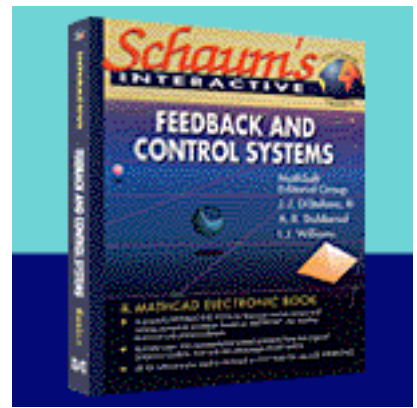


Schaums Interactive Outline Series: Feedback and Control Systems

Platform: Windows

Includes the Mathcad Engine; requires 4 MB hard disk space

Available for ground shipment

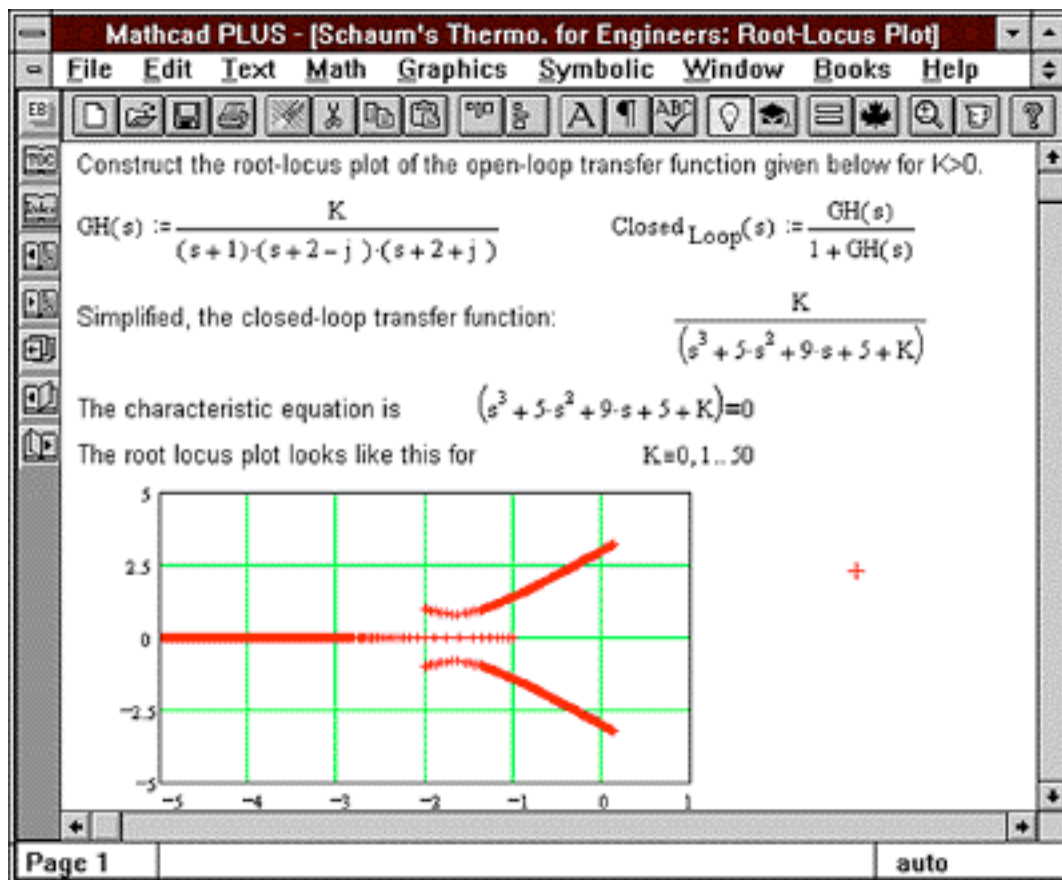


Through more than 100 solved problems in control system design and analysis, several major techniques of analysis and design are developed and demonstrated. For students and educators, this Electronic Book is an excellent tool for exploring and understanding the fundamentals of feedback control systems. Professionals get advanced numerical and symbolic techniques for plotting system behavior and solving for stability and design specifications. The early chapters develop the theoretical foundations while later sections apply this understanding to designing feedback control systems. Plus the Mathcad Engine is built-in so the math is "live" and interactive.

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Experiment with graphing techniques for root-locus plots.

Topics include: Differential Equations, Difference Equations and Linear Systems, Stability and Routh-Hurwitz Criteria, Transfer Functions and Characteristics Equations, Block Diagram Algebra Signal Flow Graphs, Nyquist, Bode and Nichols Analysis and Design, and much more.

