Review- Sp. 2015

1. *Key concepts*

   - systems, dynamic systems, linear/nonlinear systems,
   - modeling, mathematical model
   - analysis, design, synthesis

2. *Laplace Transform*

   - Laplace Transform review

3. *Mathematical Model of Dynamic Systems*

   - Mechanical Systems
   - Electrical Systems, electro-mechanical systems
   - Fluid Systems and Thermal Systems, Hydraulic Servo System

(3. *Mathematical Model of Dynamic Systems*)

- **Newton's laws**
- **spring, mass, damper, friction**
- **Energy Method**
- **Linearization of nonlinear systems**

- **Kirchhoff's laws**
- **resistor, inductor, capacitance**
- **Operational Amplifiers**
- **Complex Impedance**
- **DC Servo Motors**

4. ***Transfer Function Approach to Modeling Dynamic Systems***

- **Closed Loop Transfer Function**
- **Transient Response Analysis with MATLAB**
- **Step input response, Ramp input, Impulse response**

5. ***Mathematical Modeling of Dynamic System in State Space***

- **states, state space, state equations**
- **matrix exponential**
- **state transition matrix**
- **solution of state equation**
- **state transformation, diagonalization / Jordan Canonical Form**

6. *Linear System Analysis in Time Domain*

- First order systems, time constant
- second order systems, natural frequency, damping ratio
- higher order systems: Poles and zeros
- characteristic equations, characteristic roots, complex poles
- transient response

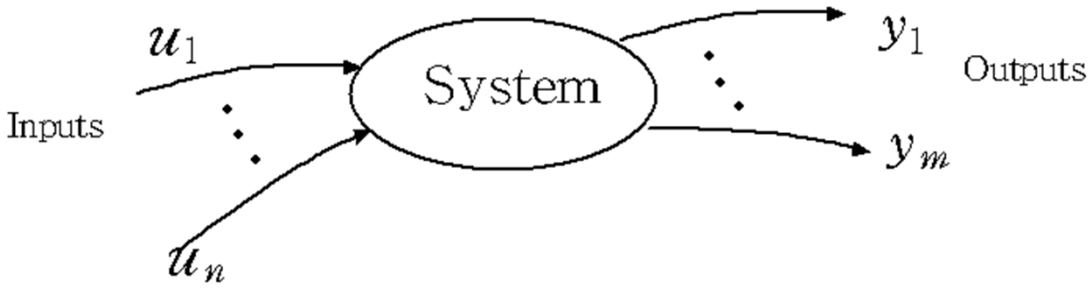
7. *Frequency Response*

- definition: Steady State Frequency Response
- unit step response versus frequency response
- Bode Plot
- Vibration Isolation in Rotating Systems
- Transmissibility
- dynamic vibration absorber
- seismograph / accelerometer

System / Control / Control System Design

- **System**

- **A combination of components acting together to perform a certain objective**



- **Control**

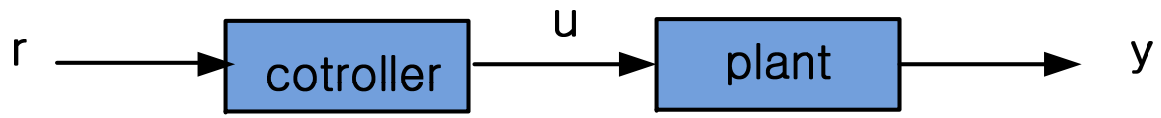
- **Applying inputs to the system to correct or limit deviation of the output values from desired values**

