

Things you must remember (or know how to derive)

Include but not limited to:

1. Block-diagram manipulation rules
2. DC motor modeling and connection with a general load
3. Open-loop plant inversion with $C_{ol} = T_{ref}P^{-1}$: what are conditions on the plant P and the reference model T_{ref} for which this is possible
4. BIBO stability: definition and criterion
5. Internal stability of interconnections (both series, in open-loop control, and feedback, in closed-loop control)
6. Steady-state specifications (steady-state error and how to compute it in the s -domain)
7. Transient specifications (definitions of overshoot, undershoot, rise time, settling time)
8. Main parameters of 1st and 2nd order systems (static gain, time constant, natural frequency, damping factor) and their *qualitative* relations with steady-state and transient characteristics
9. Understanding of the effect of extra poles and zeros on transient responses of 1st and 2nd order systems
10. Transient specs and pole location (*qualitatively*) with “good” areas in the s -plane
11. Properties of frequency responses of LTI systems (bandwidth, resonant peak) and their connections with step-response properties, like “fast”/“slow”, oscillatory (*qualitatively*)
12. Closed-loop vs. open-loop strategies: advantages and disadvantages
13. Closed-loop transfer functions in the unity-feedback configuration
14. Steady-state performance of feedback systems: number of integrators and their location (on P or in C) required to zero steady-state errors from r/d in the unity feedback configuration
15. Root-locus method: definition and meaning, number of branches, where each branch starts and ends, the gain and phase rules, the center of gravity and asymptotes angles, $j\omega$ -axis crossings, high-gain feedback insight
16. Loop shaping requirements (in low- and high-frequency ranges) and rationale behind them
17. The argument principle
18. The Nyquist stability criterion (with and without integrators in L), crossover frequency ω_c , phase crossover frequency ω_ϕ , stability margins (both on Nyquist and Bode diagrams)
19. The delay element, its effect on the frequency response and the Nyquist criterion, the delay margin
20. Connections between root locus and Nyquist plot (no. of integrators, $j\omega$ -axis crossings, stability / instability)
21. Lead and lag controllers (*qualitatively*) and their use to achieve required phase margin and static gains
22. PID controllers and their architectures (understanding of implications)
23. Ziegler-Nichols procedure and its connection with properties of $P(j\omega)$
24. 2DOF controllers: why to use them
25. Bode and Nyquist plots of elementary transfer functions: $\frac{1}{s^n}$ ($n = 1, 2, \dots$), $\frac{k}{\tau s + 1}$, $\frac{k\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$, e^{-sh}

Perhaps I forgot something, so learn more to be on the safe side...