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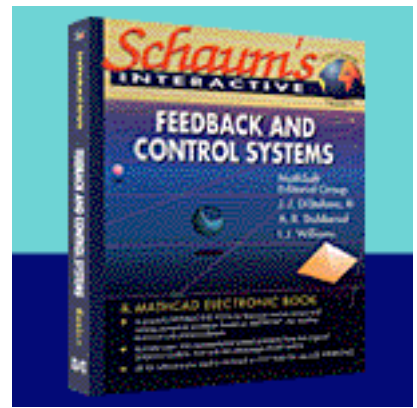
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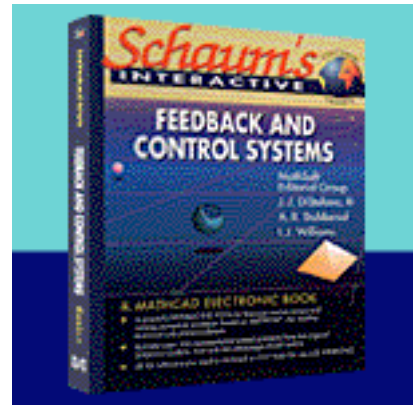
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Appendix D - Solving Polynomials Using the Companion Matrix

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The image shows the front cover and spine of the textbook "Schaum's Interactive Feedback and Control Systems". The cover has a dark blue background with a grid pattern. At the top, the title "Schaum's INTERACTIVE" is written in a stylized red font. Below it, the main title "FEEDBACK AND CONTROL SYSTEMS" is in large white capital letters. The authors' names are listed below the title. There is a small graphic of a globe and some technical diagrams. At the bottom, there is a section titled "A MICROCAD ELECTRONIC BOOK" with several bullet points describing its features. The spine of the book is visible on the left side, showing the title and authors' names vertically.

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Constructing Bode Plots

Statement

Construct the Bode plot for the frequency response function given below. Also, determine the gain and phase margins for the system.

System Parameters

$$GH(\omega) := \frac{2}{j \cdot \omega \cdot \left(1 + \frac{j \cdot \omega}{2}\right) \cdot \left(1 + \frac{j \cdot \omega}{5}\right)}$$

Solution

To create the Bode plot for this function, plot the magnitude in decibels and the phase using the phase function shown in Chapter 15.

$$\text{GH}_{\text{mag}}(\omega) := 20 \cdot \log(|\text{GH}(\omega)|) \quad \text{phase}(f) := \text{if}(\arg(f) > 0, \arg(f) - 2 \cdot \pi, \arg(f))$$

