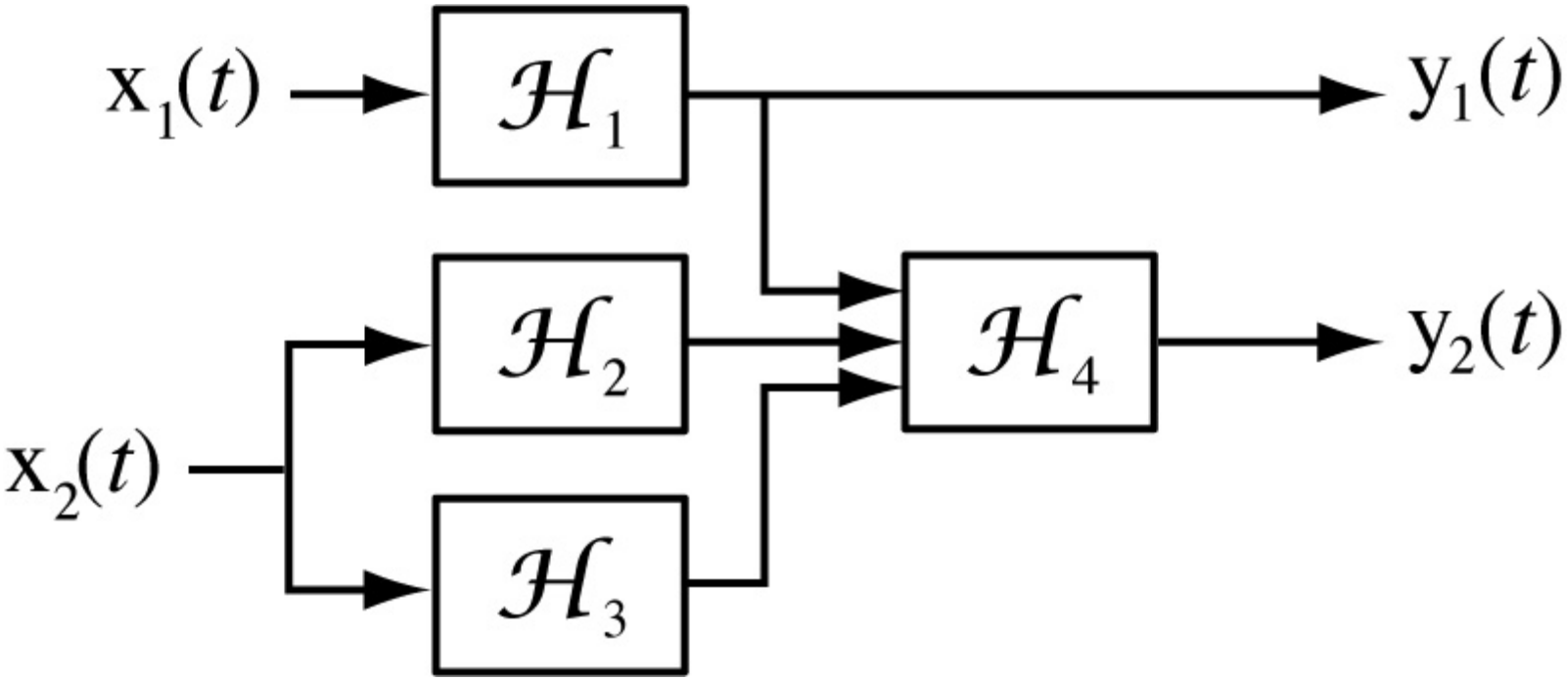
Systems

- Systems have **inputs** and **outputs**
- Systems accept **excitations** or **input signals** at their inputs and produce **responses** or **output signals** at their outputs
- Systems are often usefully represented by **block diagrams**