Control systems
Engineering systems

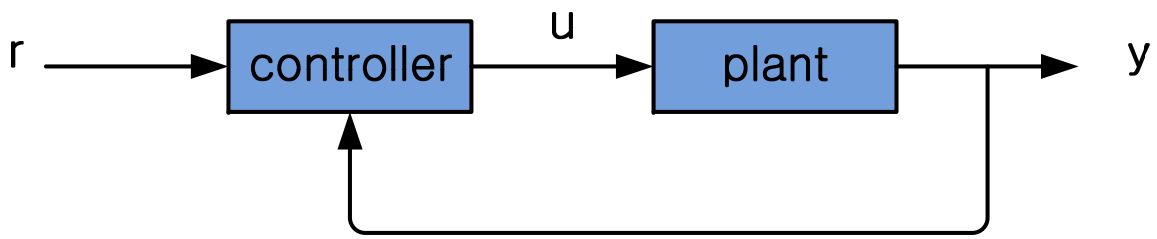
Open / Closed loop control

- **OPEN loop control**

$$u = f(r)$$

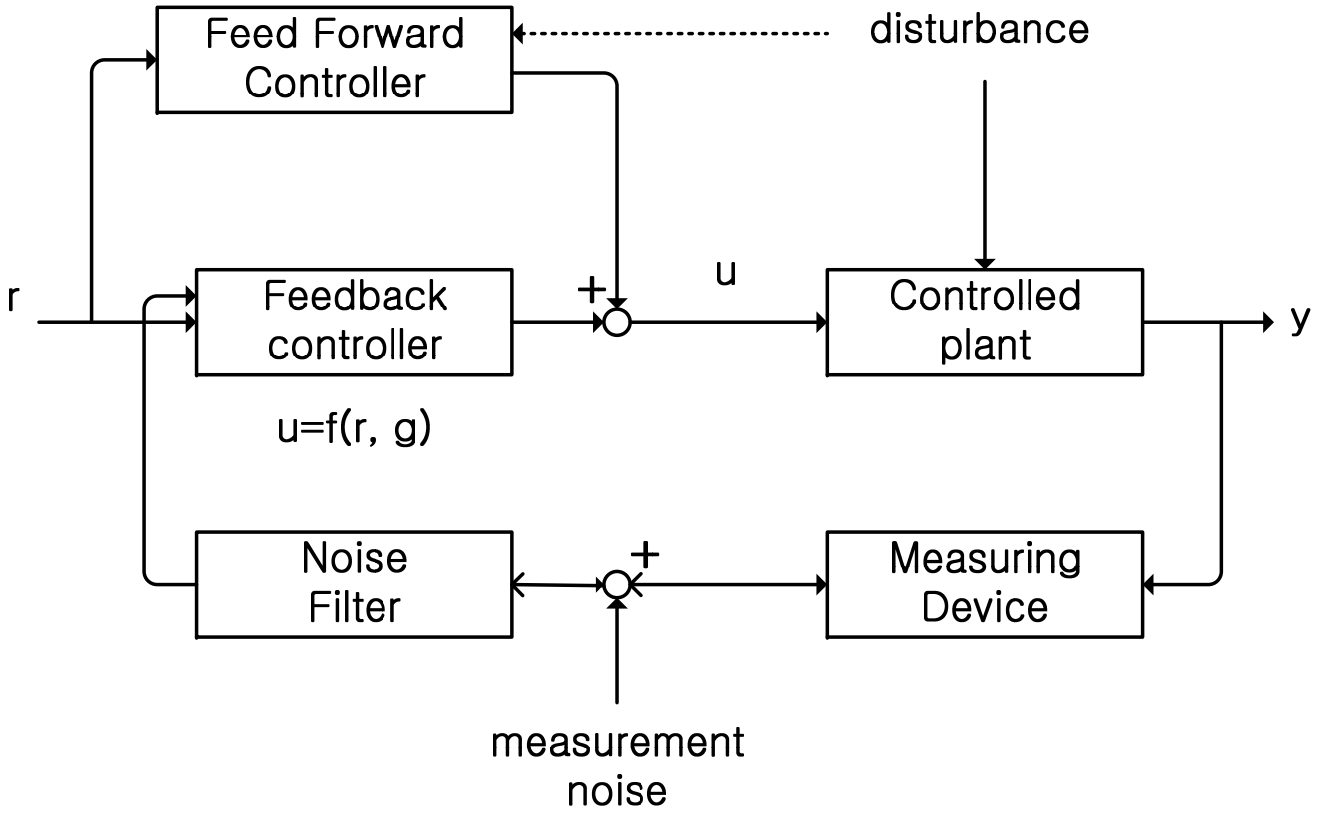


- **CLOSED loop control (Feedback control)**



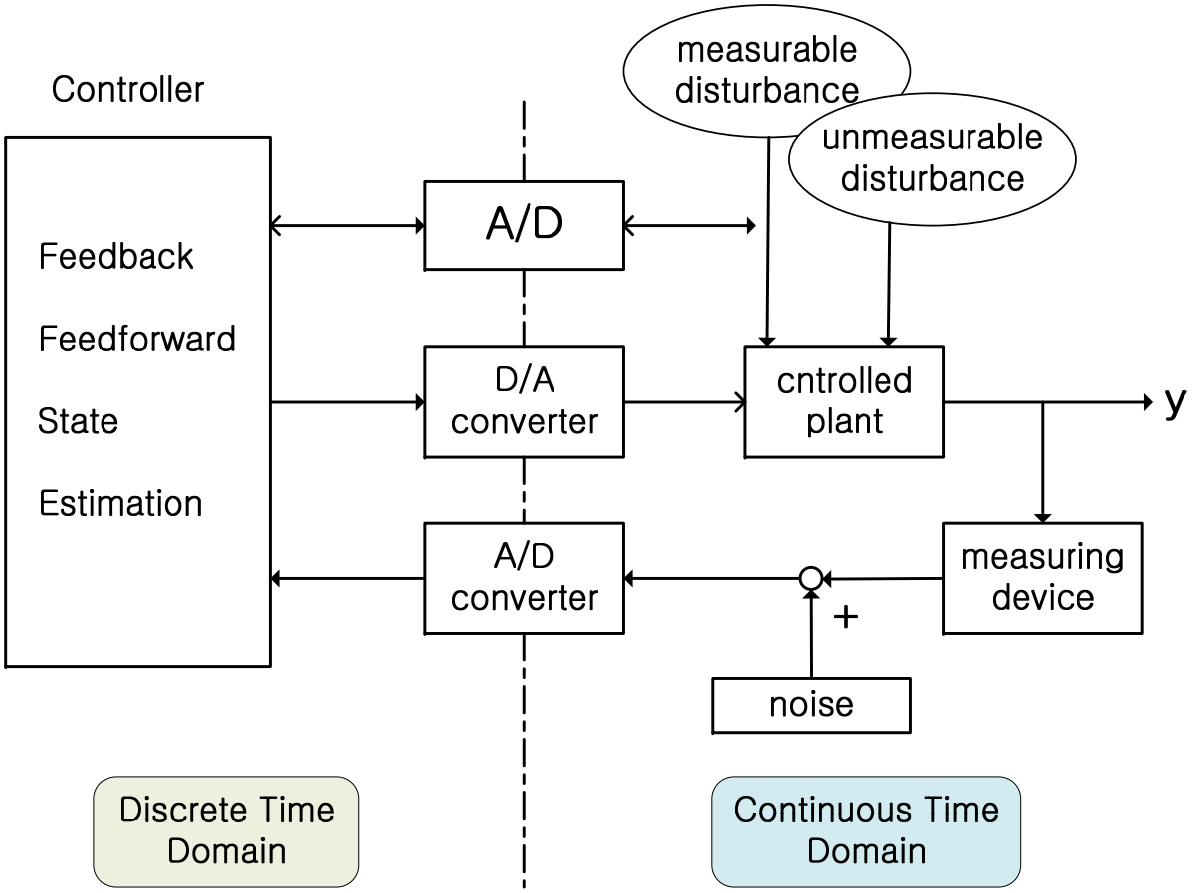
$$u = f(r, y)$$

Block Diagram of Typical control systems



Microprocessor-Based Control Systems

- **Digital Control System**



System Control (next semester)

1. **System control: Key issues in control systems**

   - **stability**
   - **performance:**
     - **Command tracking**
     - **Disturbance rejection**

   - **robustness**
     - **stability robustness**
     - **performance robustness**

2. **control system representation**
   - **transfer function**
   - **state equations**
   - **graphical representation: block diagram, signal flow graph**

3. **Stability**

   - **equilibrium**
   - **stability definition**
   - **stability of LTI systems**
   - **stability tests**

System Control (next semester)

4. Controller design

- **feedback control systems (closed-loop control systems)**
- **Root Locus method: pole placement**
- **Frequency Response method : lead / lag compensators**
- **analysys and design Using MATLAB**
- **control system simulation using MATLAB / SIMULINK**

- **PID Control**
- **state space method**