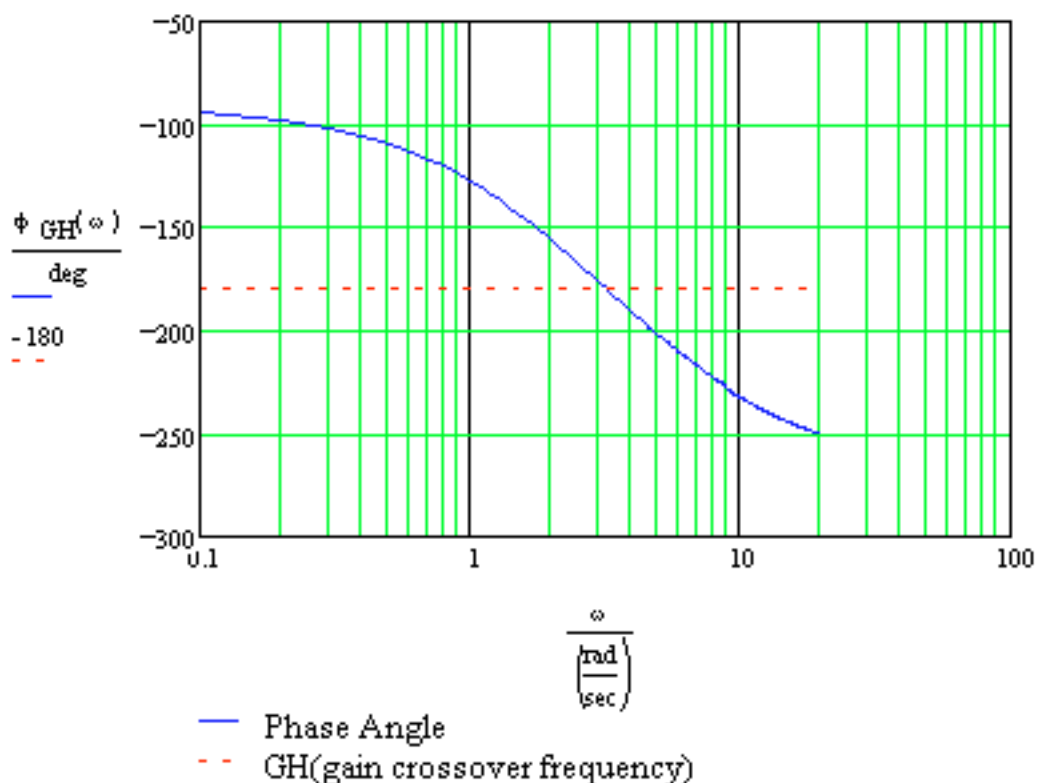
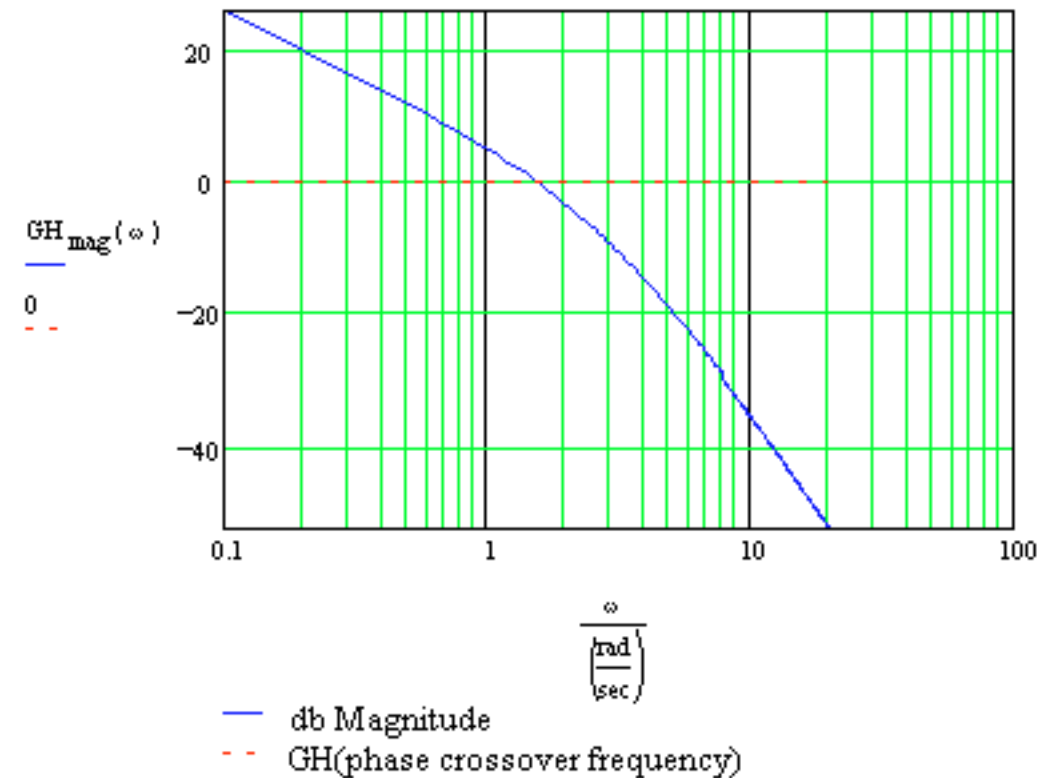
$$\phi_{GH}(\omega) := \text{phase}(GH(\omega)) \quad \omega := .1, 2..20$$

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Now find the gain and phase crossover frequencies. There are two ways to do this. First, from the magnitude and phase angle plots, we can make a good guess at where ω_1 and ω_p are, respectively, and solve the necessary equations. Or, we could find where the two curves plotted on each the magnitude and phase angle plots intersect by setting them equal to each other and solving for ω . Both ways are shown here. Solve for ω_1 by using the graph and for ω_p by using the equations.

$$\omega_1 := 1.52 \quad \left| \text{GH}(\omega_1) \right| = 1$$
$$\omega_{\text{sg}} := 1 \quad \omega_{\pi} := \text{root}(\text{phase}(\text{GH}(\omega_{\text{sg}})) + \pi, \omega_{\text{sg}})$$

$$\omega_{\pi} = 3.2 \qquad \omega_{\pi} = 1 + \sqrt{10}$$

$$\text{gain_margin} := -20 \cdot \log(|GH(\omega_{\pi})|) \quad \text{gain_margin} = 10.9$$
$$\text{phase_margin} := 180 \cdot \text{deg} + \arg(\text{GH}(\omega_1)) \quad \text{phase_margin} = 35.9 \cdot \text{deg}$$
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