Exam 3 Study Guide Fri, 4/15/22

The exam will be **closed book**, but you may use the colored sheets from exam 1 and 2 the new one for exam 3.

The exam will cover

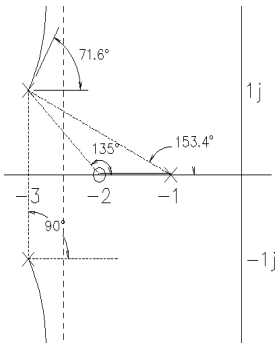
1. Root - Locus method
   a) Main rules
   b) Gain at any point on the root locus: $k = \dfrac{1}{|\mathbf{G}(s)|}$
   c) Additional rules.

   The breakaway/in points are also solutions to: $\sum_{\text{all}} \dfrac{1}{(s + -p_i)} = \sum_{\text{all}} \dfrac{1}{(s + -z_i)}$

   Phase angle of G(s) at any point on the root locus: $\arg(G(s)) = \arg(N(s)) - \arg(D(s)) = \pm 180^o, \pm 540^o, \ldots$

   Or: $\arg\left(\dfrac{1}{G(s)}\right) = \arg(D(s)) - \arg(N(s)) = \pm 180^o, \pm 540^o, \ldots$

   Departure angles from complex poles: Example. $180 - 90 - 153.4 + 135 = 71.6$ deg



2. **Root - Locus Interpretation and design**

   Concepts of what a root locus plot is and what it tells you. Movement of poles

   Good vs bad, fast response vs slow, OK damping vs bad.

   Compensators
   Know pole & zero locations of P, PI, lag, PD, lead & PID Compensators.
   PI and Lag, purpose and design, ties in with steady-state error
   PD and Lead, purpose and design ties in with root locus angle rules

   Choose points on the s-plane to achieve given required characteristics based on the 2nd-order assumption (RL Crib)
   Know that the 2nd-order assumption may be inaccurate if other CL poles and/or zeros aren't 5x farther from Imaginary axis and are not canceling one another.

   Design of a compensator to force the RL point through a given point (like RL7).

3. **Unconventional root-locus**
4. Compensator circuits & Instrumentation amplifier
5. PID tuning.
6. PLCs and **Ladder logic**. Basic switching logic.
7. **Bode Plots** (all types, including complex poles and zeros)
   Be able to draw both magnitude and phase plots and the smooth curves as well as the the asymptotic lines.

   Complex poles an zeros $s^2 + 2\cdot\zeta\cdot\omega_n\cdot s + \omega_n^2 = (s+a)^2 + b^2 = s^2 + 2\cdot a\cdot s + a^2 + b^2$

   natural frequency $\omega_n = \sqrt{a^2 + b^2}$ damping factor $\zeta = \dfrac{a}{\omega_n}$ max at approx ω_n, $\dfrac{1}{2\cdot\zeta}$ $20\cdot\log\left(\dfrac{1}{2\cdot\zeta}\right)$ dB

   Bode to transfer function

   GM, PM & DM

   Bandwidth extension with feedback, Gain - Bandwidth product

8. Concentrate on Homeworks RL5 - BP3
9. Up to Lab 7 (Advanced PLL)