Tecnológico de Monterrey

Semester august – december 2022

Computerized Control
MR2007

Final Exam

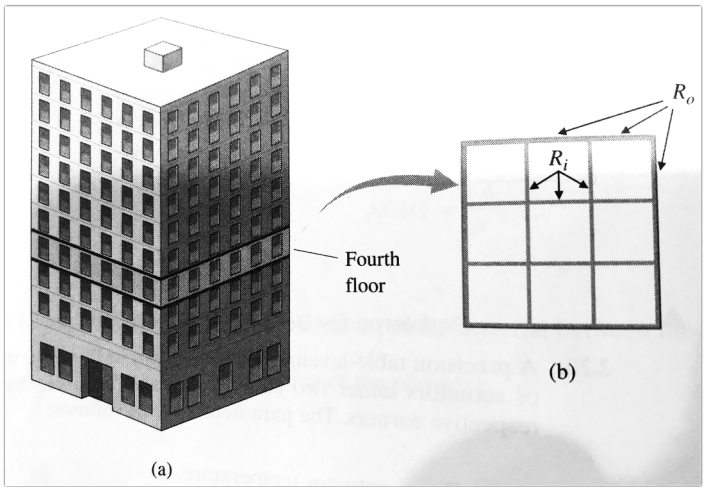
An air conditioner supplies cold air at the same temperature to each room on the fourth floor of the high-rise building shown in the figure below. Also, the floor plain is provided. Find the differential equation that describes the temperature in each room, where:

$$T_0 = temperature\ outside\ the\ building.$$

$$R_0 = resistance\ to\ heat\ flow\ through\ the\ outer\ walls.$$

$$R_i = resistance\ to\ heat\ flow\ through\ the\ inner\ walls.$$

Assume that all rooms are perfect square, there is no heat flow through the floors or ceilings, and the temperature in each room is uniform throughout the room. Take the advantage of symmetry to reduce the size of your model.



a) Draw the blocks diagram of the system
b) Find the system transfer function G(s)
c) Analyze Stability of G(s)
d) Find the system step response
e) Get the discrete form of the plant G(z)
f) Propose a sampling time
g) Analyze Stability of G(z)

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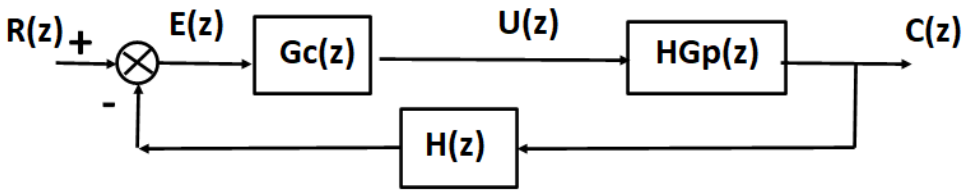
Consider the digital closed loop in the figure below.



1. Design four different controllers for the system.
   A) Propotional
   B) Proportinonal Integral
   C) Proportinoal Derivative
   D) Proportional Integral Derivative

2. Apply a step input and plot the response.

3. Consider a heat flow through windows (perturbation). Obtain its transfer function and plot the response.

4. Design a control system with next characteristics:
   a. O.S. smaller than 2%.
   b. Response Time smaller than 3 seconds.
   c. Settle Time smaller than 15 seconds.