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AUTOMATIC CONTROL SYSTEM PERFORMANCE SPECIFICATIONS

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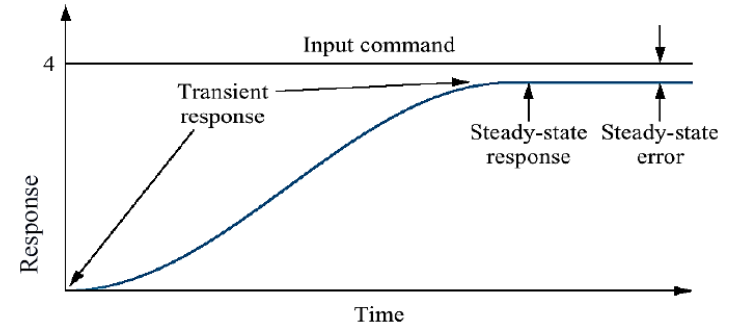
SYSTEM PERFORMANCE

- Analysis: system's performance is determined
- Design: system's performance is created or changed



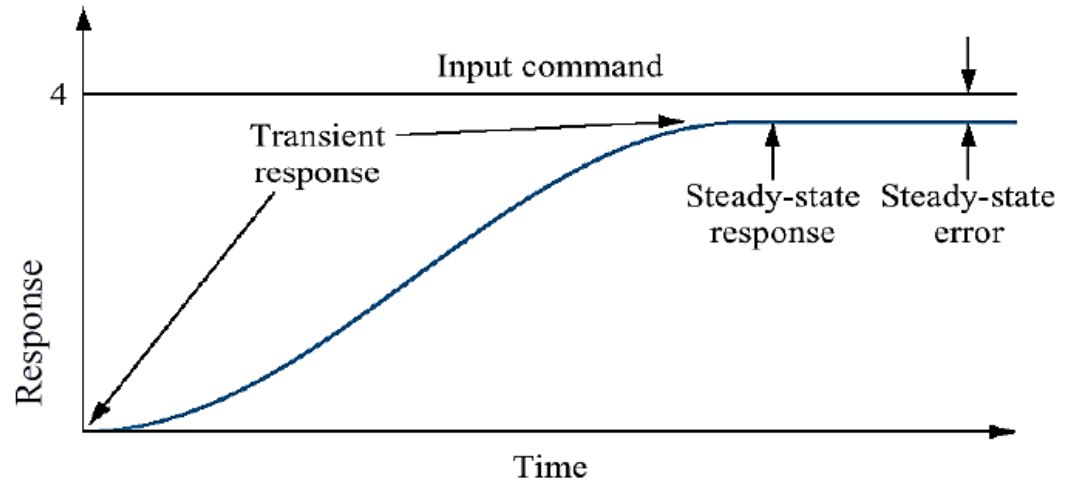
ANALYSIS AND DESIGN OBJECTIVES OF A CONTROL SYSTEM

- A control system is dynamic
- It responds to an input by undergoing a transient response before reaching a steady state response
- A control system should be designed with the following objectives:
 - It should produce the desired transient response
 - It should reduce steady-state errors
 - It should achieve stability



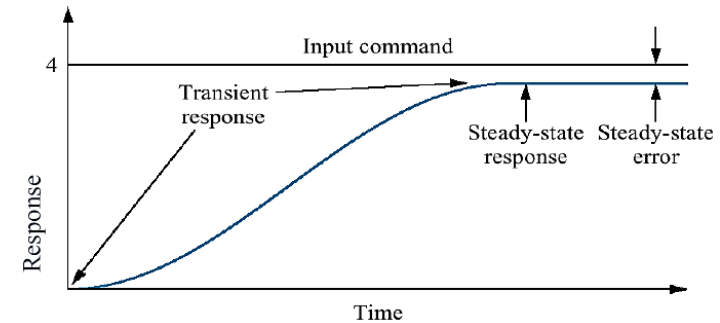
PERFORMANCE SPECIFICATIONS

- Transient response
- Steady-state error
- Stability
- Other considerations



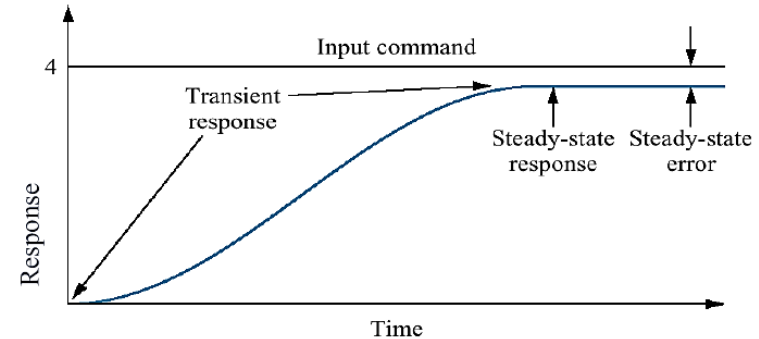
FIRST DESIGN OBJECTIVE: TRANSIENT RESPONSE

- Too fast a transient response makes uncomfortable
- Too fast a transient response could cause permanent physical damage
- First establish a quantitative definition for transient response
- Then analyze the system for its existing transient response
- Finally, adjust parameters or design components to yield a desired transient response



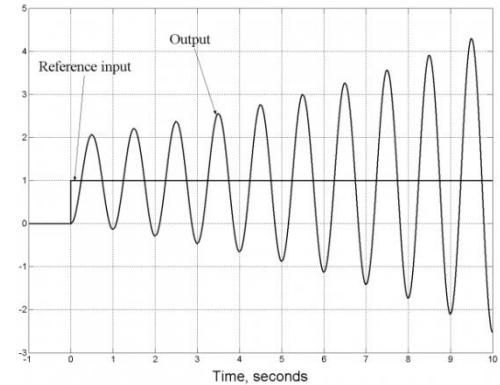
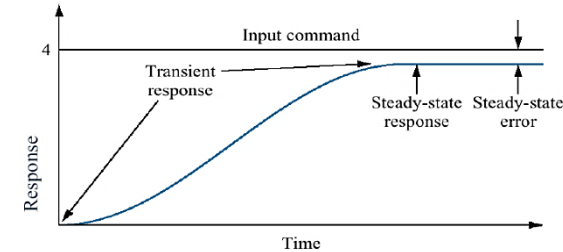
SECOND DESIGN OBJECTIVE: STEADY-STATE RESPONSE

- This response resembles the input
 - It is usually what remains after the transients have decayed to zero
 - Elevator stopped near the fourth floor. It must level enough with the floor for the passengers to exit
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- Accuracy of the SS response
 - Define steady-state error quantitatively
 - Analyze a system's SS error
 - Design corrective actions to reduce the SS error



THIRD DESIGN OBJECTIVE: STABILITY

- For a control system to be useful, the natural response must eventually approach zero, leaving alone the forced response
- In some systems, the natural response grows without bound
- Instability could lead to self-destruction of the physical system
- Elevator would crash through the floor or exit through ceiling
- A time plot of an unstable system would show a transient response that grows without bound and without any evidence of a steady state response
- Only for a stable system, the proper transient response and SS error characteristics can be designed



OTHER DESIGN CONSIDERATIONS

- **Finance:** budget allocation and competitive price
- **Robustness:** system will not be sensitive to parameter changes



REFERENCE BOOKS

- Norman S. Nise, Control Systems Engineering, Wiley, 2013
- Katsuhiko Ogata, Modern Control Engineering, Prentice Hall, 2010.

