Control Theory : Chapter 3 and Appendix

1. spinal processing, $\alpha-\gamma$ motor neurons, motor units, the stretch reflex, negative feedback
2. Spring-Mass-Damper, harmonic oscillators
3. Stability - energy-based method
   (a) Lyapunov’s Direct Method
   \[ V(0, t) = 0, \ V(x, t) > 0, \ \frac{\partial V}{\partial t} \leq 0 \]
   (b) stable and asymptotically stable
4. Frequency domain analysis - Laplace transform, characteristic equation, solving for time-domain response,
5. Stability - complex frequency domain
   (a) root locus,
   (b) stable and asymptotically stable
6. PD control - 2$^{nd}$ order dynamic response, roots of the characteristic equations, over-, under-, and critically-damped response, phase/amplitude response, bandwidth

Kinematics : Chapter 4 and Appendix

1. Terminology - links, joints, kinematic chain, mechanism, closed- and open-chain, degrees of freedom, configuration space, revolute, prismatic
2. spatial tasks, coordinate frames, holonomic and nonholonomic
3. homogeneous transforms (deriving, interpreting, composing, inverting)
4. forward kinematics $\theta^{FK} \mapsto x$,
5. inverse kinematics $x^{IK} \mapsto \theta$, workspace constraints, dextrous workspace, reachability
6. imaging kinematics - pinhole camera model, perspective distortion,
7. stereo kinematics - disparity, spatial reconstruction
8. hand-eye coordination
9. Jacobian (velocity and force relations),
10. kinematic conditioning - manipulator velocity ellipsoid, stereo localizability ellipsoid