

1. Grasping: Chapter 5
  - (a) tactile sensing - biological mechanoreceptors, robot tactile sensors
  - (b) **screw systems**, mobility analysis, the **grasp Jacobian**, velocity and force domains, **contact types**, the **selection matrix**, **effort variables**
  - (c) **form and force closure**,
  - (d) **solving for forces in force closure grasps**
2. Dynamics - Chapter 6
  - (a) conservation of linear and rotational momentum, inertia tensors, parallel axis theorem, rotating coordinate systems, Newton-Euler equations, outward/inward iterations, Lagrangian, gravity compensation, coriolis and centrifugal compensation, (coupled) inertial compensation
  - (b) the **computed torque equation**,
    - i. **feedforward compensation** - linearized, de-coupled control,
    - ii. **simulation** - integration, Roger
    - iii. **analysis** - acceleration ellipsoid/polytope
3. Infant Development - Chapter 9
  - (a) motor units - spinal processing, primitive- and postural-reflexes, dynamical systems theory
  - (b) infant sensorimotor learning - developmental reflexes, maturational processes
4. Control Basis Architecture - Chapter 10
  - (a) action architecture, landscape of attractors, taxonomy, **Markov Decision Processes (MDPs)**
  - (b) potential functions, **local minima**, differential geometry, Hessian, convexity, **harmonic functions**, **navigation functions**, multi-objective control
  - (c) **Q-learning** - Bellman equation, value functions
5. path planning - Lavelle, Sections 1.2, 5.6, DORB Appendix C
  - (a) **completeness, resolution completeness, probabilistic completeness**
  - (b) configuration space, Cartesian space, **obstacle dilation**
  - (c) representing freespace - **spatial graphs: cellular decomposition, occupancy grids,  $2^n$ -trees, visibility graphs, Voronoi diagrams**
  - (d) **probabilistic roadmaps (PRM)** - sample, select local goal, collision detect/local planner, **graph building lazy PRM, rapidly-expanding random trees (RRT)**