Umm Al-Qura Universtiy, Makkah

Department of Electrical Engineering

Control (802331)

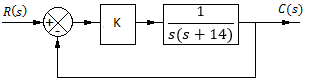
Term 2; 2016/2017

Solution Midterm Exam

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March 29, 2017 Student ID:

Max Marks: 60 Section 2



**Q1.** [5, 5, 5] Consider the system shown here:

1. Find the transfer function . What is the ‘order’ of this system?
2. Find the value of “K” such that .
3. What will be value of un-damped natural frequency?

**Solution:**

It is a 2nd order system.

**Q2.** [8, 7] Consider a PD-controller with , . The error signal is a ramp function: .

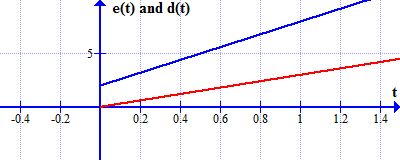
1. Find the control signal generated by the PD-controller.
2. Sketch both signals (the error signal and the control signal).

**Solution:**

Transfer function of the PD-controller:

.

Control signal =



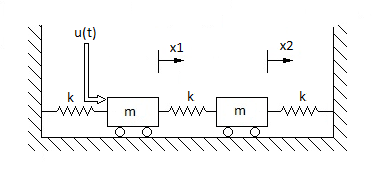
**Q3.** [15] An LTI system is described by the transfer function

Find the output of the system if the input is given by

**Solution:**

Hence

|  |  |
| --- | --- |
|  |  |

**Q4.** [5, 10] For the mechanical system shown here,

a. Show that the differential equations describing the system are

b. Find the transfer function matrix.

**Solution:**

1. Considering the forces on the left mass:

Considering the forces on the right mass:

1. Taking Laplace transforms:

From 2nd equation:

Substituting in the 1st equation:

Remember . Substituting in above

Writing in matrix form

Laplace transform

|  |  |
| --- | --- |
| Unit impulse: | 1 |
| Unit step: 1 |  |
| Unit ramp: |  |
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