

**INTRODUCTION TO CONTINUOUS CONTROL SYSTEMS**  
**COLUMBIA UNIVERSITY MECHANICAL AND ELECTRICAL ENGINEERING**  
**DEPARTMENTS: E3601**

*Homayoon Beigi<sup>†</sup>*

1340 Mudd Building  
Columbia University, New York City, NY 10027  
hb87@columbia.edu

## Homework 11 – Not Graded

**Problem 1** (Bode Plot of a First Order System).

*Consider the following first-order low-pass filter with the following transfer function:*

$$H(s) = \frac{10}{s+5}$$

1. *Determine the corner frequency (also known as the cutoff frequency) of the system.*
2. *Sketch the Bode plot for the given transfer function, including both the magnitude and phase plots.*
3. *Calculate and describe the behavior of the magnitude and phase as the frequency approaches zero and infinity.*

**Problem 2** (Bode Plot of a Second Order System).

*Consider the second order transfer function:*

$$H(s) = \frac{4}{s^2 + 0.4s + 4}$$

1. *Break Down the Transfer Function Parts*
2. *Approximate the parts of the Magnitude plot by computing values for different regions along the frequency.*
3. *Approximate the parts of the Phase plot by computing values for different regions along the frequency.*
4. *Plot Magnitude and Phase plots*

**Problem 3** (Bode Plot of a Third Order System).

*Consider the following third-order transfer function:*

$$H(s) = \frac{10}{(s+1)(s^2+2s+4)}$$

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<sup>†</sup>Homayoon Beigi is Professor of Professional Practice in the department of mechanical engineering and in the department of electrical engineering at Columbia University

1. *Identify the corner and/or resonance frequencies of the system.*
2. *Sketch the Bode plot for the given transfer function, including both the magnitude and phase plots.*
3. *What is the behavior of the magnitude and phase as the frequency approaches zero and infinity.*