A single-input, single-output system block diagram

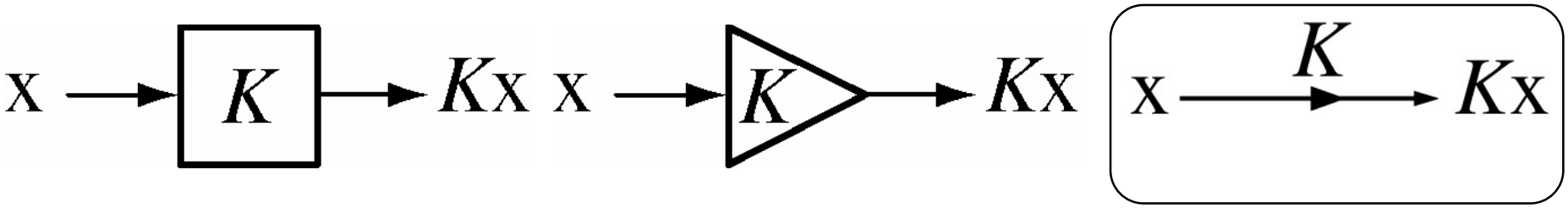


A Multiple-Input, Multiple-Output System Block Diagram

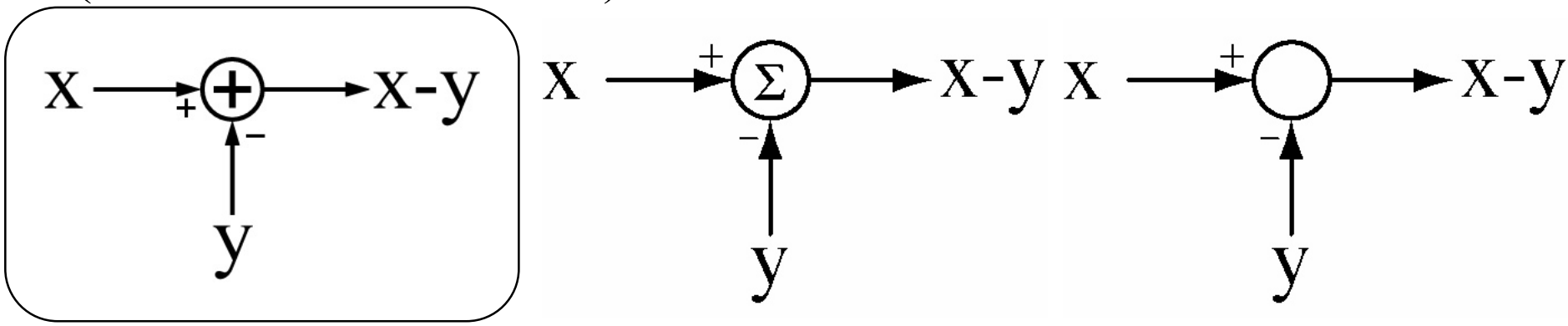


Block Diagram Symbols

Three common block diagram symbols for an **amplifier** (we will use the last one).

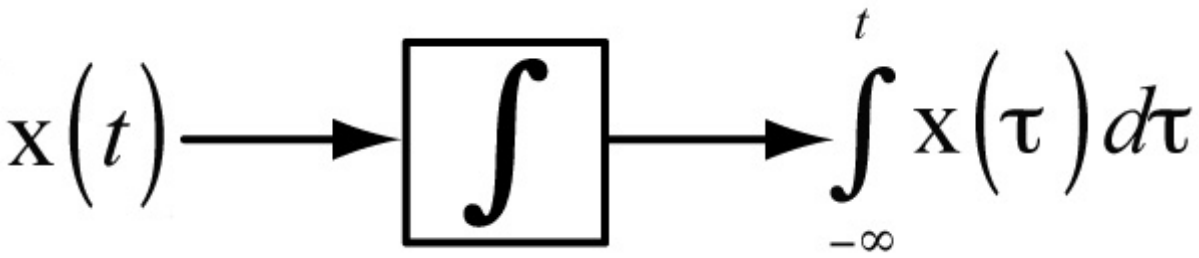


Three common block diagram symbols for a **summing junction** (we will use the first one).



