Topics – Cardiovascular Biomechanics

- Cardiovascular Anatomy & Physiology (Weeks 1 – 3)
  - Midterm at end of week 3

- Basic concepts in mechanics and fluids (Weeks 4 - 5)
  - Mass transfer
  - Mechanics
    - Stress and strain
    - Hookean –vs- non-linear materials
    - Viscoelasticity
  - Fluid mechanics
    - Momentum and continuity
    - Navier stokes equations
    - Non-dimensional parameters / Scaling
    - Reynolds number
    - Laminar –vs- turbulent flow

- Mechanics of arteries (Weeks 5 – 7)
  - Thin and thick walled assumptions
  - Constitutive modeling
  - Experimental methods

- Blood rheology (Weeks 7 – 9)
  - Newtonian –vs- Non-Newtonian fluids
  - Blood composition
  - Models of RBC
  - Fahreus-Lindquist effect

- Arterial flow dynamics (Weeks 9 – 12)
  - Cylindrical tube
    - Steady flow - the Poiseuille flow equations
    - Oscillatory flow – the Womersley equations
  - Branching
    - Flow separation and recirculation
  - Flow in a curved tube
    - Secondary flow; The Dean number

- Fluid-structure coupling (Weeks 12 - 14)
  - Basic concepts
  - 1D methods

- Cardiac dynamics (Weeks 14 – 15)
  - Ventricular shape assumptions
  - Diastolic function
  - Valvular regurgitation and stenosis

- Prosthetics & optimization (Weeks 15 - 16)
  - Stent
  - Valve
  - Artificial Heart

- Microcirculation (If time permits)