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

Homayoon Beigi[†]

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

Homework 9

Problem 1 (Hurwitz Criterion)**.**

Using the Hurwitz Criterion, determine whether the following two characteristic equations describe asymptotically stable systems.
A.

$$P(s) = s^3 + 2s^2 + s + 3 \tag{1}$$

B.

$$P(s) = s^4 + 2s^3 + 2s^2 + 4s + 2 \tag{2}$$

Problem 2 (Eigensystem)**.**

Solve the following equation by using the Eigenvalue-Eigenvector approach:

$$\dot{\mathbf{x}}(t) = \begin{bmatrix} 3 & -4 \\ 1 & -2 \end{bmatrix} \mathbf{x}(t) \tag{3}$$

$$y(t) = [1 \;\; 0]\, \mathbf{x}(t) \tag{4}$$

where the initial conditions are given by,

$$\mathbf{x}(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \tag{5}$$

[†]Homayoon Beigi is Professor of Professional Pratice in the department of mecanical engineering and in the department of electrical engineering at Columbia University

Problem 3 (Hurwitz and Liénhard-Chipart)**.**

Use Hurwitz Criterion together with Liénhard-Chipart to determine whether the following characteristic polynomials are stable. You may use Matlab ONLY to compute any determinants. If you do, please oinclude the Matlab code in your homework solution PDF file.

A.

$$P(s) = s^7 + 3s^6 + 11s^5 + 19s^4 + 36s^3 + 38s^2 + 36s + 24 \tag{6}$$

B.

$$P(s) = s^6 + 2s^5 + 4s^4 + 8s^3 + 6s^2 + 8s + 4 \tag{7}$$