Block Diagram Symbols

Block diagram symbol for an **integrator**



CLASSIFICATION OF SYSTEMS

- Linear & Nonlinear Systems
- Time invariant & Time varying Systems
- Causal & Non- causal Systems
- Static and Dynamic Systems
- Memory & Memory less Systems
- Stable & unstable system

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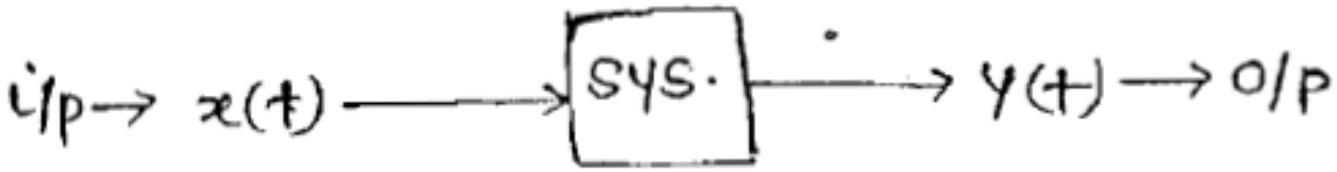
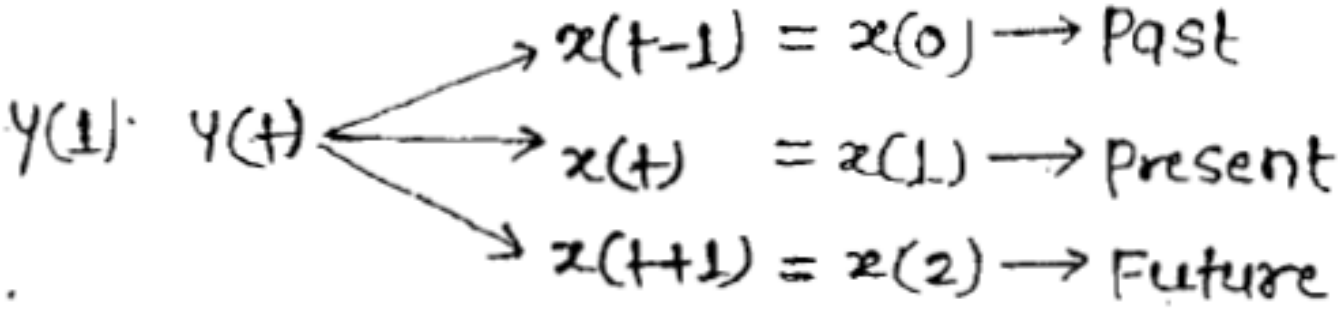
LTI Systems (continuous-time and discrete time)

Systems





Static and Dynamic Systems

(Memory less & Memory Systems)

(1) Static & dynamic sys. →

Static → If o/p of sys. depands only on present values of i/p at each & every instant of time then sys. will be static.

* These sys. are also known as memoryless system.

Dynamic → * If o/p of sys. depands on past (or) future values of i/p at any instant of time then sys. will be dynamic.

* This sys. are also known as sys. with memory.

Cont..

Q.→ Check static/ dynamic sys.

(1.) $y(t) = x(t) + x(t-1)$

(2.) $y(t) = x(-t)$

(3.) $y(t) = x(\sin t)$

(4.) $y(t) = x(t-1)$

(5.) $y(t) = \text{Even}[x(t)]$

(6.) $y(t) = \text{Real}[x(t)]$

(7.) $y(t) = \int_{-\infty}^{t} x(z)\,dz$

(8.) $y(t) = e^{-(t+1)} x(t)$

Cont..

Ans → (1.) Dynamic.

(2.) Dynamic.

(3.) $y(t) = x(\sin t)$

$y(-\pi) = x(0)$

$-3.14 \sec = x(0)$ (future) system is dynamic.

(4.) Dynamic

(5.) $g(t) = \dfrac{x(t) + x(-t)}{2}$

$(t = 1)$, past

$y(1) = \dfrac{x(1) + x(-1)}{2}$ system is dynamic.

(6.) $y(t) = \dfrac{x(t) + x^*(t)}{2}$ system is static

Cont..

Note→

(1.) Integral & derivative sys. are dynamic sys.

(2.) In case of time scaling (or) time shifting system will be dynamic.

Thank You