sUmm Al-Qura Universtiy, Makkah

Department of Electrical Engieerig

Controls (802331)

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Solution Home Work 5

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You do not have to submit this home work. There will be a quiz from this home work in the 7th week.

**Q1.** Consider the five controllers:

1. Proportional:
2. Integral:
3. Proportional-plus-integral:
4. Proportional-plus-derivative:
5. Proportional-plus-integral-plus-derivative:

Sketch u(t) versus ‘t’ for each of the following error signals:

1. e(t) = unit step function
2. e(t) = unit ramp function

Assume the following numerical values:

Proportional gain =

Integral gain:

Derivative gain:

**Solution:**

1. Control signal for proportional controller:
   1. Error is unit step:
   2. Error is unit ramp:
2. Control signal for integral controller:
   1. Error is unit step:
   2. Error is unit ramp:
3. Control signal for proportional-plus-integral controller:
   1. Error is unit step:
   2. Error is unit ramp:
4. Control signal for proportional-plus-derivative controller:
   1. Error is unit step:
   2. Error is unit ramp:
5. Control signal for proportional-plus-integral-plus-derivative controller:
   1. Error is unit step:
   2. Error is unit ramp:

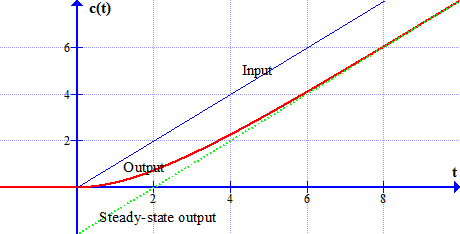
**Q2.** In the class, we found the step-response and ramp-response of the first order system. Find the impulse-response of the first order system.

**Solution:**

**Q3.** In the class, we found the ramp-response of the first order system as

Sketch this function. Assume T=2. You may use any software to make the sketch. Make it for 0<t<15.

**Solution:**

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**Q5.** A-5-1 (page 241)

**Q6.** B-5-1 (page 273)

For a first order system, the response to step function is

If

If the temperature of bath is changing at a rate of 10°/min, it is like the input of

Where t is in in minutes and r(t) is in degree.

The output would be

At steady-state

Comparing with input, the error is 2.5°.